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Re-emergence of Asia in the New Industrial Era

Siddhartha Paul Tiwari

Google Asia Pacific Pte. Ltd., Mapletree Business City II, Singapore

siddhartha@google.com

Abstract. The dawn of the new industrial era (Fourth Industrial Revolution or 4 IR, Industry 4.0, “McLuhan” stage) characterised by IT-based modern technologies and global value chains has regained the Asian economic strength. Overarching impact of 4 IR is expected on the physical, digital and biological world. Several Asian countries have maintained high growth and have displayed true globalization by possessing elements and desiderata of the 4 IR. Asia has also displayed its innovative strength in many determinants of 4 IR. Although a gradual transition from labour to capital to talent is slated to happen, Asia will have its own amalgam of the three case-by-case. For example, some Asian countries have demographic assets to use labour in low-skill jobs and they will continue to compete as low-cost manufacturing hubs for a substantially long period despite high proportion of ageing people and less birth rate. Human talent-intensive services like healthcare and education stand to benefit from 4 IR by way of cost-reduction but concerted efforts of public and private sectors are needed in these areas. Unemployment and inequality may rise initially but may be offset to a sizeable extent by new jobs and engagements and also by reorientation of knowledge, skill and attitude, the three realms of education, through continuous training, skill upgradation and self-renewal. There could be eugenic effects such as defect-rectification at early developmental stages and ultimately moving towards designer human beings in the long long run. Significant role of the state, policy and mode of governance was observed in bringing about the 4 IR. It is hoped that while thriving on the fruits of 4 IR, all stakeholders would also unite for maintaining a vigil and holding up the human values like conscience, creativity and empathy to mar the possible ill-effects of the 4IR that could be dreaded in its most dehumanized form in the long run.

Keywords. Asia, new industrial revolution, 4 IR, Industry 4.0 , impact and consequences, unemployment and inequality, Asian demographic, economic and innovative strength

Consequent upon the initial Industrial Revolution of the 18th century, the Fourth Industrial Revolution (Schwab 2016 *et seq*) or 4 IR has commenced and has come to stay and expand. The four revolutions really embodied four sequential paradigm shifts. The first industrial revolution in the late 18th and early 19th century focused on the benefits of mechanization where for the first time some animal or human labor could be substituted by mechanical power to bring about new forms of manufacturing activities concerning steel, textiles, tools, etc. The second industrial revolution in the late 19th and early 20th century relied on the mass production along assembly lines that scaled up product manufacturing through a combination of labor and machines. The third industrial revolution, in the later part of the 20th century, came owing to automation of manufacturing processes facilitating repetitive tasks

sequence with defined parameters and minimal supervision. Concomitantly globalization happened due to trade liberalization enabling developing economies to participate by offering their affordable labour force as a suitable alternative to mechanization. The fourth industrial revolution is unfolding and is mostly based on robotization with supporting IT structures (Schwab 2016/2017, Micklethwait and Wooldridge 2014).

The industrial structural transformation stages have also been sequentially viewed from a different angle and nomenclature (Ozawa et al. 2001) i.e. evolving from the ‘Hecksher-Ohlin’ labour intensive industries (typified by textiles) to the “non-differentiated Smithian” scale-driven industries (automobiles, electric and electronic goods), to “Schumpeterian” R&D-intensive industries (particularly chips, sensors, biotechnology and new materials) and finally to “McLuhan” stage that is being led and driven by information technology.

1. Re-emergence of Asian strength

The trend of world production data shows early dominance of Asia followed by a long lull and then a re-emergence (Data source - Paul Bairoch and UN; cf. Marsh 2014 and 2012). At the dawn of the First Industrial revolution (1800 AD), the major share of world production was coming from China (33.3%) and India (19.75%). In 1900 AD, the top slots went to US (23.6%) and UK (18.5%). Now in 2012, Asia has again regained the lead with top slot going, to China (22.4%) albeit followed by US (17.5%) and then again an Asian country, Japan (9.4%).

