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BRICS DIGITAL COOPERATION FOR INDUSTRIALIZATION[1]

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Abstract

This paper traces the evolution of digital economy, explains various components of digital infrastructure, provides an empirical evidence of rising digitalization of manufacturing processes in advanced countries in the world and benchmarks the extent of digital industrialization that has occurred in BRICS. The paper suggests that BRICS has the potential to challenge the emerging global digital economic structures in the west through digital co-operation for industrialization. With the world's two most populous countries in BRICS, the group already has a comparative advantage in terms of generating quantum of data and scale of operation but to use this advantage in favour of all BRICS members, there is a need to develop a digital cooperation strategy. In this context, a 10-point BRICS Digital Cooperation agenda is suggested which includes cooperation amongst BRICS for providing broadband infrastructure, building cloud computing infrastructure, establishing data infrastructure, facilitating enabling digital environment, promoting e-commerce, progressing on regional single market, sharing of experiences, promoting digital innovations, shaping global digital norms, policies and regulations and building statistics to measure digitalization.

JEL Classifications: O14, B17

Key words: BRICS; Digital cooperation; BRICS Digital cooperation agenda, Trade in Value-Added

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1 Introduction

With around 40% of the world's population, BRICS (Brazil, Russian Federation, India, China, and South Africa) have steadily increased their share in global GDP from 10% in 2000 to 21% in 2016. BRICS share in world's merchandise exports has grown even faster in this period, i.e., from 8% to 20%[4]. Much of this growth has been contributed by China and India, although other countries have also recorded higher growth than the average global growth. With the onset of the Industry 4.0, BRICS countries have the potential to accelerate their growth and their share in global GDP as well as in global trade, but this will primarily depend on the extent and pace at which they are able to digitalize their production processes to compete with the advanced economies.

As the world moves towards a digital economy, new structures of economic and political power are fast emerging which are mostly west, and chiefly US, dominated. BRICS represents an aspiration for a more de-centralized world economic order in the digital era, moving away from its currently west or US-EU axis centric political and economic systems. BRICS countries represent the strongest emerging economies that have both the greatest stake in a shifted world order and the capacity to cause such a shift. It is this congruence that keeps this group together and lends it strength. All developing countries stand to benefit from a more decentralised global economic and political order that BRICS can help achieve in the digital era. This paper discusses how BRICS can challenge the emerging global digital economic structures in the west through digital co-operation for industrialization, and how its members can develop their own digital infrastructures and capacities. This needs to be done urgently by BRICS to avoid becoming lower level players in west-centred digital value chains, as is still largely the case in the pre-digital industrial economy.

In this digital industrial era, connectivity and scale play an important role. Analytics on 'Big Data' becomes more efficient larger the data and cloud computing becomes more cost effective larger its scale. With the world's two most populous countries in BRICS, the group already has a comparative advantage in terms of generating quantum of data and scale of operation but to use this advantage in favour of all BRICS members, there is a need to develop a digital cooperation strategy. BRICS has been able to cooperate best in economic areas, especially of the globally systemic nature. An important issue for BRICS cooperation in the area of digital economy would be to disentangle the economic from political-strategic aspects of the “digital”, whenever developing common positions become difficult. Such difficulties often arise as BRICS countries do have substantially different geo-political and -strategic interests and viewpoints in many areas.

This paper traces the evolution of digital economy, explains various components of digital infrastructure, provides an empirical evidence of rising digitalization of manufacturing processes in advanced countries in the world and benchmarks the extent of digital industrialization that has occurred in BRICS over the period 2000 to 2014. Further, it provides a possible digital cooperation agenda, which, if adopted by BRICS, can accelerate their progress in digital industrialization. Other regional blocs in the world, like the EU, are in a well advanced stage in terms of setting up digital cooperation agenda and in many areas are entering the implementation phase. The paper

[4] World Development Indicators (2017) and World Integrated Solutions (WITS)

also draws from the experience of EU's single digital market initiatives and provides lessons for the BRICS.

The paper is organized as follows: section 2 discusses the evolution of digital economy; section 3 describes various components of digital infrastructure; section 4 examines the rising competitiveness of BRICS in global trade and manufacturing trade; section 5 compares the existing digital capacity and the extent of digitalization that is taking place in manufacturing exports in BRICS as compared to other advanced countries; section 6 presents a possible digital cooperation agenda for BRICS; and section 7 summarizes and concludes.

2 Evolution of Digital Economy

The evolution of digital economy can be traced back to the software revolution which emerged in the US in 1990s, when most business processes begun to be simulated in and supported by software, leading to huge increases in productivity. Software was able to transform business (and many other social) processes as it was able to process information at humanly impossible levels of efficiency. Sustained high productivity in the US in the late nineties is considerably attributed to IT and its effects.[5] With the growth of global digital networks, this software revolution also led to high level of manufacturing outsourcing, because it became possible to coordinate globally distributed activities in real time. This had a considerable impact on the global economic scene, perhaps seen most dramatically in the rise of China as a global manufacturing giant, which completely transformed its economy in a few decades.

US software companies quickly became some of the largest corporations globally. Software has very little marginal costs of production, and considerable consumer stickiness due to network effects and the learning curves involved. These factors resulted in first mover US companies becoming global monopolies. Therefore, not only did the software revolution greatly increase the productivity and competitiveness of US business, US software companies earned huge profits from across the world.

Following this, US software companies began to out-source low-end code writing and latter also higher-end testing etc. tasks, to emerging IT centers in developing countries, like India. It had important economic implications for the outsourced countries. For the US, it was a very significant economic perch and advantage to be the principal global supplier of software. But it yet only provided limited advantage or power. This can be called 'software power', which is the first building block of digital power. It implied some degree of business process homogenization in favor of US based forms and templates, as US business software became ubiquitous. This contributed to furthering US economic hegemony and strength in many ways. This factor while important was not a paradigm shift.

Paradigm shift came with the advent of the Internet and US Internet companies providing mass internet applications across the world. Google and Facebook are the prime examples. In the earlier period of stand-alone or non-networked software, though US based mass software was generally cheaper and of very high quality, businesses all over the world retained considerable

[5] https://www.mckinsey.com/global-themes/americas/us-productivity-growth-1995-2000

latitude to develop their own software if they so preferred. But internet applications have an exceptional network effect whereby first movers are able to completely dominate their respective sectors, and are then difficult if not impossible to compete with or replace. Whoever owns the key nodes of a digital network holds huge amount of power, which when leveraged with an appropriate business model manifests as economic power. This can be called- 'network power',[6] which is a very important aspect of digital power. The power here is basically of, mostly monopolistic, dominating and controlling of the medium and channels of digital interactions in a given sector. US Internet companies began to so thoroughly dominate the economic sectors involving information and communication, like advertising, media, etc, that they completely changed their very nature, including fully globalizing them.

But the best, or the worst –- depending of whether one is looking from a digital evolution or digital control point of view, was yet to come. Internet companies slowly realized that even more than the network power, their key resource was the digital data that they collected, sitting over key nodes of the network. The detailed real time information and intelligence that such data provided them about any given economic sector was an unparalleled asset. Their business soon began to become data-centric, whereby data power was added to their network power. 'Data power' or digital intelligence power builds over network power but is even more potent and transformational[7]. Not only companies involved in information and communication related business, but also others, that hitherto may have just networked actors in an economic area, like transport and hotel booking, began to become data centric. In the process, they came into a position of not just facilitating information search and communication in a particular sector but to effectively exercise the central organizing control over big chunks of it. Uber, AirBnB, etc emerged as de facto digital taxi and accommodation renting companies, respectively. Increasingly the legal understanding is also turning to considering them formally as taxi and accommodation renting companies[8], and not just technology platforms which description these companies prefer in order to escape sectoral regulators.[9]

The combination of data power with network power and software power has led to transition into the digital mode leading to such huge economic power that whoever exercises it migrates towards the top of the value chain in any given sector[10]. As this process takes place in all sectors – from transportation to accommodation and travel to finance and logistics, to education, health and agriculture – it has led to emergence of a digital economy.

The advent of an industrial society represented automation of physical power, first with steam and then employing mineral oil and electricity. Digital economy correspondingly centers on automation

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[6] https://faculty.georgetown.edu/irvinem/theory/Castells-Network-Power-2011.pdf

[7] An analysis of three components of digital power – software power, network power and data power, as defining "digital economy" is developed in the paper "Digital Industrialization in developing Countries: A Review of the Business and Policy Landscape", Commonwealth Secretariat, forthcoming, draft at http://www.itforchange.net/sites/default/files/1468/digital_industrialisation_in_developing_countries.pdf

[8] http://www.bbc.com/news/business-42423627

[9] https://citizen.co.za/news/south-africa/1454013/were-a-technology-company-not-a-taxi-service-says-uber/

[10] See Banga and Kozul-Wright (2018), "South-South Digital Cooperation for Industrialization: A Regional Integration Agenda", UNCTAD.

of intelligence, and its disembodiment from human agents. This leads to large-scale reorganization of all economic activities and sectors based on data-driven artificial or digital intelligence. The efficiency gains of such reorganization are extremely high, and it would soon be impossible for pre-digital processes and activities to compete with digitalized ones. It is therefore not possible to stand out of, or even delay, the process of economic digitalization or what can also be called at the macro-level as digital industrialization.[11]

Apart from the technical and organizational challenges, the main problem that confronts most nations today in their digital industrialization efforts is the highly US centric nature of digital value chains and industry, and the difficulty to compete with it effectively even at the local levels. This industrial revolution, often termed as digital industrialization or Industry 4.0, differs from the earlier industrial revolutions, which were born local, and then expanded upwards and outwards. While the global scale of digital revolution gives it value in form of larger data sets, and other forms of efficiencies, the US centric monopolistic nature of global digital industry remains a key concern. Even the EU has not been able to effectively challenge this global concentration of digital economic power.

One of the biggest digital economy challenges facing the BRICS group is therefore to decentralize the structures of global digital power. Since digital power permeates all aspects of economy (and other social sectors), such decentralization is sine qua non for overall rapid economic growth of BRICS countries. In this process of decentralization, BRICS countries can themselves set up competing centers and structures of digital power. This can also give a fillip to regional economic development through appropriate regional cooperative frameworks, including regional digital single markets.

In order to progress in digitalization, it is imperative to build digital infrastructure. The next section discusses the digital infrastructure which is required for digitalization.

3 Building Digital Infrastructure

As discussed above, a digital economy has evolved with data power combining with software power and network power. Digital Infrastructure (DI), can therefore be said to comprise of three kinds of infrastructure- *Broadband infrastructure*; *Cloud Computing infrastructure* and *Data Infrastructure*.

The first step towards developing DI is building *Broadband infrastructure*. With the advent of digital economy, broadband infrastructure takes up the same role as roads, railways and ports did in the industrial economy, shaping, and supporting the growth of, all sectors. Even while encouraging private telecom business, the governments should not hesitate in investing in broadband as a core public infrastructure. The fact that giant digital corporations are eager to privately invest for no costs to the governments in universalising connectivity to reap its advantage– for example, Google's Project Loon and Facebook's Aquila Drone project – eloquently illustrates the low cost

[11] As we use the term digital industrialisation, the earlier industrial phase can be called as mechanical industrialisation as a matter of distinguishing the two.

to digital benefits ratio of universalising connectivity. This is in spite of the fact that as private companies they can never fully internalise all its digital benefits.

The real problem is not the costs. It is confusion about the right business, institutional and policy models for universal broadband connectivity. The telecom sector had largely been a public-owned monopoly infrastructure in most countries till the nineties, but it rightly went through large-scale liberalisation and privatisation in context of the mobile telephony phenomenon. That mind-set still rules the telecom sector. However, with the accent shifting to internet connectivity in the new millennium, by late 2000's, it was already being felt that wired broadband connectivity especially to remote areas is not adequately served by private companies. Most countries therefore brought in public sector programs and investments. With the imminent digitalisation of all sectors in a digital economy, the logic of quickly universalising broadband is now fully transformed. Broadband is a universal public infrastructure first, and a business area later. Multiple private connectivity businesses in fact will best thrive over an open access back-haul broadband infrastructure, as discussed in a later section.

If universal broadband is the condition of a digital economy, software is its building blocks, forming its body. Software is the new sub-stratum for social and organisational processes, represented in code and made highly efficient through automated information processing. Internet itself is software, but was deliberately designed extremely light so that it just did the 'connecting role', with intelligence remaining at the edges in the software that got connected.

But soon the internet began to mix more deeply with the connected software, and became thick, giving birth to what is called as *'Cloud Computing'*. To that extent, this new paradigm replaces both standalone software and, to a considerable extent, also the thin connector internet.[12] Cloud Computing provides computing services remotely as a general utility to internet users. It could be just sterile infrastructure like storage, means for processing, networking and servers (Infrastructure as a service, or IaaS), or also provide operating software and platforms for building custom applications (Platform as a service, or PaaS) or consist of remote provision and management of the whole range of computing needs right up to fully-functional applications and data-based processes (Software as a service or SaaS). Cloud computing combines software power with network power, as huge global internet applications provide the digital body and space for whole set of activities in any given sector.

Cloud computing, as 'the' computing model of the future, allows quick, wide and deep global spread of relatively inexpensive cutting-edge technologies, availability of which is basic to the digital revolution. All countries will therefore need to remain considerably invested in its global structures. However, it must be remembered that cloud computing does not involve just "innocent" resource provision. Its global models build abiding digital structures, which are imbued with subtle and obvious power. The dependence increases from IaaS through PaaS to SaaS models, but all of them can structure power towards global companies that control the major business in each

[12] Studies have found that many resource-poor young people in developing countries almost exclusively used only Facebook and considered the Internet as Facebook and called it by that name. Facebook is basically a private cloud application for social communication and networking. See, https://qz.com/333313/milliions-of-facebook-users-have-no-idea-theyre-using-the-internet/

segment. Walmart, for instance, refuses to use Amazon cloud service, even of just the IaaS kind, in order to avoid getting caught in its digital standards and frameworks as Amazon also employs its cloud computing business to help structure consumer goods supply chains, which is basic to its e-commerce business.