Several of the south, south-east and east Asian countries have emerged as the fast developing economies. Asian economies have been able to satisfactorily bounce back from their financial crises (of 1997 and 2008, the latter being global crisis rather than Asian crisis exclusively). It is opined by Ozawa et al. (2001) that the financial crisis of some Asian countries had an aftermath of internet revolution that was not only a technological revolution *per se* but an institutional revolution as well involving both the real and financial sectors of the economy. The internet revolution and concomitant institutional reforms resulted in an upsurge in economies of several Asian countries. Availability of infrastructure, ease of doing business and globalization has particularly led to the emergence of the so-called Asian tigers viz., South Korea, Singapore, Hong Kong and Taiwan. Some countries viz., China and India also have a huge realized and realizable demographic and related technological scale needed in business and hence in growth and development. China and India have rapidly emerged as prime locations for low-cost manufacturing as well. All these Asian countries have maintained high growth in GDP albeit with a period of recession and economic shock in some cases. Japan has displayed strength in many areas esp. telecommunication infrastructure and R&D and robotics. Several of these Asian countries have consummated expertise in modern realms such as artificial intelligence, robotics, the Internet of Things, autonomous vehicles, 3D printing and nanotechnology that are the crucial technologies to the 4 IR.

Advancement in the form of a range of technologies in digital world in confluence with that in physical and biological worlds has made the so-called Fourth Industrial Revolution (4 IR) reach the starting point but the large scale race of this ensuing revolution is yet to commence. At this juncture, it would be interesting to take stock of some regional capabilities in Asia selectively that would determine the velocity and scale of realization of 4IR to eventually confer a higher level of flexibility in terms of the locations, the manufacturing processes, the scale and scope of the output, and the customization of the products.

2. Global scenario - Trends and drivers

Talking in essence and brevity and as also stated by Schwab (2016 *et seq*), the global advances in physical, digital and biological realms comprise as follows.

In physical world, autonomous vehicles, 3D printing, advanced robotics and new materials such as graphene, thermoset plastics - recyclable thermosetting polymers or polyhexa-hydro-triazines (PHT) have come up.

In digital realm, we have already moved out of the stagnant data storage legacy of the information age to a digital age characterised by enhanced computing ability, access to the internet including

Internet of Things, cloud, access to and proliferation of mobile devices and apps and app-building platforms. Technologies for and with sensors, remote monitoring, transmitter or radio frequency identification (RFID), blockchain (“distributed ledger”), bitcoin and technology-enabled platforms for on-demand or sharing economy are either actuated or looming large for large scale actuation.

In biological field, determining our individual human genetic makeup will dramatically change the way human diseases are treated such as through gene therapy, tailor made pharmaceutical products, predictive testing and improving the understanding of disease mechanisms. In agriculture, new breeds of plants and animals are being developed using molecular breeding, and genetically modified crops are already commercially grown in many countries. Biotechnology has been used for societal benefits in countless ways. Biosafety and biosecurity, however, have been the rising concerns within and between countries.

3. Asia scenario and desiderata

Asia is apparently fully geared to actuate the opportunities that the new revolution is offering. Several analyses reveal that South Korea, Singapore, Taiwan, Japan, China and Hong Kong are making rapid strides and even countries with large cultivable area, like China and India and particularly China, are registering a gradual shift from an agriculture and manufacturing driven economy to one that is innovation focused. ICTs have been used in myriad contexts and have played a great role in bringing about socio-economic upliftment in large Asian countries (Tiwari 2008). A sectoral modern technological progress scenario in Asia is attempted below.

3.1. Urbanization and ageing population

Urbanisation is the expected outcome of growth and development in and around manufacturing and supply hubs. The Fourth Industrial Revolution will speed-up the process of urbanization. The concomitant well-being will help increase the longevity and hence proportion of aged people. China and India have the largest portion of 758 million and 410 million urban population, accounting for about 30% of the world’s urban population. The survey and estimates show that the urban population of the world was 3.9 billion in 2014 amounting to about 54% of the world population that will increase to reach 66% of the world population by 2050 (UN 2014). About 90% of this increase, of 2.5 billion people by 2050, will be concentrated in Asia and Africa. Besides Tokyo, Shanghai, Mumbai and Delhi, which are the largest megacities of Asia, the medium-sized cities will grow fast. As Asia continues to urbanize fast, the social amenities needs and sustainable development challenges are also increasing.

The Republic of Korea has experienced high urbanization rate spurred on by rapid globalization that positively affected country’s economy. The urbanization in India, of late, has been at a modest rate but even the conservative estimates indicate 400 million additional persons

in the labour force by the year 2050 necessitating a massive transfer of people from primary to secondary and tertiary sectors, and from rural to urban areas (Kundu 2011). Asian countries are well aware of the need for policies for planning and managing the spatial distribution of populations and internal migration. Provisions like urban development, allocating land/house rights, managing land use, creating regional development zones etc. are in vogue towards successful sustainable urbanization. South Korea has decisively modernized through urban growth, the city of Ulsan that grew into an important industrial town being an example of such directed modernization. The South Korean urban planning, in view of growing urbanization, has smart cities with features like ubiquitous broadband convergence network and ubiquitous sensor network along with modern and eco-friendly waste management (Kang 2014). China, with an estimated migrated worker population of 277 million, according to China Labor Bulletin, has already announced expanding urban ‘*hukou*’ or residency permits to 100 million migrant workers by 2020 for building a highly urbanized consumer-driven economy. It has been stated by concerned authority that 28.9 million new urban residency permits have been issued in 2016 with 1.69 million issued in Beijing, 406,000 in Shanghai, 810,000 in Guangzhou, and 1.71 million in Shenzhen.