Global cloud applications like those provided by Google, Facebook, Uber and AirBnB are beginning to become virtual control panels for re-organising whole sectors. Google not only "organises the world's information" but by its own claim has also launched services like "Google Jobs" which makes it "the" platform for jobs search globally. Similar is the situation of Facebook in terms of global media, and Uber and AirBnB in transport and short-term accommodation-renting. Global corporations are also attempting to be the first movers to dominate technology application based ecosystems and platforms like for "Internet of Things" or IoT, Machine Learning, Block-chain, Augmented Reality, and so on. To understand what digital ecosystem based domination in a sector means, one need only see the advantage that the Android platform provides to Google in its digital strategies and positioning.[13]

Both Google and Amazon have come up with Machine Learning platforms as a service, in a close race to dominate this most important of digital areas. Commentators claim that a major advantage for Amazon here is that a very large number of businesses already use Amazon Web Services for other cloud computing services which renders more convenient for businesses to develop Machine Learning (ML) services over its ML platform. Google on the other hand is focussing on ML services on mobiles where it controls the main operating system, Android. This illustrates how command over any infrastructural layer can help dominate other layers.

Cloud computing forms the main infrastructure of a digital society and economy. As networked software extends seamlessly across the globe, cloud computing provides the structure of a globally unified digital economy, formed in a manner that allows easy monopolization by first movers in all areas[14] (currently mostly US based) and resists all influences outside its own commercial logic beholden to the key involved corporations, including of public law and regulation, and values like diversity and local ownership. To have some control over the digital economy phenomenon it is important for countries to obtain sufficient handle over the digital infrastructural layer of cloud computing.

The third step towards developing digital infrastructure is building *data infrastructure.* It has now become the most valuable component of digital infrastructure with the ability to give rise to global monopolies and change the relative positions of the countries in terms of their shares in global production, consumption, investments and international trade. If cloud computing is the body and structure of digital systems, data is the key substance that runs through them. It has been called the oil or the currency of digital economy. It is this digital data, auto-generated from social and economic digital interactions, that provides the all-important digital intelligence. The latter is the

[13] Google's Android platform is currently being investigated by EU regulators for alleged anti- competitive practices.

[14] This McKinsey report highlights how digital drives a winner-takes-all economics, https://www.mckinsey.com/business-functions/digital-mckinsey/our-insights/why-digital-strategies-fail

chief resource of the digital society/ economy, and central to its social and economic re-organisation.

Unlike cloud computing, big data is born local. It largely comes from real social relationships and physical things that are territorially situated. The most valuable data in digital economy is that which is collected by digital corporations from outside sources – whether personal, social, artefactual or natural. Its true ownership remains unclear, and it is doubtful whether the full economic value of such "outside" data can legitimately be monopolised by the collecting digital companies, as is currently the main digital business model. Digital data's greatest value is also in situated local application, which further strengthens the logic of its local ownership.

General social data, as society-wide information, has strong aspects of a public good. It gets produced through collective processes, and is best utilised in a non-rival manner. As a common infrastructure, it can provide very valuable insights and intelligence to all business and other actors, who can then build their business models around employing these to deliver value-added intelligent or digital services in any sector, addressing diverse specific contexts and needs.

The OECD compares the role of data to that of industrial age infrastructures like roads and bridges: "Physical infrastructure such as roads and bridges enables benefits to 'spill over', for instance, by fostering trade and social exchanges. In the same way, greater access to data also has beneficial spill-overs, whereby data can be used and re-used to open up significant growth opportunities, or to generate benefits across society in ways that could not be foreseen when the data were created".[15]

Rather ironically then, the current digital economy is almost entirely built on private (as against public) and exclusive (not common-infrastructural) appropriation of this key social resource by large digital companies. It lies at the centre of their business models. This model is globally pushed by the US, home to most of these companies. The EU follows the US lead, although somewhat hesitantly. The EU is yet to reconcile different views about the place of personal and other forms of data in digital business models. It has recently begun to look into ownership patterns around data from Internet of Things (IoT), whether those who own the points of its production have economic rights to it or the digital platform providers.[16] The same policy paper explores if big data controllers can be obliged to share data openly on FRAND (Fair, Reasonable and Non-Discriminatory) terms, and whether such data should be accessed by public authorities for free when required in public interest, as, for instance, commuting data for traffic planning. The Economist recently mooted the idea of "compulsory licensing" regarding large amounts of data collected by digital corporations.[17] Such proposals begin to shape a commons/ public ownership, or an infrastructural, framework around big data. Data infrastructures, like health data

[15] https://www.oecd.org/sti/ieconomy/PolicyNote-DDI.pdf
[16] http://ec.europa.eu/newsroom/dae/document.cfm?doc_id=41205
[17] https://www.economist.com/news/leaders/21735021-dominance-google-facebook-and-amazon-bad-consumers-and-competition-how-tame

infrastructure,[18] agriculture data infrastructure,[19] financial risk data infrastructure,[20] education data infrastructure,[21] energy data infrastructure[22], transport data infrastructure[23] and "data infrastructure for smart cities"[24] have been proposed and discussed in academic and policy documents, and have been implemented in some cases.

Data infrastructure is formed of 'data' which provides 'data intelligence'. Everyone using internet generates digital data, be it producers or consumers or people in general using social media. However, data is like unrefined oil, which is of no use to anyone unless processed as 'data intelligence.' Data intelligence arises from combining layers of data to form 'Big Data' and transforming this big data into information and knowledge by analyzing it. The very high value generated from big data forms the basis of 'Artificial Intelligence (AI)' producing unique products and services, which are more efficient and less costly to produce and consume. Ownership of data and capability of intelligently transforming this data into highly efficient products and services lead to monopolies.

Apart from the need to decentralize global digital power, it is important to assess whether BRICS has the necessary means to do so in terms of existing digital capacity and digital infrastructure. The two next sections examine the rising share of BRICS in global trade, especially in manufacturing trade and the challenges imposed by digitalization, in terms of the existing digital capacity and the rising digitalization of manufacturing activities in BRICS as compared to advanced countries.

4 The Rising Share of BRICS in Global Trade

BRICS has emerged as an important strategic block in global trade landscape with rising share in global merchandise exports and imports in the face of declining shares of USA and the EU27. However, within BRICS, most of the contribution to global merchandise trade has come from China, followed by India. Even in terms of intra-BRICS trade, China is leading the way. In manufacturing exports, which is an indicator of industrial competitiveness, BRICS has surpassed USA in terms of its share in global manufacturing exports. This section provides trends on the shares of BRICS, USA and EU27 in global merchandise and manufacturing trade.

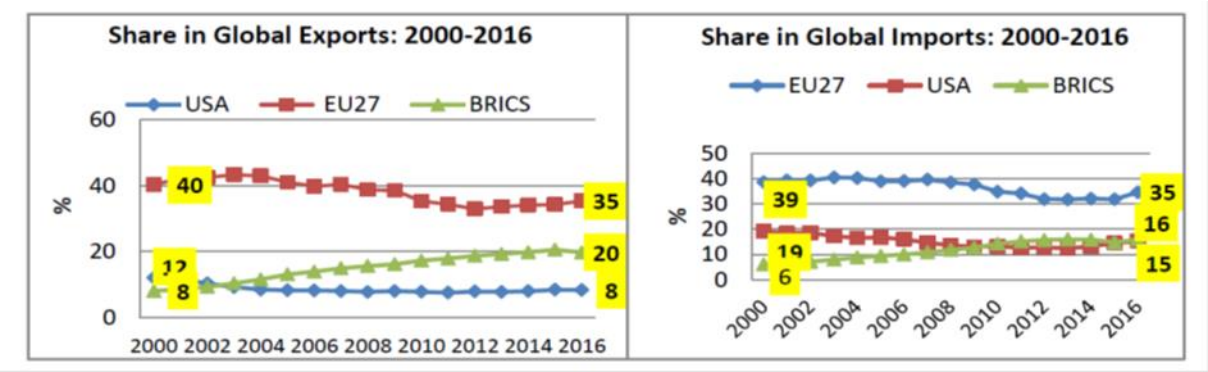
4.1 Rising Share of BRICS in Global Merchandise Trade

The importance of BRICS in international trade has grown steadily since 2000. While EU27 has always enjoyed the highest share as a regional block in global trade, especially in merchandise trade, share of BRICS in global merchandise exports has grown steadily, rising from 8% in 2000

[18] https://www.healthit.gov/sites/default/files/ptp13-700hhs_white.pdf
[19] https://opendatacharter.net/agriculture-open-data-package/section-2-towards-open-data-infrastructure-agriculture/what-is-a-data-infrastructure/
[20] https://home.kpmg.com/content/dam/kpmg/pdf/2014/05/risk-data-infrastructure-extract-april-2014.pdf
[21] http://wonkhe.com/blogs/a-brief-history-of-higher-education-data/
[22] http://smartklub.org/uncategorised/city-blog/building-the-energy-data-infrastructure-for-a-city/ and http://nnsso.com/working-groups/
[23] http://transportdatainitiative.com/wp-content/uploads/2016/07/How-our-existing-data-can-benefit-individuals-and-localcommunities-2016.pdf
[24] http://www.smartcityresearch.com/2015/08/know-your-place-realise-your-value.html

to 20% in 2016. Share of USA and EU27 fell by 4 and 5 percentage points respectively during this period BRICS share in global imports more than doubled in this period rising from 6% in 2000 to 15% in 2016 while the shares of USA and EU27 declined (Figure 1).

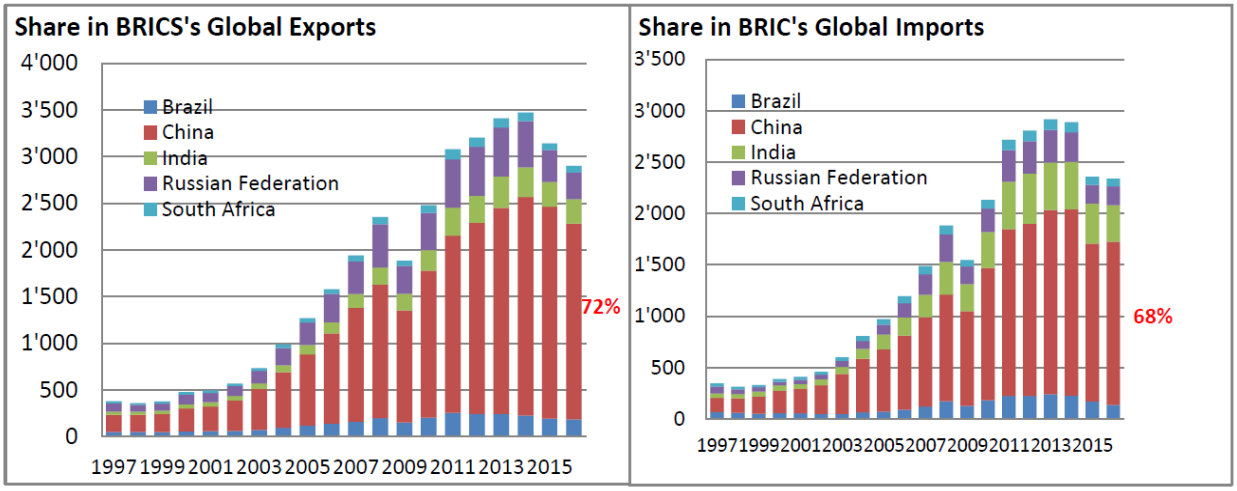
Figure 1: Share of BRICS, USA and EU27 in Global Merchandise Trade: 2000-2016



Source: World Integrated Solutions, COMTRADE

Within BRICS, growth in merchandise trade has been highest for China, followed by India. While BRICS's global merchandise exports increased from USD 379 billion in 1997 to USD 2.9 trillion in 2016, share of China in BRICS's global exports increased from 48% to 72%, that of India remained around 9%, while the shares of rest of the countries fell. Similar trend is found for global merchandise imports of BRICS, which increased from USD 346 billion in 1997 to USD 2.3 trillion in 2016, with share of China rising from 41% in 1997 to 68% in 2016, while that of India increasing from 12% to 15%. Shares of rest of the three countries in global imports of BRICS declined during this period (Figure 3).

Figure 2: Share of Countries in BRICS's Global Trade (USD Billion): 1997-2016

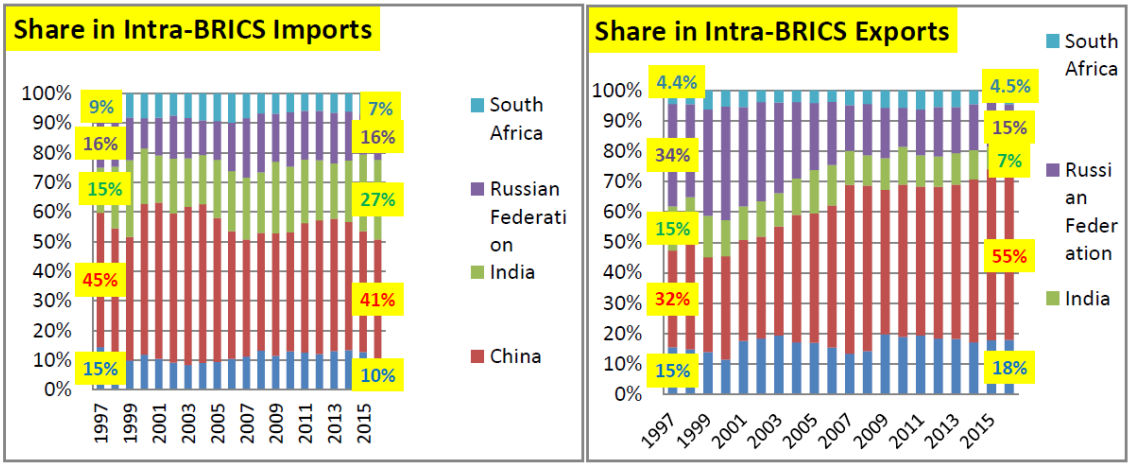


Source: World Integrated Solutions, COMTRADE

Although, share of BRICS in global trade has been rising, share of intra-BRICS merchandise trade has remained low since last one and a half decades. Share of intra BRICS merchandise exports

in BRICS's global exports increased only marginally from 0.3% in 2000 to 1.7% in 2016. Intra-BRICS exports increased from USD 15 billion in 1997 to USD 234 billion in 2016. Most of the rise in intra-BRICS trade has come from China. China's share in intra- BRICS exports increased from 32% in 1997 to 35% in 2016, while Brazil's share increased from 15% to 18%. Share of the other three countries has declined over the years (Figure 3).