Increase in the proportion of aged persons is a growing trend. Some Asian countries have demographic asset to use labour in low-skill jobs and they will continue to compete as low-cost manufacturing hubs for a substantially long period high proportion of ageing people and less birth rate. China, in particular, as the result of anti-natalist policy in vogue for 36 years (1979 to 2015), is distinguishable by features namely, (i) 222 million people aged 60 or above (about 16% of the total population) and out of these, 143.9 million (about 10% of the total population) were 65 or above at the end of the year 2015, (ii) reduced fertility rate which is presently estimated to be between 1.5 to 1.6, well below 2.1 i.e. the rate needed to maintain a stable population, and (iii) growing scarcity of females. The revival measures are being taken and the workforce, however shrinking, will still have a sizable number available till the situation improves.

3.2. Health and education

Healthcare and education are the two primary and most needed services that are becoming costlier day by day. The obvious reason thereof is their human-intensive nature needing a requisite human expertise and number. The Fourth Revolution is expected to impact these sectors favourably by making these services less labour intensive and much cheaper in the time to come. As William Jack Baumol (1996, 2012), the economist, said that every society, every rich society is going to devote more and more of its resources to these sectors. The rich can afford it but the middle class suffers the most. To reduce the human-dependence, we can use modern technologies. Baumol gave the example of producing sound quality of string quartet by modern technology thus reducing the cost of talent required to play it. Likewise, modern technology could arrest the cost of healthcare and education, the talent intensive services, from going up and could make it going down to an extent. It can be argued that Internet of Things or its use in medical prescription etc. also requires talent but this talent is used to ultimately enhance the accessibility and reduce the cost. Internet use is increasing for health-related information (Ohura *et al.* 2011) yet a lot remains to be done in this area. Several Asian countries are serving as hubs of international medical tourism, have global networking, sizeable private investors into such medical services that are online with mobile phone apps providing online access to licensed doctors, medical consultations and e-prescriptions and bill payment, with access to even rural areas.

Biomechatronic applications are increasing in Asia. There could be prevalence of apps having health monitoring including heartbeat recognition using a sensor to read a person's electrocardiogram. A recent concern, however, has come to surface. Hackers have a premium in accessing health data in the form of personal and clinical files. This really has happened in an Asian city when Department of Health found suspicious files in the server with a lurking danger that hackers may have accessed up to 17,000 personal and clinical files kept by the department. Further, dangers are also on increase. If a hacker gets the serial number of the pacemaker of a person, he can easily break into the device and shut it down remotely putting the man's life in great danger. A very high degree of privacy and security is needed in handling health-related information and apps thereof.

3.3. Unemployment and inequality: labour to capital to talent shift

Inequalities already exist to an extent and the 4 IR can probably be dreaded, and rightly so, to create and further add to it in the society (Schwab 2016, Brynjolfsson and McAfee 2016, Fan *et al.* 2010, Ravallion 2007 and 2010, Sharma *et al.* 2011). Two of these appear obvious.

Firstly, there will be gender inequality. Women workers in Asian countries are predominant particularly in places of business like tourist-related managers at gross root levels, call centres in emerging markets, retailing and lower administrative roles and who will be adversely affected by the automation and other effects of 4 IR. Men are predominant and will keep on retaining and dominating their jobs in certain areas such as in computer science, mathematical and engineering professions, and highly specialized technical skill.

Secondly, in future talent, more than capital, will represent the critical factor of production. Talent production and availability is known to have significant effect on technological innovation and consequently on economic growth (Li and Florida 2006). Talent makes possible the most efficient use of labour (more so in future through automation, artificial intelligence, use of drones etc.) and capital. It is talent that allows you to do business efficiently sometimes even without possessing the full amount of labour and capital i.e. with a minimalistic ownership requirement of the latter two (e.g. Uber's growth in the greater 'shared economy'). The situation will lead to a tiered segregation of job-groups but broadly there will be two groups. More skilled and experts will form 'high skill-high pay' whereas low-skilled people will come under 'low skill-low-pay'. Between these two ends, it is again apprehended that there will be a hollow or thin presence. This hollowing out will deprive the persons who self-judge themselves as higher than low skill but not matching to high skill requirements.