Figure 3: Share of Countries in Intra BRICS's Exports

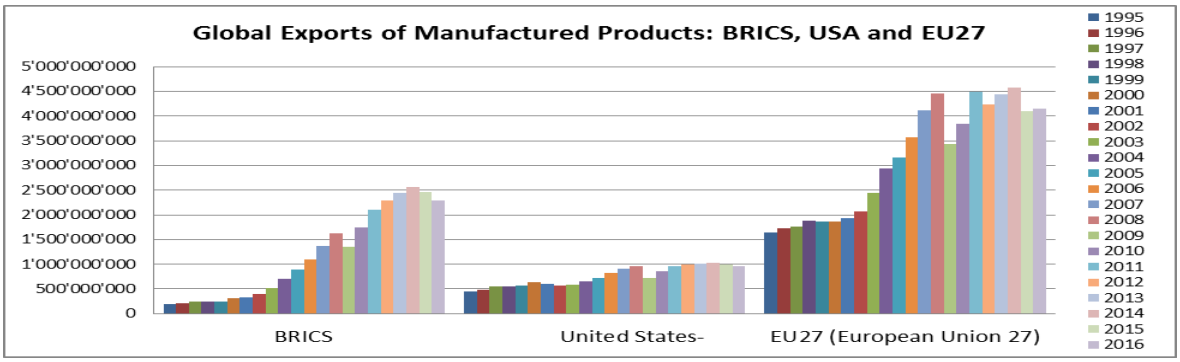


Source: World Integrated Solutions, COMTRADE

4.2 Rising Share of BRICS in Global Manufacturing Exports

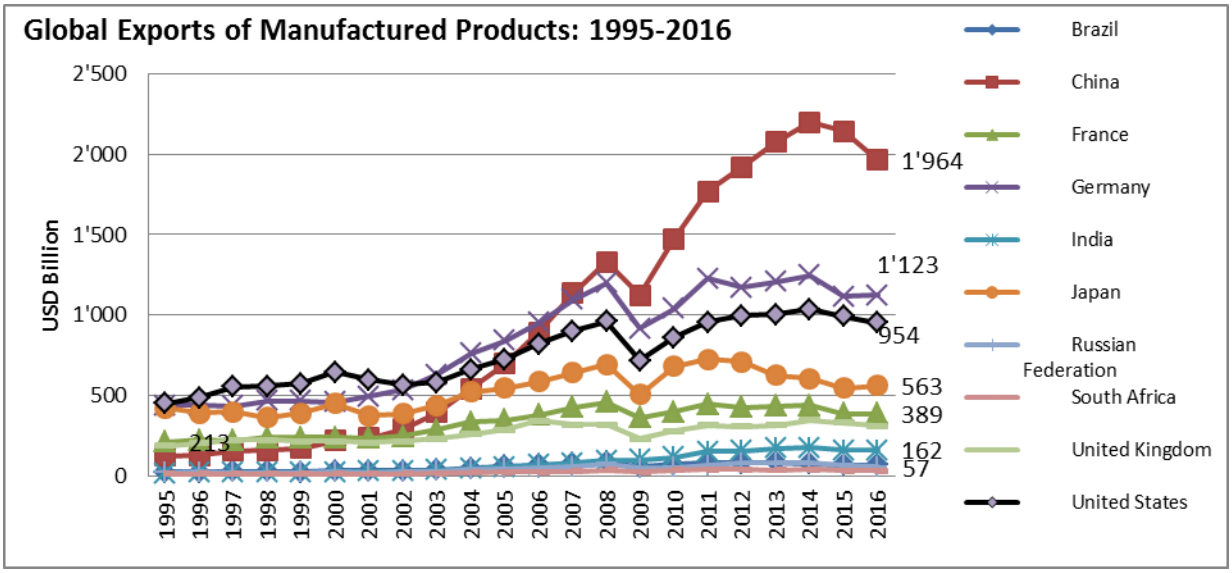
Manufacturing plays a key role in structural transformation of the economies by creating formal employment, income and demand and accelerating productivity which in turn boosts incomes and demand. Expanding exports of manufactures, with strong domestic linkages, can therefore support industrialization (TDR 2016). BRICS has increased its manufacturing exports from USD 300 million in 2000 to USD 2.3 billion in 2016, while manufacturing exports of USA increased from USD 600 million in 2000 to USD 954 million in 2016, which is considerably lower than that of BRICS. Manufacturing exports of EU27 amounted to USD 4.1billion in 2016 (Figure 4). Share of China is dominant within BRICS, with USD 1.9 billion of manufacturing exports in 2016, higher than USA and other advanced economies (Figure 5).

Figure 4: Global Exports of Manufactured Products: BRICS, USA and EU27



Source: UNCTADSTAT; Note: Manufactured Products cover -SITC 5 to 8 less 667 and 68.

Figure 5: Global Exports of Manufactured Products: BRICS and Advanced Countries



Source: UNCTADSTAT; Note: Manufactured Products cover -SITC 5 to 8 less 667 and 68.

Rising share in manufacturing exports indicates growing industrialization as well as growing global competitiveness in manufacturing products. However, in the digital era, this competitiveness will largely depend on the capacity of countries to digitize their manufacturing production and exports. To assess the changing competitiveness due to digitization, the next section compares the existing digital capacities in BRICS and compares them to advanced countries. The use of digital services in manufacturing exports is also compared.

5 Existing Digital Capacity and Rising Manufacturing Digitalization in BRICS

5.1 Existing Digital Capacity

BRICS countries have progressed rapidly in terms of their ICT infrastructure. Brazil, Russian Federation, India and China are among top 20 countries in the world with highest number of internet users. They also occupy high ranking in terms of ICT Development index, which brings together ICT access, use and skills into a single measure. However, compared to advanced countries like Germany, USA and the UK, the digital infrastructure in BRICS is still limited. This refers to the broadband infrastructure and internet related infrastructure. Table 1 compares the existing digital capacity in BRICS to advanced countries using some indicators. Although it is found that China and India have higher number of internet users as compared to USA, UK and Germany, they rank much lower in terms of ICT development index which is based on access, price and use of internet. BRICS compare unfavourably to advanced countries when it comes to fixed broadband subscriptions per 100 inhabitants and percentage of households with internet access. The international internet bandwidth refers to the total used capacity of international Internet bandwidth, in megabits per second (Mbit/s). Used international Internet bandwidth refers to the average traffic load of international fibre-optic cables and radio links for carrying Internet traffic. This is also found to be much lower in most of the BRICS countries as compared to the advanced countries.

Table 1: Existing Digital Capacity in BRICS and Advanced Countries in 2017

	Number of internet users in selected countries as of 2017 (in millions)	ICT Development Index Ranking (1DI)	Fixed Broadband Subscriptions per 100 inhabitants	Active Mobile-broadband subscription per 100 inhabitants	3G coverage (% of population)	Percentage of households with internet access	International internet bandwidth per internet user (kbits/s)
China	1'004	80	22.9	69.1	98.0	55.5	14.7
India	332	134	1.4	16.8	79.7	22.6	16.0
Brazil	120	66	13	89.5	96.9	52.4	66.2
Russia	88	45	19.4	74.9	75.0	74.8	51.9
South Africa	36	92	2.1	58.6	98.0	53.0	263.0
Germany	67	12	38.8	76.5	96.2	90.8	107.5
United Kingdom	55	5	39.2	91.4	99.6	91.3	66.2
United States	272	16	32.4	124.9	99.9	84.0	126.5

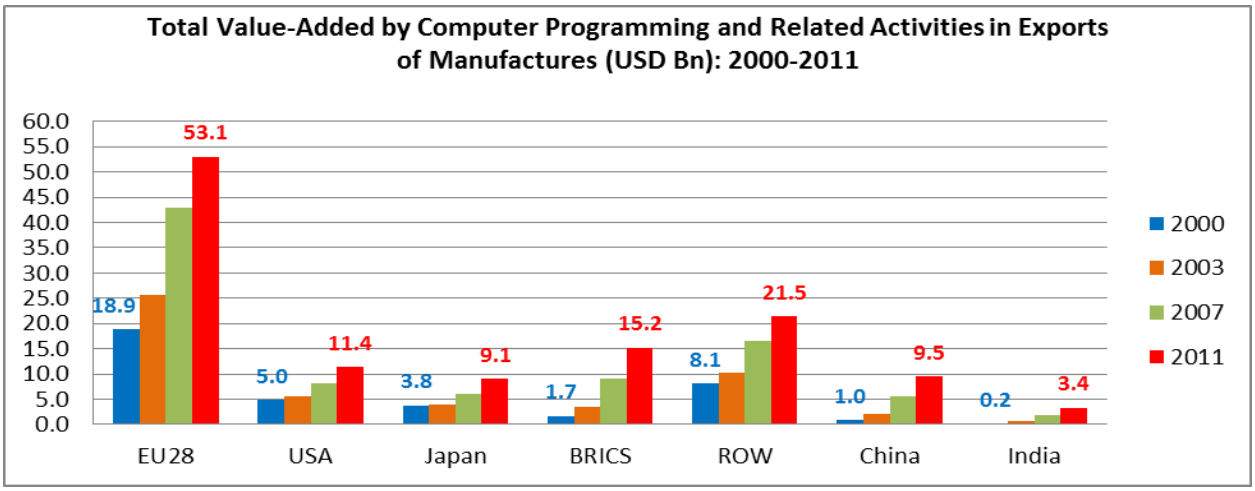
Sources: Statista; Statista DMO@2 Statista 2018, ITU Estimates (2017) https://www.itu.int/en/ITU-D/Statistics/Documents/publications/misr2017/MISR2017_Volume2.pdf

Although, BRICS are found to have lower digital capacity in terms of basic digital infrastructure, they have been able to steadily increase their share in global manufacturing exports. But, with the advent of Industry 4.0, the competitiveness of countries in manufacturing production and trade will depend critically on the extent to which countries are able to digitalize their production and distribution processes. Digital services are increasingly playing an important role in manufacturing, paving the way for digital industrialization.

5.2 Digitalization of Manufacturing Exports

To examine the extent to which the manufacturing exports of BRICS have been digitalized as compared to US and EU27, we use data from Trade in Value-Added (TiVA) provided by OECD. Comparison is made of total value-added by computer programming and related activities in manufacturing exports. Domestic and foreign value-added by computer programming activities are added to arrive at the total value-added by computer programming activities in exports of manufactures. The rising product digitalization is evident from the fact that the use of computer programming in manufacturing exports has increased for all countries, although the levels are very different. While total value-added by computer programming more than doubled from USD 5 billion in USA in 2000 to USD 11.4 billion in 2011, it increased almost 9 times in China, increasing from USD 1 billion to USD 9.5 billion. In India, use of computer services in manufacturing exports is relatively low, rising from USD 0.3 billion to USD 3.4 billion (Figure 6).

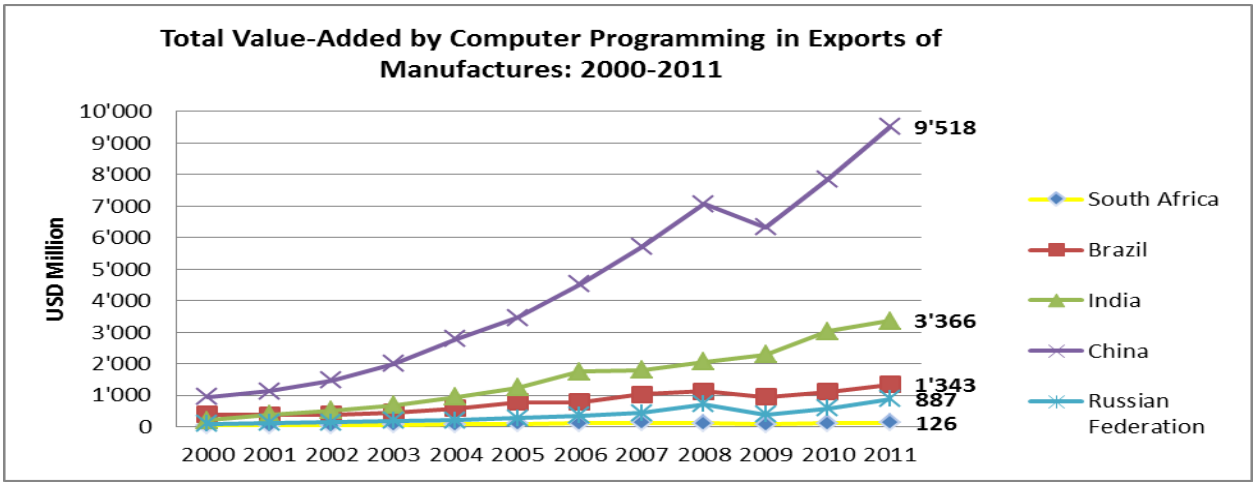
Figure 6: Total Value-Added by Computer Programming and Related Activities in Exports of Manufactures: 2000-2011



Source: Trade in Value-Added, (TiVA), OECD

Examining the extent of total value-added by computer programming in manufacturing exports in BRICS, it is found that manufacturing exports have experienced a rising digitization in all BRICS countries in the period 2000-2011, with highest use in China, followed by India, Brazil, Russian Federation and South Africa respectively.

Figure 7: Total Value-Added by Computer Programming and Related Activities in Exports of Manufactures: 2000-2011



Source: Trade in Value-Added, (TiVA), OECD

Although in absolute terms, the extent of total value-added of computer programming used in exports of total manufactures is highest in China, when taken as a ratio to gross exports of manufactures, it is found that India has experienced maximum increase in its digitization of manufacturing exports, with the ratio increasing from 0.7% to 1.5% i.e., a rise of 100% in the period 2000 to 2011, while, Brazil and South Africa have not experienced much change. Both

China and Russian Federation have experienced 20% and 50% increase respectively (Table 2). Comparative ratio increased from 1.5% to 1.7% in UK.

Table 2: Total Value-Added by Computer Programming and Related Activities in Exports of Manufactures (%) in BRICS: 2000-2011

	South Africa	Brazil	India	China	Russian Federation	USA	UK	GERMANY
2000	0.2	1.0	0.7	0.5	0.2	0.8	1.5	0.9
2001	0.3	0.9	1.2	0.6	0.3	1.0	1.6	1.1
2002	0.3	0.9	1.5	0.6	0.3	1.0	1.6	1.0
2003	0.2	0.9	1.5	0.6	0.3	1.0	1.7	1.0
2004	0.3	0.9	1.6	0.6	0.2	1.0	1.5	1.0
2005	0.2	0.9	1.7	0.6	0.2	0.9	1.4	1.0
2006	0.3	0.9	1.9	0.6	0.2	0.9	1.4	1.0
2007	0.3	0.9	1.5	0.6	0.2	0.9	1.4	1.0
2008	0.2	0.9	1.4	0.6	0.3	1.0	1.4	1.2
2009	0.2	1.0	1.7	0.7	0.3	1.1	1.8	1.5
2010	0.2	1.0	1.6	0.6	0.3	1.1	1.7	1.4
2011	0.2	1.0	1.5	0.6	0.3	1.1	1.7	1.4

Source: Trade in Value-Added, (TiVA), OECD

Examining the total value-added by computer programming in exports of different sectors, it is found that, in absolute terms, it is highest for India (USD 26 billion), followed by China (USD 14 billion), Brazil (USD 3 billion), Russian Federation (USD 1.5 billion) and South Africa (USD 367 million) respectively. However, in manufacturing exports, China has the highest value-added by computer programming. The manufacturing exports which use the maximum amount of computer programming in China are electrical and optical equipment followed by chemicals and non-metallic mineral products. Interestingly, value-added by computer programming in total exports is found to be highest for India (USD 26 billion) of which around 87% is used in exports of services. In mining and quarrying, Brazil uses the maximum amount of value added from computer programming (Table 3).

Table 3: Total Value-Added by Computer Programming in Exports of Different Sectors in 2011 (USD Million)

	Brazil	China	India	Russian Federation	South Africa
Total Exports	3'460	13'920	26'149	1'566	367
Agriculture, Hunting, Forestry and Fishing	96	26	18	11	5
Mining and Quarrying	1'021	28	17	228	43
Manufactures	1'343	9'518	3'366	887	126
Food products, beverages and tobacco	297	151	230	16	5
Textiles, textile products, leather and	23	1'005	490	3	1
Wood, paper, paper products, printing and publishing	100	182	47	30	4
Chemicals and non-metallic mineral products	276	1'065	692	352	29
Basic metals and fabricated metal products	197	544	270	354	26
Machinery and equipment, nec	108	811	256	65	19
Electrical and optical equipment	111	4'833	321	36	9
Transport equipment	227	569	331	30	27
Manufacturing nec; recycling	3	357	729	3	5
Total Services	995	4'321	22'731	422	193

Source: Trade in Value-Added, (TiVA), OECD

In terms of gross total exports, value-added by computer services is maximum in India, which is above 5% , followed by Brazil (1.2%), China (0.7%) and South Africa and Russian Federation (0.3%). In traditional export-oriented sectors like textiles, leather products &footwear and wood, paper & paper products, India is found to have more than 2% value-added contributed by computer and related services in their total exports., while this is much lower in other BRICS countries (Table 4).

Table 4: Total Value-Added by Computer Programming as a Percentage of Exports of Different Sectors in 2011 (%)

	Brazil	China	India	South Africa	Russian Federation
Total Exports	1.2	0.7	5.7	0.3	0.3
Agriculture, Hunting, Forestry and Fishing	0.4	0.2	0.2	0.2	0.2
Mining and Quarrying	1.8	0.4	0.3	0.1	0.1
Manufactures	1.0	0.6	1.5	0.2	0.3
Food products, beverages and tobacco	0.7	0.4	1.3	0.2	0.3
Textiles, textile products, leather and footwear	0.6	0.5	2.1	0.2	0.4
Wood, paper, paper products, printing and publishing	1.2	0.7	2.8	0.3	0.4
Chemicals and non-metallic mineral products	1.1	0.5	0.8	0.2	0.3
Basic metals and fabricated metal products	0.9	0.4	1.3	0.1	0.4
Machinery and equipment, nec	0.9	0.6	2.5	0.3	0.4
Electrical and optical equipment	1.8	0.8	2.1	0.4	0.4
Transport equipment	1.2	0.6	1.8	0.3	0.5
Manufacturing nec; recycling	0.5	0.4	2.2	0.2	0.4
Total Services	1.4	1.0	10.9	0.8	0.3

Source: Trade in Value-Added, (TiVA), OECD

While Table 5 and Table 6 depict the absolute figures and ratios of the existing extent of digitization of manufacturing exports, Table 5 presents the growth in use of value-added by computer programming in exports of manufacturing. The growth in value-added by computer and related activities in total exports had been highest for India during the period 2000-2011 (85%), followed by Russian Federation (63%), China (55%), South Africa (46%) and Brazil (11%). Contribution of computer and related services in total exports of services has been maximum in South Africa (240%), probably from a low level, followed by China (169%) and India (80%). In exports of manufactures, growth of value-added by computer programming has been highest for India, which has experienced more than 100% increase in most of its manufacturing industries' exports.

Table 5: Growth in Total Value-Added by Computer Programming in Gross Exports of Different Sectors from 2000-2011 (%)

	Brazil	China	India	South Africa	Russian Federation
Total Exports	11	55	85	46	63
Agriculture, Hunting, Forestry and Fishing	15	62	79	21	145
Mining and Quarrying	7	23	-11	-2	6
Manufactures	-2	26	103	-6	85
Food products, beverages and tobacco	-1	35	103	4	116
Textiles, textile products, leather and footwear	8	29	148	1	83
Wood, paper, paper products, printing and publishing	0	51	440	11	109
Chemicals and non-metallic mineral products	8	25	77	-10	66
Basic metals and fabricated metal products	11	19	66	-10	106
Machinery and equipment, nec	0	32	157	-1	103
Electrical and optical equipment	13	11	197	-9	84
Transport equipment	4	21	29	2	101
Manufacturing nec; recycling	-5	32	182	2	189
Total Services	6	169	80	240	71

Further, in terms domestic value-added by computer programming in total exports in the period in 2011, which reflects the country's digital capacity, maximum increase has been experienced by India (96%) followed by Brazil (85%), China (52%), South Africa (51%) and Russian Federation (41%). In manufacturing exports, more than 80% of value added in India and Brazil is domestic value-added, while in China, only 33% is domestic value-added by computer programming in manufacturing exports. In South Africa, in manufacturing exports, domestic value-added by computer services is less than 30% in all manufacturing industries.

Table 6: Domestic Value-Added by Computer Programming in Gross Exports of Different Sectors in 2011 (%)

	Brazil	China	India	South Africa	Russian Federation
Total Exports	85	52	96	51	41
Agriculture, Hunting, Forestry and Fishing	73	62	77	8	27
Mining and Quarrying	88	42	68	9	42
Manufactures	81	33	80	15	33
Food products, beverages and tobacco	81	51	86	11	31
Textiles, textile products, leather and footwear	82	48	86	9	26
Wood, paper, paper products, printing and publishing	84	22	84	15	20
Chemicals and non-metallic mineral products	81	35	73	14	37
Basic metals and fabricated metal products	82	41	78	13	34
Machinery and equipment, nec	77	41	84	21	24
Electrical and optical equipment	82	25	81	27	24
Transport equipment	77	38	80	12	24
Manufacturing nec; recycling	80	50	77	12	32
Total Services	90	93	98	85	57

The above analysis highlights three key points,

BRICS is growing in terms of its share in global trade, particularly in global manufacture exports, which has surpassed USA's manufacturing exports. However, this growth has been fueled mainly by China. In the digital era, the trade competitiveness of countries will critically depend on the extent of digitalization of their manufacturing exports, i.e., the extent to which they use digital technologies and services in production and distribution of their manufacturing products.

To capture digitalization of manufacturing exports, total value-added by computer programming and related services in manufacturing exports is estimated and compared across BRICS, USA and EU27. It is found that value-added contribution of computer programing and related activities in exports of manufactures has increased for BRICS and has surpassed that in USA. This has increased in all BRICS countries in absolute terms, although it is much higher in China as compared to other BRICS countries. However, value added by computer programming in manufacturing exports as a ratio of total manufactures exports is found to be highest in India in 2011, along with its growth over the period 2000-2011.

Domestic value-added by computer programming in exports is a good indicator of existing digital capacity for digital industrialization in a country. The analysis shows that India has the highest domestic value-added by computer programming in its exports, which is 96%, followed by Brazil (85%) but in other BRICS countries it is around 50% or less.

From this it follows that to sustain its competitiveness in manufacturing exports as well as in global trade and to decentralize global digital power; it becomes extremely important for BRICS to develop their digital capacity and also capacity to use digitalization for industrialization. Given the vast differences in the existing digital capacities within the BRICS, and some complementarities as will be discussed, it may be extremely important for BRICS to have a digital cooperation agenda for industrialization so that the countries could pool their resources and knowledge to support digital infrastructure within BRICS. The next section presents a possible digital cooperation agenda for BRICS which can help them to progress rapidly in building their digital infrastructure and catching-up with the fast progressing digital powers.

6. BRICS Digital Cooperation Agenda for Industrialization

BRICS as a group faces daunting challenges in terms of attempting to decentralize digital power because of its congenital global nature and unprecedented economies of scale, with winner-takes-all tendencies; however, there are some helpful positive factors as well. Digital technologies are a recent and emerging phenomenon and, relatively speaking in comparison to the earlier industrial technologies, they are easier to master to the highest levels, given the right conditions. Digital technologies are very social technologies, in the sense that they are mostly a large-scale co-creation through diverse, often distributed, efforts. Core science and technology, while no doubt important, matter relatively less than how available technical skills are incentivized and organized productively. Just in a few years, China has come close to US's digital technology prowess, and top class digital technology skills and even artefacts exist in other BRICS countries as well. The most important issue is to organize such skills into large productive units and business models, which is a challenge different from the basic technology itself. A second positive factor for BRICS countries to be able to develop counter digital power to US centric digital order is that the digital space overcomes the problem of BRICS not being a geographically contiguous group. Political will withstanding, they can work together as efficiently in the digital space as any geographically proximate group of nations. What matters most are complementary and additive competencies and interests.

Apart from the need to direct efforts towards decentralisation of digital power and its different specific structures, there is a second cross-cutting imperative that BRICS must address. This is to develop the necessary separation of public and private competencies and roles in the digital economy and society, and invest appropriately in both of them. One important characteristic of the current digital economy is that it almost entirely consists of the private sector, extending even to the traditional public sector roles, of providing infrastructure, developing standards and defining laws and regulation. Its predominant modes are of self- and private- regulation, big business driven standards development, and even the services of infrastructural and utility nature being provided privately.

This all-private-sector paradigm serves very well the dominant model of one undifferentiated, and largely unregulated, global digital economy centred in the US. First, it keeps at bay public interest laws and regulation that could "interfere" in and "retard" quick development and entrenchment of first movers, mostly from the US. (US itself has taken a very laissez-faire attitude to the Internet and digital industry, against its traditionally tough pro-competition enforcements, for the obvious global domination reasons.) It gives these first movers the required time and space to become so

dominant and entrenched that they soon become “too big to fail”. Such quickly achieved gigantic sizes with enormous cash reserves arising from unbridled profiteering enables these digital companies to monopolise digital R&D, buy off competing or otherwise promising start-ups, use predatory techniques to kill competition, make vertical and horizontal consolidations, develop and dominate sectoral digital ecologies centred on themselves, and also overwhelming influence policy discourse and development. All of this is done at a global scale, which, in a very short time, renders them practically unbeatable.

Second, since public sector is territorially based, any digital economy paradigm based on due public sector roles in development of law and standards, regulation, and infrastructure provisioning will tend to correspondingly territorialize the global digital economy. The latter is currently attempted to be developed as a single, seamless and borderless, global digital space, which the US companies can easily monopolise.[25] The dominant global digital economy paradigm seeks to escape both these possibilities that arise from defining due public sector roles in the emerging digital economy sector. This is sought even with respect to areas and aspects where such roles appropriately belong to the public sector, and such role definition and fulfilment would be most beneficial to overall economy and society.

It is also important to keep in mind that BRICS countries have very unequal economic conditions between some highly-developed urban centres and other populations, including in dispersed semi-urban and rural areas. In the circumstances, if an equitable development of a digital economy is sought, purely market-based solutions will not suffice and the public sector will in any case need to step in to complement business efforts.

These two elements – of decentralising global digital structures, and appropriate defining of public sector roles in various digital areas – will run across the analysis of areas of possible cooperation among BRICS countries for them to take their rightful place in the global digital economy.

A 10-point BRICS Digital Co-operation Agenda suggested is as follows:

BRICS countries need to cooperate on:

I. Providing Broadband Infrastructure
II. Building Cloud Computing infrastructure
III. Establishing Data infrastructures
IV. Facilitating Enabling digital infrastructure (digital payments, identity/ authentication, etc)
V. Promoting e-commerce
VI. Progressing on Regional single digital markets
VII. Sharing experience on e-governance and smart cities
VIII. Promoting digital innovations, technology, skills and education
IX. Shaping global digital norms, polices, laws, regulation and standards
X. Building statistics for measuring Digitalisation

[25] The typical e-commerce rules proposed by the North, largely following the model of the e-commerce chapter of the Trans Pacific Partnership Agreement, basically seek such a unified global digital economic space

6.1 BRICS Cooperation for Providing Broadband Infrastructure

As discussed earlier, it is of paramount importance that public sector plays a central role in providing broadband infrastructure. Within BRICS, China and Russia have retained a central role for public sector telecoms and seek to achieve their connectivity goals through prodding these companies towards them. But these are still companies with balance-sheets to take care of, and generally a commercial mind-set. The question remains how much direct investment, with no returns expectation, needs to be made by public authorities, especially to test new technologies, and new connectivity models, even providing connectivity free at places as required. India, Brazil and South Africa, on the other hand, have largely privatised their telecom sectors, though public sector companies remain in the picture. They have partly directed their public companies to get into under-served areas, but also developed specific national broadband plans and investments. But in the latter's case too dilemmas mostly remains whether to employ public broadband investments through private telecoms via reverse auction kind of models, use public sector telecom companies, or develop special purpose vehicles just for extending connectivity as a core public infrastructure.