Owing to increasing gap between returns to capital and returns to labor and the ensuing shift in doing business from labour to capital to talent may create unemployment and inequality. On the other hand, it is also possible that the displacement of workers by technology will, in aggregate, result in a net increase in better jobs. Let us try to see the possible balancing effects. It is the accepted effect of the 4 IR is that automation will substitute capital for labour in business. Nevertheless, new goods and products and new services will be in demand. This will result in loss of some old jobs but it will also mean reorienting or creating new occupations, business and even industries altogether. This balancing may and probably will not be as complete as desired. It will result in some, but not total, compensation in the form of new jobs or gainful engagement in an enterprise or entrepreneurship.

Further, if the state and the persons thereof wish that they are not affected when existing jobs are lost, then they will have to relocate their capabilities elsewhere. There are three realms of education viz., skill, knowledge and attitude and all these are to be continually revised and

honed up as per the changing context of job-need, similar to saw sharpening or self-renewal (Covey 1989). State and personal efforts both will be needed to meet the educational, in-service training and skill upgradation requirements. Lifelong learning cities have been the characteristics of several asian countries (Han and Makino 2013) and these need to be further supported as detailed later in this article.

Ultimately, it appears that there will be ‘human cloud platforms’ comprising a task-oriented human mass from where the needy companies or customer groups can take whomever they want, wherever they want, whenever they want and how they want. So hired persons will not be employees and, therefore, companies will be saved from many regulatory hassles. Workers or experts in these human platforms will also have freedom of work in many senses.

3. 4. Artificial intelligence (AI)

Asian progress in AI is remarkable and at par with that anywhere in the world. There is already an increase in major investments for product development and research. There are massive investments and new advances made in deep learning technologies, AI and robotics capability. Facial recognition and related applications are gaining traction at a remarkable pace. Above all, the foremost accomplishment is the development of innovation centres for advancement of AI that challenges the present supremacy of those outside Asia. Innovation centres for AI have emerged in Japan (Tokyo), China, South Korea, Singapore, India (Bengaluru) and other places. The cited publications abound in China but language barrier somewhat waylays their spread to rest of the world. If the recently held Consumer Electronics Show organized by the Consumer Technology Association i.e. CES 2017 in Las Vegas is any indication then Asia’s Toyota, Honda, Xiaomi, LG, Samsung and several others have established their AI and robotics capability by means of cutting edge global products manufactured and made available to the world. Baidu, China’s search engine, ranks high in smart companies’ list and has already attracted high global talent. They have local and global research centres/labs and another one is in the offing solely for Augmented Reality (AR). Recently, Baidu has been in news to go for making the driverless cars a reality and intending to introduce self-driving cars to the masses at large in 2018 for public transport. Singapore (through ‘nuTonomy’, an autonomous vehicle software startup) has already put self-driving taxis on the road in 2016 in the district called “one north” albeit on a small scale to start with. Enhancing safety of such autonomous cars and who should be liable in case of an accident are, however, some issues that need attention.

3. 5 Biological development

Biotechnology has been put to use in many ways in Asia. Most of the countries have benefitted from the efforts and achievements. Genetically modified organisms have been developed. There are large-scale cultivations of biotech crops particularly in large countries. India ranked fourth with an area of 11.6 million hectares of transgenic Bt cotton (same as 2014), and a resilient high adoption rate of 95%. China ranked 6th in the world with 3.7 million ha of transgenic cotton, papaya and poplar (ISAAA Brief 2015). India became the largest biotech cotton producing country in the world with 11.6 million hectares planted in 2015 by 7.7 million small farmers. Between 1997 and 2014, biotech cotton varieties brought an estimated \$17.5 billion worth of benefits to Chinese cotton farmers, and they realized \$1.3 billion in 2014 alone.

Genetic editing technology to ‘cut-and-paste’ any genetic sequence at will, even in living organisms, is in offing in Korea. China researchers of Yat-sen University in Guangzhou have reported probably the world’s first attempt of altering the DNA of human embryos. The

vast realm of curing diseases at DNA level has opened up even in case of humans. This is in line with the tremendous and rather terrifying possibilities of future expressed by Aldous Huxley in the book 'Brave New World' and George Orwell in 'Nineteen Eighty-Four', the two relating to today's biotechnology and information technology respectively. In coming decades we may be able to realize what Ray Kurzweil (2006) stated that humans will transcend biology.