There are two key areas for BRICS cooperation here; (1) technology exploration and maturation models, and (2) business, institutional and policy models for universalising inexpensive broadband that can meet society's entire range of digital requirements.

There is a need to set up joint programs to test new connectivity technologies, and their on-ground implementation. BRICS countries have considerably similar conditions and requirements in this regard, and making joint efforts will ensure the required funds and scale to come up with appropriate practical technology models. Cheap and robust fibre optic deployments and last mile wireless models should be the focus. Commons-based wireless technologies like open spectrum, white spaces, etc should be explored from a public infrastructural deployment point of view, and not just commercial development, which remains the dominant mode of technology exploration. Some of these technologies can exhibit very different trajectories, and possibilities, following these two different approaches. This can be a focus of BRICS's collective work in this area.

BRICS has announced setting up of BRICS Institute for Future Networks. While its remit is the entire range of digital technologies, this institute needs to also work on innovative broadband technologies, specifically from the perspective of large-scale public infrastructure or commons-based deployment. Further, new models need to be worked on networking like Virtual Private Networks, which will become increasingly common with more specialised digital society/economy needs, and of network management, like Software Defined Networks. BRICS should aspire to become the leader in next generation network technologies and implementation models as the global economy stands at the threshold of rapid transformation of how networks are seen, deployed and managed in a digital economy/society.

Equally important is to research and develop new business, institutional and policy models for broadband universalisation. The current confusion about the role of private sector versus direct public investments in this sector must be overcome. An appropriate balance and separation of competencies between the two is required. Broadband today is at once a strategic, social, business and developmental infrastructure which underpins every sector, including governance

and community development. Private investments must be encouraged in areas and aspects of digital networks where they meet the requirements and conditions best. However, where required, there should be no hesitation to take a core public infrastructural approach to plough in direct public investments, even without any revenue models.

Big global digital corporations eager to provide free infrastructure should contribute their due taxes in the countries where they do business and earn profits. These taxes could be used to fund infrastructural development, as per the best public interest. It is often the appropriate approach in case of infrastructures to lay them at public expenditure, and to provide them very cheap or free, because their availability has a upward – supra-structural – multiplier effect on an entire range of economic and social activities. It is always economically beneficial to tax the "benefited" economic activities for financing such infrastructure. In this respect, it will be useful to explore setting aside a portion of taxes on digital businesses for digital infrastructure development. For similar reasons, inputs into infrastructure development, spectrum for instance, should not be priced too high.[26] In fact, commons based models like open spectrum and spectrum pooling and sharing, as proposed in a recent white paper by government of South Africa,[27] should be explored.

Broadband infrastructure requires two kinds of investments, in the back-haul and the last mile. Other than in densely populated areas where multiple parallel lines are feasible, back-haul has a natural monopoly characteristic. It is important to put public investments for backhaul optic fibre as is being done by most BRICS countries. Cheap and robust models of such backhaul deployment should be explored at BRICS research centres. But the biggest cost in broadband connectivity is in the last mile, which is less about technology costs and more about business models and institutional costs (servicing, maintenance, payments, etc). In this respect, very different thinking is required to be applied by BRICS countries than existing today. They should come out of treating telecom basically as a highly centralised strategic infrastructure and see it more as a decentralised development infrastructure.

Public sector companies and other organisations should consider letting local governments and local communities take up last mile deployment, as is often advised for most development infrastructure. The former should just focus to provide them the backhaul, leaving the rest to them, with perhaps some guidelines and technical help if required. The cost of deployment, maintenance and servicing will come down drastically, since a lot of current costs relate to the high expenses of involving professionals of large remotely based organisations for services at local deployment points[28]. And, the coverage and quality will go up greatly, because connectivity is now considered almost a necessary service and local communities will exert pressure on local players for these purposes. Even in rich countries like the US, it has been found that local government and local communities controlled last mile broadband models provides the best coverage and quality, at the lowest prices.[29] If this holds for the US, it is even more so for resource

[26] Many countries, including BRICS, tax broadband service too heavily, or render input factors costs too high, for what is an essential infrastructure.
[27] https://techcentral.co.za/ict-white-paper-calls-for-radical-shake-up/68904/
[28] Local governments and communities can involve local entrepreneurs for this purpose. Extensive coverage of cable TV in many developing countries provided very inexpensively by local entrepreneurs is a good model to consider.
[29] https://dash.harvard.edu/handle/1/34623859

poor and far flung communities that BRICS countries have to service. Local governments/ communities run last-mile broadband models should be a key area of BRICS cooperation through developing and sharing lessons.[30]

Private telecoms should be encouraged to provide backhaul connectivity on open access principle to all local connectivity businesses on equal terms.[31] In the digital age, private telecoms are often less interested in connectivity service based revenues than in monopolising access to consumers for the whole variety of digital services, and making money from the other side, by charging digital businesses for preferential access. Open access models can contribute to checking such possibilities. This also connects to the issue of net neutrality. Most BRICS countries have net neutrality rules in place prohibiting telecoms from giving preferential treatment to any traffic for commercial benefit. However, as digitalisation advances, pressures for circumventing net neutrality will keep increasing.[32] BRICS countries should develop policy models that not only ensure full net neutrality but also discourage, or at least keep a close regulatory watch on, vertical integrations across connectivity business and digital content/ services. A non-net neutral internet and such vertical integrations will mostly benefit global corporation with deep pockets to monopolise digital services in all sectors – from shopping and transport to finance and logistics to health, education and governance – at the expense of smaller domestic digital businesses.

There is a need to have twofold objectives for broadband policies in BRICS, *first*, making sure that broadband quickly becomes universal and extremely affordable. For this, governments must overcome narrow ideological conceptions, mostly built by western powers in interest of their economic hegemonies. As required, they should take public infrastructural and commons-based approaches for broadband, in addition to supporting private investments. *Second*, there is a need to guard against connectivity business ownership becoming a means for consolidating monopolistic global digital value chains, by smothering domestic competition. This is achieved through open access and net neutrality policies, and regulations against problematic vertical integrations across connectivity and digital content/ service business.

Further, BRICS need to look at the international connectivity infrastructure, which currently is lopsidedly US centric. A few years ago Brazil had mooted a proposal for a BRICS submarine cable[33]. It is important to decentralise global connectivity through new physical infrastructure and alternative inter-connections on existing infrastructure. This is important from economic as well as security and strategic perspectives. Regional connectivity infrastructures must also be explored by BRICS. China and some of its neighbouring countries have announced such a regional initiative.[34]

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[30] The city of Cape Town in South Africa is setting up a city owned open access fibre optic network for connecting citizens and businesses. http://www.ann7.com/cape-towns-connectivity-grows/

[31] India is developing a Public Data office model of decentralised retailing of data services based on open access model. https://www.medianama.com/2017/03/223-trai-public-wifi-recommendations/

32 The Federal Communication Commission of the US recently reversed the net neutrality order issued by the commission under the previous administration.

[33] http://thebricspost.com/brazil-brics-cable-aids-cyber-security/#.WoOmHXWWZ7g

34 http://www.chinadaily.com.cn/business/4thwic/2017-12/04/content_35190135.htm

6.2 BRICS Cooperation for Building Cloud Computing Infrastructure

Dominant actors in the global cloud computing industry define the digital structures of the whole world. These digital structures are actually “hard structures” which fully constrain and enable as per defined fields of activities and choices, unlike “soft structures” of cultural practices and habits implied in earlier mentioned dominations. As famously said, in software, “code is law”, which can be more difficult to transgress than law.

The appropriate role of BRICS countries is therefore to challenge this instrument of geo-economic domination. This again requires work on two inter-connected planks. One, decentralise cloud computing architectures, to make them globally more open, fair and inclusive. Second, involve the public sector in two ways, (1) to help develop essential cloud computing infrastructure in areas under-served by the market but which are essential to digitalisation, and (2) exercise regulatory power to curb inappropriate dependencies on monopolistic cloud platforms, through inter-operability standards, and checking problematic vertical integrations.

Domestic and regional level cloud computing alternatives need to be developed, by offering policy support but also public private partnerships where appropriate. Cloud computing works at scale, and BRICS should attempt to lead regional and across-the-BRICS initiatives, leveraging complementary and additive competencies. For instance, China and Russia have developed good IaaS capacities and skills, and India is developing into a key global SaaS centre. China and Russia has also seen attempts by public sector bodies to encourage domestic players to get together for developing domestic digital ecosystems in different sectors.[35] EU has public sector driven digital ecosystem development initiatives in key areas like transportation and health services. A good strategy will be to involve traditional businesses in each sector to play an important role in developing digital ecosystem for it in partnership with domestic start-ups.

Governments in BRICS countries have invested in developing private clouds for e-governance activities. These efforts can be further built upon towards developing public cloud computing infrastructures in key areas of highest societal and economic importance. EU has a EU Cloud program currently providing its facilities to research activities, but expected to be extended soon to small businesses.

Non-availability or inadequate availability of increasingly important digital technologies like high performance computing, machine learning platforms, etc to small digital businesses can have a very detrimental effect. EU has a programme for providing high performance computing as public infrastructure. BRICS has set up a Working Group on ICTs and High Performance Computing. Russia proposes development of alternative software products in collaboration with BRICS IT companies, including mobile operating system. The Russian Prime Minister has encouraged “all BRICS-countries to start mutual work in order to change situation on global software market, when share of one market players will be no more than 50%”.[36]

35 https://www.rbth.com/business/2016/12/16/sberbank-mulls-launch-of-national-e-commerce-system-in-russia_660078 and https://venturebeat.com/2018/01/09/baidu-coo-says-chinas-government-will-help-the-country-dominate-ai/

36 http://minsvyaz.ru/en/events/33237/

BRICS countries need to take the benefit of global development and availability of cutting edge digital technologies, and cloud is currently the dominant platform for this purpose. They should therefore remain invested and integrated in global cloud computing developments and use, even in their currently dominant forms. However, at the same time, domestic strategies need to evolve on the lines discussed above. Even as major emerging economies, it is not easy for BRICS countries individually to shape alternative or complementing cloud computing strategies and models. This is an area where there is a need to put collaborative efforts, from technical research and models development to developing alternative cloud computing platforms and ibusiness-to-business exchanges. While it may not be possible to produce spectacular results in a short period, this area is of such deep and abiding importance that it is important to develop well-funded and institutionalised BRICS initiatives that begin the necessary cooperation and work.

6.3 BRICS Cooperation for Establishing Data Infrastructures

BRICS countries are best placed to begin developing appropriate domestic data infrastructures, both because of their relatively large sizes and considerable economic and digital capacities. It particularly serves these countries' policy objective that digital economy should equitably benefit their less advantaged populations. Pronouncements often emanate from BRICS countries about data based global economic exploitation, how data is a national resource, and the need for various kinds of data localisation. However, these do not yet fit into any coherent political economy conceptions or model, much less active digital society/ economy policies and programs.

For BRICS countries to establish an equitable position in global digital value chains, and also for inclusive digital economy development at home, they should take the lead to;

(1) establish the basic principles about infrastructural/commons nature of much of society's big data, whether collected by governments or by digital corporations from personal, social, artefactual or natural sources outside these organisations, and;

(2) actually develop data infrastructures in key economic and social sectors, including with the involvement of private sector players. A formal platform for cooperation should be developed by the BRICS in this most important of digital economy areas.

All BRICS countries have open data initiatives, which is about sharing data that governments collect and/or produce with society and economy in general as an openly accessible and usable resource. Open government data can therefore be considered as an economic infrastructure, and it gets utilised as such. In the emerging digital economy context, however, it is no longer governments alone that hold the most important society- and sector-wide data sets. Some of the most significant and extensive ones are with digital corporations that constantly suck off data from our digital interactions, which is increasingly the dominant form of our social and economic relationships. We discussed how an exclusive ownership of such social and economic data by these companies is questionable. It is therefore needed to extend the concept of "open data" infrastructure to such privately-collected social data as well. It is possible to do so while providing enough incentives to the data collecting companies, for instance through the earlier mentioned FRAND and compulsory licensing concepts.

State's or community's interest with regard to big data in private hands, and data localisation, are currently mostly spoke of only from security, regulatory and territorial jurisdiction angles, although there often exist unexpressed economic motives. It is required to appropriately conceptualise and clarify upfront the economic interest, ownership and rights of a national community with regard to collective data about itself[37]; rights of its economic exploitation for its own best purposes, as against in ways that could harm or under-optimize its overall economic and other interests. What is being sought is not socialisation of all data and data processes, but framing political economy conceptions around what should be appropriate public and private roles in big data ecology. Much of data will remain fully in the private sector as a key economic and business resource and the basis of comparative business advantage. Usage rights over a given data set may also be divided between private and public appropriation, as appropriate.

Public sector's new economic role in society's data management needs to be accompanied with adequate privacy protections, regarding which genuine concerns remain among citizens. Such protections have to relate to both governments and private players. Most BRICS governments have developed a government cloud strategy to host and manage government services in an efficient networked and data-based manner.[38] They have also begun to

employ big data analytics on their data for better governance.[39] However, there are still very limited efforts to develop public data infrastructures that could support overall economic activity in different sectors. Initiatives that do exist in this regard are most pronounced in two areas, geo-spatial data and smart cities data infrastructure.

Beginning with ground maps and then satellite data, geo-spatial data has always been a public sector managed data infrastructure widely used by private players including businesses. Coming into the age of software and internet, these public involvements first took the name of Geographic Information Systems (GIS) and now increasingly Spatial Data Infrastructure (SDI). All BRICS countries have full-fledged SDI initiatives. Brazil has undertaken an extensive drive to connect SDI to general statistical data.[40] Russia and China have extended their SDI approaches to connect to intelligent transportation systems.[41] India is using SDI for urban planning, and

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[37] Such community right to data about itself (community data) is akin to an individual's right to data about oneself (personal data), which concept is well-developed. It is possible for data to be anonymised whereby it escapes personal data protections, but the data still pertains to a certain identifiable population, and identifiable groups within it, and can be used for purposes that benefit this population/ groups or exploits, or even harms, it/them. This concept also translates into national rights over national data.

38 South Africa, for instance, is developing a cloud computing platform for government services https://mybroadband.co.za/news/industrynews/201780-why-the-government-cloud-has-a-silver-lining.html

39 India has a Big Data Initiative (BDI) program which aims to develop a robust data analytics ecosystem in India, http://dst.gov.in/big-data-initiative-1

[40] https://unstats.un.org/unsd/statcom/statcom_09/seminars/population_census/2009%20IBGE%20UN%20NSDI%20final%20short.ppt

[41] http://www.hostcity.com/news/city-development/russia%E2%80%99s-road-smarter-transport and http://www.scmp.com/tech/china-tech/article/2125912/baidu-unveil-latest-self-driving-software-flagship-ces-las-vegas

proposes employing Machine Learning to spatial data.[42] All these SDIs have been made available to the general public, including businesses. South Africa has a policy for what SDI products will be made available for free and which can be charged for.[43]

Smart cities is another area where important digital data has begun to be seen as a public infrastructure. However, almost all such projects currently rely on *ad hoc* pooling of private sector and public data without any clarity about the overall ownership of data infrastructures thus created. Digital corporations often partner with governments on smart city applications, or even drive the whole project, at very low fees or even for free, with eyes principally on accessing large amounts of public data. As Andrew Ng, the founder of Google Brain project and then the head of AI at Baidu, the Chinese search giant, said in a January 2017 talk at Stanford, "at large [tech] companies, we often launch products not for the revenue but for the data … and we monetise the data through a different product."[44] The involved local governments tend to look at the immediate gains, which are no doubt important, but mostly ignore long term implications of what happens to the data infrastructures, and the digital intelligence arising from them, especially with regard to their future use. Most smart city programs are in their initial phases, but soon governments will have to face these questions squarely. It is best to be prepared for them, as data related relationships are built with private companies in this area.

Beyond the above two kinds or areas of data infrastructures, core data in most social and economic sectors also can, and likely needs to, be considered as infrastructure. Areas like health data infrastructure, agriculture data infrastructure, financial data infrastructure, education data infrastructure, energy data infrastructure and transport data infrastructure are some important ones, but there are others as well.[45]

Brazil and India have proposed a nationwide electronic health record system and health information exchanges.[46] These form the bedrock of a national health data infrastructure. China's national energy utility is undertaking development of a Smart Grid involving the concept of an energy Internet. It involves three layers, the transport layer which represents the actual energy delivering networks, the data layer, which provides intelligence to the system, and the operations layer, which focusses on actual value added services to end customers.[47] Cape Town in South Africa is also planning smart grids.[48] India is developing public digital education databases across

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[42] https://analyticsindiamag.com/indian-government-using-machine-learning-big-data-better-metrics/

[43] http://www.engineeringnews.co.za/article/south-african-spatial-data-infrastructure-is-developing-but-not-as-fast-as-desired-2017-04-10

[44] https://www.theguardian.com/technology/2018/jan/28/morozov-artificial-intelligence-data-technology-online

[45] https://www.ft.com/content/ef4730f0-10ff-30ce-b05e-74918dc48eac

[46] https://www.enterpriseinnovation.net/article/brazil-deploys-tech-solution-improve-health-data-interoperability-95968750 and https://www.medianama.com/2017/03/223-aadhaar-ehr-health-information-network/

[47] https://www.lek.com/sites/default/files/insights/pdf-attachments/2005-L.E.K._EI_Smart%20Energy_EN_VF.pdf

[48] https://talkiot.co.za/2016/11/09/cape-town-is-emerging-as-one-of-the-worlds-smart-cities/

public and private schools.[49] However, in the digital age, data systems need to move beyond structured data collection about enrolment, achievements etc to more granular data about education behaviour of diverse actors, data which is actively being collected by digital companies from schools and students. The Indian government is also setting up comprehensive data services for farmers, building a data infrastructure of soil, micro-weather, market demand, etc data. A recent symposium in South Africa focussed on farmers' rights to digital agriculture data.[50] It is obvious that any such rights can only be operationalised through collective strategies and systems.

Governments hold extensive financial and economic digital data about the entire economy, and also sector-wise. In the age of big data, there are very important information and insights that can dynamically be extracted from such data, and made available in real time. These are not only valuable for governments' own planning and interventions but also to business activity in all sectors. Some BRICS countries have begun to take a more systemic look at such possibilities. Transport sector is an area where infrastructural transport data is already seen as important for all kinds of transport services. Russia has announced its intention to create an IT and telecom infrastructure for driverless transport across the country's roads and highways, also involving artificial intelligence.[51] China too is taking steps in such directions.

Use of transport data infrastructure for better transport policies and services is being tried in many cities, but most of the required big data currently lies with private digital companies, often foreign owned. These are the companies that provide dynamic digital maps, telco data on movement of mobiles, and commuters and taxi services data with ride-hailing service providers. These digital corporations currently often provide their data *pro bono* to public authorities for traffic and town planning. But, it is unclear how this could be a sustainable long-term arrangement in an emerging digital context where all transportation planning and services, including public sector based ones, will necessarily require access to all this data, which, accordingly, is of an infrastructural nature.

Not all digital data needs to be considered as infrastructural, and/or be directly managed by the public sector. Digital big data can be arranged on a spectrum as per its nature, which will involve many criteria, and accordingly its relative infrastructural nature, and appropriate public or private roles, determined. Some kinds of data infrastructure may largely be public sector managed, others through public private partnerships, and still other kinds can be like regulated utilities whereby private sector provides data infrastructure services under regulation. Here, to repeat, FRAND terms and compulsory licensing kind of concepts can come into play. Much of data meanwhile will still be completely private. But even here, governments will have a role to ensure efficient data

[49] http://indianexpress.com/article/india/india-news-india/hrd-ministry-student-tracking-system-shala-asmita-yojana-smriti-irani-2817574/

[50] http://www.gfar.net/events/training-course-farmers-access-data

[51] http://www.ewdn.com/2017/08/16/russia-prepares-plans-to-develop-high-tech-infrastructure-for-driverless-transport/

markets,[52] that protect people's rights and consumer interests, which ensuring maximum creation of economic value and growth of digital economy.

6.4 BRICS Cooperation for Enabling Digital Infrastructure

Earlier sections have discussed how three kinds of infrastructures form the basis of a digital economy, broadband, software or cloud-computing, and core data facilities. There is another infrastructural set of facilities that are universally needed for digital economy interactions and operations, which can be called as the enabling digital infrastructure. It is oriented towards ensuring safe and secure transactions, in an environment where the concerned parties are not face-to-face. Important elements of such enabling infrastructure are digital identity management, digital documents authentication, digital payments and general security of online systems. Traditionally, or in the offline space, all these roles are played by the public sector– government identity cards, official registration of key documents, government currency and the central role of the state in security provision.

Digital systems begun as small private networks and then rather quickly, in less than two decades, expanded to become a whole new means and space for social organisation at a global scale. The Internet was also born in an extremely neoliberal environment in the US, especially with regard to the IT/Internet/digital phenomena.[53] For these reasons, all the mentioned enabling digital infrastructures have largely been privately provided. Another important relevant factor is that many of the mentioned, normally considered, public goods like security are more easily made exclude-able in the online space than in the physical space.

As the digital becomes all pervasive, and hybridize with physical realities, new challenges have arisen with regard to exclusive private provision of these infrastructural digital services. Private providers of such services of infrastructural nature could profiteer from monopolies, or leverage their position for unfair advantage in other layers of the digital economy, or both. Globally organised private systems may not align well with territorial law, which causes very significant problems as the digital spreads across the society. Also, basic digital enablement's as market goods and not public goods works against the interests and inclusion of resource poor sections of the society. All the mentioned processes -- identity, authentication, payments etc – basically involve ensuring of security and trust. Digital security and trust should be equally available to all, and its degree of availability cannot be limited by one's purchasing power.

This can be illustrated through an example. Even as more and more privacy protection laws put the reins of data control in the hands of the concerned individual, it is mostly recognised today that it is not humanly possible for individuals to actually exercise these rights in any meaningful way for the scores of digital services that one regularly accesses. They cannot really be expected to read all the complex terms of services and exercise relevant choices. The solution that often

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[52] http://ec.europa.eu/newsroom/dae/document.cfm?doc_id=41205

[53] US's "Framework for global electronic commerce" promulgated in 1997 was the first general policy framework for the Internet in which it was treated primarily as an electronic marketplace. This set the tone for how Internet has continued to be seen, although the fact is that the Internet was first a means of collaborative academic work, and then of social connections at a global-scale, before if also accommodated a marketplace.

gets proposed nowadays is of private services working as data agents for individuals to front their data and privacy choices as per their general expressed preferences.

Many such services, called Personal Information Management Services (PIMS), are emerging. Supported by Finnish government, MyData is a very promising initiative to develop an open and interoperable architecture for PIM services. The goal of the initiative "is to build an infrastructure level service for the management of personal data".[54] A PIMS is basically a consent management service, and may or may not involve actual storage of the concerned personal data which could be managed separately.

Such an open and interoperable architecture for infrastructural PIM services, with strong public-interest principles, still leaves the question open of universal and equitable access to this key enabling service for everyone, including the resource poor. Data related protection has to be a basic right, and not dependent on whether one can buy PIM services, and what quality of PIM services one can buy. Because lack, or poor quality, of data protection directly translates into vulnerability to various kinds of economic, political and social exploitation. Protection from such exploitation, even possible injury, needs to be available as a public good, similar to how physical security is. This issue is especially important for BRICS countries, and developing countries in general. It means that BRICS governments, on one hand, must support development of open and inter-operable architectures of PIMS, but also go further and actually provide quality PIM service for people who may not be able to afford, or want, private PIM services.

PIMS is evidently an important enabling digital infrastructure, and the public sector has a significant role here. Managing identity data, required for authentication, and financial data, required for payments, are also forms of personal data related consent services. All these enabling services are therefore of one genre, anchored basically on providing online trust and security. The framework as discussed above for PIMS therefore also applies to all these services. Consent management for personal data, digital identification, digital authentication, and digital payments are important digital infrastructural services of an enabling kind. They are essential for a robust and equitable digital society and economy. An important public sector role here does not mean that there may not simultaneously exist private players and services as well in this area, but they will need to be adequately regulated.

South Africa operates a digital national ID card with biometric authentication. It now plans to add multiple biometric authentication factors. Brazil recently announced plans for a centralised identity system that will be used for authentication and access to various services. India's Unique ID system (UID or *Aadhaar*) is now world-famous, while still ridden with controversies and court cases. UID begun as a program for proper targeting of recipients of welfare benefits but is now also being used by many digital businesses. Interestingly, a group of Indian digital businesses recently petitioned to the Supreme Court, which is examining the legality of UID, how it is very useful, often indispensable, to their businesses.[55] Global digital corporations do not have similar stakes because they have their own digital identity management processes. Russia recently took

[54] https://www.lvm.fi/documents/20181/859937/MyData-nordic-model/

[55] http://www.firstpost.com/tech/news-analysis/coalition-for-aadhaar-group-of-private-companies-bat-for-use-of-aadhaar-for-ekyc-and-background-verification-process-4306369.html

note of India's UID and plans to build a similar one.[56] China, on the other hand, has been running pilots to employ identity management systems of its top domestic digital giants for governmental transactions as well.

A payment system needs to just authenticate and grantee an economic transaction, and the money-value exchange that is involved. Most private digital payment services are built on business models where the real value is not in financial transaction certification but in other areas, like using payments data for developing credit services, and for developing or locking customer "loyalty" to monopolistic digital services, including e-commerce platforms. As with physical currency, in the digital realm too the public sector should the main basic guarantor of value exchange. China has developed a national clearing-house for online payments. India has created a public sector Unified Payment Interface. The main Russian public sector bank is getting strongly involved in digital payments, partnering with e-payment services of the dominant domestic search engine Yandex.

BRICS governments have begun to work on cutting edge technologies like block-chain to ensure highest level of security and trust in e-transactions. An official involved with Brazilian government's pilot of a block-chain based identity application hopes that it will "create a new trust model between the government and the public".[57] After the Russian Prime Minister exhorted official to explore how block-chain could be leveraged in public administration and the economy of the Russian Federation, the main public sector bank recently carried out its first block-chain based payment as a pilot project.[58] The central bank of South Africa has signalled its desire to explore this area.

The Indian government has developed an integrated set of APIs, which provide solutions for identity management, e-payment, e-signature and document authentication. It is now working on an e-consent framework that can be applied to all kinds of personal information, putting individuals in charge of how their personal information is used. As discussed earlier, it is not possible to leave such a consent management service just to market players especially in developing countries with a huge number of people who are resource poor.

As the public sector gets centrally involved in society's data management processes, it is important not only to strengthen data protection laws but perhaps take an entirely new look at the citizen-state relationship in the digital context. New institutions need to be built that are based on the principle of an individual's full rights over her personal data, as an extension of her personhood. Even while aiming for sufficient efficiency, identity and personal data systems may need to be managed in appropriately decentralised and federated manners, which is a delicate balancing act. Cross-connecting as many digital data systems as possible appears to give more and more immediate value from different perspectives. But this must be weighed against the very acute dangers of building panoptic surveillance by corporates and the state, causing the loss of individual autonomies and problematic systemised behavioural controls in mid- to long-terms.

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[56] http://www.livemint.com/Politics/UEQ9o8Eo8RiaAaNNMyLbEK/Aadhaar-goes-global-finds-takers-in-Russia-and-Africa.html

[57] https://cointelegraph.com/news/brazilian-ministry-of-planning-partners-with-microsoft-in-blockchain-identity-app-trial

[58] https://www.rt.com/business/411447-sberbank-first-blockchain-technology/

Extremely important that it is, this is too vast an area to be given the space that it requires in this paper which focusses on economic strategies.

Lastly, and connected to the above discussions, general security of digital systems is also an area where the public sector will increasingly find itself taking a greater and greater role – regulatory but also of some basic provisioning. Some digital security services accordingly will also have to be seen as infrastructural. This becomes more and more important as digital systems underpin almost every activity, organisation and physical infrastructure.