4. Role of the state, policy and mode of governance

Despite the end of history expected (Francis Fukuyama 1992), the state will exist to continue to deliver services and cater to the social needs. Fukuyama (2014) himself has maintained that modern liberal democracy cannot happen without (i) the prior establishment of a well-armed and functional territorial state, and (ii) an independent judiciary responsible for overseeing the rule of law that robust state power then makes possible. Further, liberal democracy probably cannot be built by liberal democratic means and achieving high growth and development, therefore, probably need a cautious liberal-cum-authoritarian approach, at least in the beginning of setting up the future course and means to be adopted for realizing it. There are already studies conducted (Ma *et al.* 2005, Gurbaxani *et al.* 1990, Kraemer *et al.* 1992) and many more are in offing that show that governments do matter in the creation of digital economies. It is also obvious that the states have played significant roles and the region has seen the growth in China, Singapore and other countries that is worth emulating.

At global level amidst fierce competition, one has to be quick to assess, create and meet demand, manufacture needed goods and supply them appropriately in the context of contemporary geographical and functional complexity of value chains. Asia efficiently minimizes input costs primarily through its natural demographic asset and availability of labour on one hand and maximizes market accessibility by appropriate placing of manufacturing hubs (e.g. SEZs of China) and developing linkages of supply hubs for distribution activities on the other. There has been growing urbanisation. Asia has, thus, experienced the industrial paradigm shifts of not only having industrial cities and regions but sequentially evolving to embark upon global production networks and value chains. There are myriad examples, particularly in four tiger countries referred to earlier, in support of this. In China, there is glaring example of such evolution in Zhuhai, a special economic zone of the country, that is a global printer consumables manufacturing centre among other global supply chains in electronics present there. Role of the state has been significant in such cases.

One aspect which needs emphasis is the directed emergence of learning cities. The concept of learning society and continued lifelong learning came about in the 1970s and 1980s to take care of effects of post-industrial risk society. Norman Longworth (1999) defined a learning city as follows:

"A learning city, town or region recognizes and understands the key role of learning in the development of basic prosperity, social stability and personal fulfilment, and mobilizes all its human, physical, and financial resources creatively and sensitively to develop the full human potential of all its citizens."

Asia already has lifelong learning cities in Asia. Need-based new such cities may be helped to emerge. It has also been suggested that these cities may enshrine and retain their "community relations model" rather than "individual competence model" (Han and Hakino, 2013).

5. Summarising the societal effects and desiderata

The possible effects of the new industrial revolution on society and suggested desiderata for ensuring the societal well-being is succinctly presented below in tabular form.

4 IR technology aspect	Impact on society	Desiderata for societal well-being
Human healthcare	Arresting the rising cost of healthcare and reducing it to an extent	Awareness creation, taking medical help to far-flung areas, security of health data and legislation to prevent its hacking and mis-utilization
Education	Learning available anytime anywhere, cost reduction	Enabling intensive e-Learning, distance learning esp. for remote and needy areas/regions identified, help emerge lifelong learning cities
Automation	Unemployment to an extent, those between low skill-low pay and high skill-high pay to suffer more	Skill upgradation mechanisms to be out in place and facilitated to operate, continued on-job reorientation and skill enrichment
Autonomous vehicles	Improved rides and transportation, freeing up parking space, saving time, safety and accident liability are concerns	Regulatory measures for Road Traffic Regulation/ Amendment, from general trial run or sandbox to customised measures, liability and compensation for accidents, more concern for allocating costs than apportioning blame
The new revolution in its holistic form	Overall progress yet various societal concerns arise that need to be addressed and so facilitated at state and stakeholders level	A cautious liberal-cum-authoritarian approach with an independent judiciary responsible for overseeing the rule of law that robust state power makes possible; growing urbanization, increase in aged population, hacking, cyber wars and biosecurity issues may emerge and be settled; actuate the desiderata suggested

Let us make progress but let us bring about happiness also along with it. Even though the world has changed for the better in overall terms, individuals are increasingly stressed out.

Capitalism thrives on creative destruction turbocharged by new technologies but the very birth of disruption depends on creative endeavours and socio-economic interactions which even artificial intelligence cannot replace. It is through such oases, where humans beat machines, that the human concerns upsurge and human values are upheld. Our responsibility lies not only for the present but also for the time to come as de Condorcet stated “ ... (we) have a duty towards those who are not yet born , that duty is not to give them existence but to give them happiness ...”. While dearly embracing the new world, let us strive for the coveted goal of overall prosperity but with this bounden duty.

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