Developing similar public interest oriented perspectives on basic digital infrastructures, BRICS countries can share lessons on the appropriate public sector roles as well as develop commercial services and products that cater to a similar understanding of the digital ecosystem, which can then be traded easily across BRICS economies.

The first four sub-sections went to considerable length in building and proposing a new infrastructural approach to digital ecosystem as forming the bedrock of BRICS cooperation in this area. The next three sub-sections deal with specific areas of digital activities and possible BRICS collaborative engagements – promoting e-commerce, building regional digital markets and e-governance and smart cities development. Finally, the following three sub-sections discuss soft infrastructure – innovation and skills development, international digital governance and measuring digitalisation from alternative perspectives.

6.5 BRICS Cooperation for Promoting E-Commerce

Adequate digital infrastructure is the necessary condition for developing digital economy and e-commerce. Whether and how well the digital economy will actually develop depends on a number of other economic and policy factors. Data based digital intelligence will change the basic organisation of all sectors, giving rise to entirely new business models, while traditional businesses also need to transform themselves.

The current early-phase digital economy scenario is acting out at two simultaneous levels. At one level there is an explosion of innovation and entrepreneurial energy, in form of many start-ups. At another level, big digital business is seeking to entrench itself into key rent-seeking positions in the digital economy structures at any cost. Digital economy is based on monolithic data-based digitally intelligent networks which uniquely tend towards monopolistic, or narrowly oligopolistic, structural configurations. Policy responses must address both these levels or aspects of digital economy development.

A three-way contest for capturing digital value and business space can currently be witnessed among (1) established large digital corporations, that are often global, (2) digital start-ups, and (3) traditional businesses in different sectors that are being disrupted by the digital phenomenon. Since the digital sector has extraordinary monopolistic tendencies, cut-throat attempts are being made at digital supremacy in each sector, and each service element , cornering the first mover advantage. At the same time, there are moves towards digital ecosystems development, with different kinds of economic actors in complementary, if often hierarchical, roles. Sectoral digital ecosystems get dominated and then driven by one, or at the most 2-3, companies, and it is these pole positions that are being bitterly fought over. It involves huge amount of upfront investments,

which have been criticised in some cases as capital dumping.[59] In the digital business game are both global companies - digital corporations and some global start-ups, and domestic businesses – which could be start-ups or traditional businesses in different sectors. Global capital is also seeking to take early key rentier positions in the digital economy through investing in domestically grown digital businesses, especially those aiming at sectoral leadership.

If China went into the digital economy principally employing the leadership of its large domestic Internet companies, Russia is equally relying on its traditional big businesses to take sectoral digital leadership. Brazil, South Africa and India have witnessed considerable domination by foreign digital companies, and foreign capital, while they are trying their best to support a local digital start-up ecology through various initiatives and incentives. They are however yet to put in place strong policies that could nudge their traditional sectoral businesses to take digital leadership in their respective sectors. These countries are also unsure between encouraging foreign digital companies, and foreign capital, to fuel their economic digitalisation and trying to ensure that domestic digital companies do well and retain a large portion of the national digital pie.

Promotion of e-commerce requires, on one hand, supporting digital innovation and developing a vibrant start-up ecology, and on the other, to establish extensive open digital infrastructures of the kind we have discussed. It also needs a sophisticated calibrated approach to the role of foreign digital corporations, and of foreign investments, in early stages of digital industrialisation. Skills – both technical and business – and capital so brought in are required for quick scale-up of the digital sector, but adequate domestic ownership of key digital businesses and ecosystems may need to be protected, both from strategic and long-term economic points of view. Such a view is strongly taking root in the EU too for key digital businesses and platforms/ ecosystems,, which otherwise has been very liberal in its foreign trade orientations.[60]

It is important for BRICS countries to recognise and fully understand the transformational nature of larger structural forces that are causing the economic shifts in all sectors. It will be inadequate to just react in *ad hoc* manners addressing the particular manifestations of the fast-moving digital impacts. Such responses will become an unending race against larger irrepressible logics of change, and not be fruitful. It is required to step back from piecemeal engagements with current changes and comprehend the big picture of the nature of digital transformations, in a forward looking manner. Business literature on digital changes provides good leads but a larger macro-economic, social and political perspective must be built through a dedicated well-resourced process. This may involve institutional strengthening, and changes, in government's policy development apparatus. It would help develop a strategic overview, and policies should emerge out of such a strategic orientation.

It is not easy for countries on their own to undertake this stupendous task, and a BRICS framework of cooperation in this area will be very useful, and timely. Over the last few years, individual BRICS

[59] https://www.vccircle.com/flipkart-ola-others-launch-lobby-group-for-indian-e-commerce-firms/
[60] https://www.reuters.com/article/us-eu-trade/eu-plans-measures-to-block-foreign-takeovers-of-strategic-firms-idUSKBN16H1DZ

countries have developed good knowledge, policies and practical lessons to share with others, on start-up policies, digital infrastructures, PPPs, business regulation, nudging traditional businesses towards digitalisation, and managing global digital businesses and foreign investments in the area of digital economy. Pulling them together into a common framework, with flexibilities for different contexts, preceded by a thorough analysis of the digital economy basics, can help BRICS become key global engines of digital economy.

The 7th meeting of BRICS trade ministers agreed to "undertake research and joint studies that can cover, based on consensus, among others the following areas: global trends, current status of e-commerce in BRICS, measuring dynamism in e-commerce, regulatory and legal frameworks in BRICS related to e-commerce, participation of MSMEs, existing barriers to cross-border e-commerce among BRICS, the development aspects of e-commerce and recommendations for strengthening e-commerce cooperation within BRICS."[61] A BRICS E-commerce Working Group has also been set up. Proposals have been made, most of them from China, for developing "BRICS cross-border e-commerce platform" and cross-border logistics and payments chains.[62] The Framework for BRICS E-commerce Cooperation does aim to better integrate its e-commerce markets.[63] While considerable economic and political challenges will have to be met before such a close integration takes place, it is important to recognise that the virtual environment of digital economy does help overcome the issues with geographical distantness of some BRICS countries from one another.

6.6 BRICS Cooperation for Progressing on Regional Single Digital Markets

International trade is important for domestic economic growth, and digital businesses are especially integrated in global value chains and ecosystems. Proper development of digital economy requires a large enough scale due to various networks effects that are involved. Currently, globally digital value chains mostly centre in the US. Creating a more decentralised architecture of global digital systems will require BRICS to adopt and lead appropriate regional economic strategies. EU is focussing on a EU digital single market to develop its digital strengthen. Easy flow of data, and common standards and regulatory frameworks, are key to EU's approach, apart from public sector's direct involvement in platforms and ecosystems development in some key areas like health and transportation.

BRICS is a much looser bloc, and it will not be easy for it to move towards digital single market strategies. Further, getting binding commitments typical of a digital trade agreement among BRICS may be difficult at this stage, and the effort should focus on voluntary cooperation and facilitating trade. A BRICS Model E-Port Network has been proposed by BRICS to explore a mechanism for improving supply chain connectivity and trade facilitation among its members[64]Complimentary strengths should be worked upon; for instance, India's considerable software skills could be useful to the Chinese digital industry which has somewhat leapfrogged

61 https://www.brics2017.org/wdfj/201708/t20170831_1827.html
62 http://www.globaltimes.cn/content/1064968.shtml
63 http://www.brics.utoronto.ca/docs/170831-ecommerce.html
64 https://www.brics2017.org/wdfj/201708/t20170831_1830.html

directly to a greater focus on the data and digital layers. This point of "complementary strengths in ICT hardware, software and skills" has been stressed in the 2017 BRICS Summit Declaration.

As software and digital applications become almost indispensable for all activities, and they especially begin to underpin re-organisation of all sectors, from transport, manufacturing and energy, to education, health, agriculture and governance, it will become increasingly important that they incorporate domestic legal and regulatory requirements. This is still generally not the case with global digital software and applications which are mostly built from the US legal/regulatory perspective. As BRICS countries seek better understanding towards possibly aligned or bringing closer their regulatory structures, there is great scope for developing cloud computing platforms and services that are more acceptable in BRICS, and developing countries, in general. Such services could, in general, also be architecturally more open to be customised as per domestic law and regulation.[65] This can be an important niche to work on for BRICS businesses. It will also help easier progressive integration of e-commerce markets of BRICS. Common standards especially help such integration. The BRICS Working Group on ICT Cooperation recommends "standardization in tune with the huge BRICS market requirement for ICT products and services and promoting ICT ecosystem". Greater business to business exchanges and cooperation in the digital area is key to better integration of BRICS digital markets.

BRICS countries are major economic powers in their respective regions, and therefore well placed to pursue regional digital single market strategies in their respective regions. Africa recently finalised the details of a Continental Free Trade Area Agreement to be signed in March 2018. South Africa can take the lead on working on developing a regional digital free market for Africa. Brazil can do so for Mercosur, the South American trade block. Other BRICS countries have similar regional opportunities. Such approaches can begin with voluntary cooperation efforts, regulatory alignment, and business-to-business cooperation efforts, before taking a formal shape. While exploring opportunities for their own businesses, economic leadership of BRICS countries in these respective regional strategies should help build strong domestic digital economies in all the involved countries, and not be predatory. Genuine win-win in digital economy systems that tend towards centralisation do not happen automatically and needs to be consciously invested in.

6.7 BRICS Cooperation for Sharing Experience on E-Governance and Smart Cities

Governments around the world are undergoing digital transformation. There are many similarities in the governance challenges for BRICS countries, which makes this a very useful area for cooperation, in terms of both technical and operational models. The 8th BRICS Summit affirmed "the value of sharing expertise and experiences among BRICS countries with regard to usage of Information and Communication Technology (ICT) in e-governance, financial inclusion, and targeted delivery of benefits, e-commerce, open government, digital content and services and bridging the digital divide.[66] In the BRICS Working Group on ICTs Cooperation, Russia and India lead the track on e-governance.

65 Technical governance is getting into advance areas, at least conceptually at this stage, like algorithmic governance.
66 http://pib.nic.in/newsite/PrintRelease.aspx?relid=151706

E-governance efforts are central to spread of digitalisation to different sectors, especially small and informal sectors of the economy, and to different regions and social segments, especially the disadvantaged ones. E-governance frameworks and platforms can also help set up default digital models and standards for the whole national society. As discussed, similar legal and regulatory systems can stimulate common ICTs markets that produce products and services in conformity to domestic law and regulation. BRICS cooperation in e-governance is therefore both helped by and can trigger better-integrated digital markets across these countries. Robust and sustained e-governance efforts are also basic to development of public digital infrastructures that were discussed as key to developing digital economy in BRICS countries.

The most advanced site of e-governance today is smart cities. BRICS meetings and seminars on smart cities have taken place in India and Russia, including in the framework of BRICS Urbanisation Forum. Russia and India have signed an agreement on smart cities implementation. Digital technology and business models for city governance are unique, and cooperation among BRICS countries can be extremely useful in this area. Smart cities involve data based applications that help coordinate and manage sector-wide activities, from energy, transportation and sewage management to health and education. Most smart cities applications are implemented on PPP basis, but city governments must retain full policy and adequate operational control, and also ownership of the all-important data that is involved. While benefiting from the best private sector competencies, it is important to also develop the required public digital and data infrastructures that not only assist governance but also development of local digital business. It is also required to incorporate participatory models in smart city governance, so that digitalisation improves rather than circumvents citizen engagement. City governments will have to develop entirely new forms of skills and competencies, which may be the biggest challenge. How best to employ and manage smart city PPPs is an important area for BRICS cooperation and sharing lessons.

6.8 BRICS Cooperation for Promoting Digital Innovations, Technology, Skills and Education

As digital changes sweep through the society, it is most important to develop the soft infrastructure of innovation, technology, other skills and education, with a focus on the needs of a emerging digital economy and society. BRICS leaders' statements have repeatedly stressed this point. BRICS has an Action Plan for Innovation Cooperation, and a Science, Technology and Innovation Framework Program. BRICS Working Group on ICT Cooperation also stresses R&D and innovation.

It is required to move beyond sharing of technology developments and common R&D programs, which are no doubt important, to understanding unique contexts and characteristics of digital innovation, and developing innovation polices based on it. For instance, digital technologies are innately collaborative technologies that develop best in open models. This is once again reiterated at the cutting edge of digital technologies, Machine Learning, whereby big corporations have open sourced their ML platforms and AI capabilities. It should be explored how such open platforms and engines of innovation can be developed in BRICS countries, and what is the respective roles of the public sector, voluntary techie communities, and domestic businesses.

It is required to take a new look at education and skill development at all levels, beginning from higher secondary education to bring in digital skills, not just related to technology but also

fundamentally new paradigms of social and business organisation. Digital businesses require skills that integrate technical expertise with social and business competencies. Both technical and business management education needs to be changed accordingly. Further, humanities and policy studies also need to be able to cater to new contexts and needs. BRICS cooperation in this area should therefore go deep below the surface of just R&D showcasing and sharing.

6.9 BRICS Cooperation for Shaping Global Digital Norms, Policies, Laws, Regulation and Standards

Digital systems are globally organised, and provide the hard structure enabling and constraining digital activities. As digital enmeshes with activities and processes in all sectors, this means that the nature of its global form can influence to a good degree how all sectors develop and operate. Most digital systems originated in the US and are still centred there, and have considerably inbuilt in them its social and legal norms, as also its political and economic interests. The Internet is largely based on private sector led standards and protocols development. Such a system helped develop an open and flexible global network that triggered unprecedented innovation. Increasingly, however, it is greatly swayed by the interests of North-based global digital corporations. Northern governments also have a disproportionate formal or informal influence over them. This is becoming increasingly more problematic as digital begins to underpin all social and economic sectors in all countries. The global digital order requires globally fair and representative governance, and BRICS countries are best placed to push towards it.

The 2017 BRICS Summit called for a "more just, equitable, fair, democratic and representative international political and economic order….. (and to) promote an open, inclusive and balanced economic globalization…. redressing North-South development imbalances and promoting global growth". [67] It also specifically advocated "the establishment of internationally applicable rules for security of ICT infrastructure, data protection and the Internet".

BRICS countries, as a group or in sub-groups like IBSA[68] and Russia-China[69], have been closely collaborating on global Internet governance and putting forward proposals to democratise its architecture. The BRICS Working Group on ICT Cooperation proposes an action plan to "engage collectively with ITU and other International Organizations on ICTs in promoting new technologies, standardization in tune with the huge BRICS market requirement for ICT products and services and promoting ICT ecosystem".

While there could at times be some differences in actual content of proposals on specific issues, it is strongly agreed among BRICS countries that the very architecture of global Internet governance is currently very lopsided and needs to be made democratic and representative. It will be useful to focus on this institutional transformation aspect by making a thorough assessment

[67] https://timesofindia.indiatimes.com/realtime/28912_XiamenDeclaratoin.pdf

[68] IBSA has made joint statements seeking a new inter-governmental platform for developing international Internet related public policies, for instance, see http://unpan1.un.org/intradoc/groups/public/documents/un-dpadm/unpan043559.pdf

[69] China and Russia have proposed an International Code of Conduct for Information Security on the Internet, http://www.unidir.ch/files/conferences/pdfs/a-cyber-code-of-conduct-the-best-vehicle-for-progress-en-1-963.pdf

of the current situation and the possibilities going forward. On its basis, common proposals can be made, and support for it canvassed for among other countries. The imperative to democratise global Internet governance architecture needs to be worked at with the same urgency and focus as BRICS have been striving to democratise the global financial architecture. In a similar way as global finance underpins all global and national economic activities, digital systems are becoming a key global infrastructure of extra-ordinary systemic importance.

BRICS countries should meanwhile strive to build common norms, policies, regulatory frameworks and standards among themselves, and begin applying them. In the digital area, law often follows practice As commons norms, policies and standards are adopted by BRICS, and then by other countries that find them more suitable, it will provide the required impetus to seek common global norms, polices and standards that are fair, democratic and representative.

6.10 BRICS Cooperation for Building Statistics for Measuring Digitization

Any macro-economic phenomenon needs to be measured suitably to understand it and to provide policy leads for where most effort may need to be put. As discussed, the key defining feature of a digital economy, involves data and digital intelligence centred economic and social reorganisation. It is therefore not just a linear, additive phenomenon that can be adequately illuminated by measuring the extent of use of some new technologies by social and economic actors but a structural one involving deep-reaching organisational changes. While the levels of ICT infrastructure and its use, and the extent of electronically mediated transactions, are indicators of progress towards digitalisation, being its essential pre-requisites, digitalisation proper has to measured by factors involving data practices, intelligent systems and the extent of resulting digital re-organisation.

Current indices development exercises in this area involve measuring extent and use of basic ICT infrastructure (ITU), access, use and impact of network resources (WEF networked readiness index), or further include the extent of electronic commercial transactions, and the enabling legal and other requirements for it, like payments, logistics, etc (UNCTAD's e-commerce and e-trade for all indices). Over these must be added data, digital intelligence and digital re-organisation related factors to give an adequate picture of the emerging extent of digitalisation of an economy and society. This requires undertaking an elaborate exercise to recognise relevant factors that are both important and measurable. Some of these could be in the areas of;

I. Data collection and use practices
II. Data protection policies and practices
III. Open data and data reuse practices and policies, data rights and ownership frameworks
IV. Public data infrastructures
V. Sectoral digital platforms and eco-systems– extent, effectiveness, competition, openness
VI. Nature and maturity of core sectoral data systems – transport, energy, health, agriculture, education, etc
VII. Nature and maturity of data markets – efficiency, regulation, etc
VIII. Use of data-based digital intelligence in business
IX. Extent and current role of data-intelligent digital businesses in each sector
X. Development of digital skills, R&D, shifting technical and business studies landscape

XI. Use of data and digital intelligence in governance, smart city programs, etc

BRICS should take the lead in developing such measurements of digitalisation and digital economy, which also brings in a world-view of more open and decentralised digital structures, that are appropriately regulated in public interest, along with public sector's active role in key data infrastructures, as required. These are the requirements for robust and inclusive development of digital economy in BRICS countries.

7 Summary and Conclusions

The growing digitalization with the advent of Industry 4.0 has raised the anxiety of the developing world with respect to their future global competitiveness, especially in manufacturing trade. Digital industrial revolution is being accompanied by emergence of giant digital companies, like Google, Amazon, Apple and Facebook, which are increasingly concentrating digital power in the west. BRICS, as a group of fast growing developing countries, has the potential to decentralize the world economic order in the digital era. However, this will require BRICS to have a strategic digital cooperation agenda for industrialization, which will help BRICS countries to strengthen their digital infrastructure and build their digital capacities.

With the objective of providing a possible digital cooperation agenda for industrialization in BRICS, the paper traces the evolution of digital economy and the rise of US as a digital power. It highlights that the combination of 'data power' with 'network power' and 'software power' can give countries huge economic advantage that can migrate them towards the top of the value chain in any given sector. Once firmly established, such monopolistic digital power can be extremely difficult for the developing countries to challenge. This can lead to a dramatic shift in the global trade competitiveness of the developing countries. The paper explains different components of digital infrastructure, which are- broadband infrastructure; cloud computing infrastructure; and data infrastructure.

Comparing the existing digital capacities in BRICS with some of the advanced countries, the paper highlights the digital strengths and weaknesses of BRICS. Although China and India are found to have higher number of internet users as compared to the advanced countries like USA, UK and Germany, in terms of other indicators, BRICS is found to lag behind. Comparison is also made of the extent to which digital services like computer programming and related activities are contributing value-added to manufacturing exports in BRICS and advanced countries. The estimations show that in absolute terms the total value -added by computer programming in manufacturing exports is much higher in advanced countries as compared to each of the BRICS countries, but as a group BRICS has higher value-added by computer programing to manufacturing exports, compared to the US. In terms of proportion of gross exports, India is found to take a lead and has comparable ratio to the advanced countries. It is argued that although BRICS has steadily increased its share in global manufacturing trade in the past, for it to continue doing so, it will be important for BRICS to develop a digital cooperation agenda.

The paper provides a possible 10-point BRICS Digital Cooperation Agenda for Industrialization, which suggests BRICS cooperation for:

I. Providing Broadband Infrastructure

II. Building Cloud Computing infrastructure
III. Establishing Data infrastructures
IV. Facilitating Enabling digital infrastructure
V. Promoting E-Commerce
VI. Progressing on Regional single digital markets
VII. Sharing experience on e-governance and smart cities
VIII. Promoting digital innovations, technology, skills and education
IX. Shaping global digital norms, polices, laws, regulation and standards
X. Building statistics for measuring Digitalisation

7.1 BRICS Cooperation for Broadband Infrastructure

The digital cooperation agenda highlights that in the area of providing broadband infrastructure BRICS countries have considerably similar conditions and requirements and making joint efforts will ensure the required funds and scale to come up with appropriate practical technology models. BRICS should therefore set up joint programs to test new connectivity technologies, and their on-ground implementation. It is important for BRICS to focus on cheap and robust fibre optic deployments and last mile wireless models. Equally important is to research and develop new business, institutional and policy models for broadband universalisation in order to overcome the confusion regarding the role of private sector versus direct public investments in this sector. Big global digital corporations eager to provide free infrastructure should rather contribute their due taxes in the countries where they do business and earn profits. These taxes could then be used to fund infrastructural development, as per the best public interest. Appropriate emphasis should be laid on the last mile of broadband connectivity, with emphasis on local government/community led initiatives. Private telecoms should be encouraged to provide backhaul connectivity on open access principle to all local connectivity businesses on equal terms.

7.2 BRICS Cooperation for Building Cloud Computing infrastructure

Global cloud computing architectures form the very body and space of digital economy and are its key infrastructure. It is important to decentralise them for BRICS to have an equitable role in global digital economy. Governments in BRICS need to cooperate to develop essential cloud computing infrastructure in areas under-served by the market, but which are essential to digitalisation, or those otherwise of strategic importance. They must also together exercise regulatory power to curb inappropriate dependencies on monopolistic cloud platforms, through inter- operability standards, and checking problematic vertical integrations.

7.3 BRICS Cooperation for Establishing Data infrastructures

With respect to establishing data infrastructures, the paper highlights that the key data in the digital age is often of a personal nature or otherwise have strong embedded “community interests”. The ownership of the value derived from such data therefore should lie with the concerned person and community, respectively, including a national community. For BRICS countries to establish an equitable position in global digital value chains, and also for inclusive digital economy development, they need to take a lead for establishing basic principles about infrastructural/commons nature of much of social big data, whether collected by governments or

by digital corporations from personal, social, artefactual or natural sources outside these organisations. Further, they need to actively develop data infrastructures in key economic and social sector, including with the involvement of their private players.

An area where digital data has begun to be seen as an infrastructure is in developing smart cities. It is argued that, almost all such projects currently rely on *ad hoc* pooling of private sector and public sector data without any clarity about the overall 'ownership' of the data infrastructure thus created. Digital corporations often partner with governments on smart city applications, or even drive the whole project, at very low fees or even for free, with their eyes principally on accessing large amounts of public data. There is a need for cooperation in developing clear policies regarding data ownership within BRICS as, given its size, BRICS has inherent global comparative advantage in generating huge amounts of data. BRICS countries can also develop commercial services and products that cater to a similar understanding of the digital ecosystem, including data ownership patterns, which can then be traded across BRICS economies.

7.4 BRICS Cooperation for Promoting E-Commerce

The paper emphasises that over the last few years, individual BRICS countries have developed good knowledge, policies and practical lessons to share with others, on start-up policies, digital infrastructures, PPPs, business regulation, nudging traditional businesses towards digitalisation, and managing global digital businesses and foreign investments in the area of digital economy. Pulling them together into a common framework, with flexibilities for different contexts, along with a thorough analysis of the digital economy basics, can help BRICS become key global engines of digital economy. Given that a BRICS E-commerce Working Group has been set up, the paper proposes that a framework for BRICS e-commerce Cooperation should be developed to better integrate its e-commerce markets[70], in a manner that promotes overall rapid and equitable digitalisation of economies of all BRICS countries. It is highlighted that although this may encounter considerable economic and political challenges but the virtual environment of digital economy will help overcome the issues with geographical distantness of BRICS countries from one another.

7.5 BRICS Cooperation for Progressing on Regional Single Digital Markets

The paper highlights that EU, as a regional bloc, is focussing on a EU digital single market to develop its digital strength. Easy flow of data, and common standards and regulatory frameworks, are key to EU's approach, apart from public sector's direct involvement in platforms and ecosystems development in some key areas like health and transportation. However, BRICS is a much looser bloc, and it will not be easy for it to directly move towards digital single market strategies. Even getting binding commitments typical of a digital trade agreement among BRICS may be difficult at this stage, and the effort should focus on voluntary cooperation and facilitating trade. It is suggested that complementary strengths should be worked upon by BRICS, for instance, India's considerable software skills could be useful to the Chinese digital industry which has somewhat leapfrogged directly to a greater focus on the data and digital layers.

[70] http://www.brics.utoronto.ca/docs/170831-ecommerce.html

The paper highlights the scope for BRICS businesses to develop cloud computing platforms and services that are more acceptable in BRICS, from socio-cultural and legal-regulatory points of views. Such services could, in general, also be architecturally more open to be customised as per domestic law and regulation. This can be an important niche to for BRICS businesses and will help easier progressive integration of e-commerce markets of BRICS.

7.6 BRICS Cooperation for Sharing Experience on E-Governance and Smart Cities

The paper highlights the role of BRICS cooperation in e-governance, which can also trigger better-integrated digital markets across these countries. Robust and sustained e-governance efforts are basic to development of public digital infrastructures. In the BRICS Working Group on ICTs Cooperation, Russia and India have led the track on e-governance. The most advanced site of e-governance today is smart cities. Russia and India have signed an agreement on smart cities implementation. Digital technology and business models for city governance are unique, and cooperation among BRICS countries can be extremely useful in this area.

7.7 BRICS Cooperation for Promoting Digital Innovations, Technology, Skills and Education

BRICS has an Action Plan for Innovation Cooperation, and a Science, Technology and Innovation Framework Program. BRICS Working Group on ICT Cooperation also stresses R&D and innovation. The paper proposes to move beyond sharing of technology developments and common R&D programs to understanding unique contexts and characteristics of digital innovation, and developing innovation polices based on it. For instance, digital technologies are innately collaborative technologies that develop best in open models. There is a need to explore how open platforms and engines of innovation can be developed in BRICS countries, and what could be the respective roles of the public sector, voluntary techie communities, and domestic businesses.

7.8 BRICS Cooperation for Shaping Global Digital Norms, Policies, Laws, Regulation and Standards

The paper highlights the current lopsided nature of the global Internet governance and the need to make it more democratic and representative. It suggests that BRICS can make common proposals and seek support for it from other developing countries. The imperative to democratise global Internet governance architecture needs to be worked at with the same urgency and focus as BRICS have been striving to democratise the global financial architecture. In a similar way as global finance underpins all global and national economic activities, digital systems are becoming a key global infrastructure of extra-ordinary systemic importance.

7.9 BRICS Cooperation for Building Statistics for Measuring Digitization

The paper emphasises the importance of cooperation among BRICS for taking a lead in developing measures of digitalisation and digital economy. The exiting measures are inadequate and there is an urgent need to develop measures for data, digital intelligence and digital re-organisation related factors to get the full picture of the emerging extent of digitalisation. This requires undertaking an elaborate exercise to recognise relevant factors that are both important and measurable. EU is doing such an exercise for its economies, BRICS need to develop similar

and more advanced measures which will then help BRICS to progress in their implementation of digital industrial policies.

The above discussed BRICS Digital Cooperation Agenda will not only help BRICS to progress faster in their digital industrialization but will also empower BRICS in shaping international trade and investments rules in the digital era. These rules, if left to the west, may become heavily biased in favor of growth of a few big-tech companies making it even more challenging to regulate their operations for inclusive growth in the digital era.

8 References

Banga R. and Kozul-Wright, R.(2018), "South-South Digital Cooperation for Industrialization: A Regional Integration Agenda", UNCTAD (forthcoming)

Castells, M. (2011), "Network Theory: A Network Theory of Power" *International Journal of Communication,* 5: 773-787.

Chen, H. et al (2018), "Breaking Into *the '*Energy Internet*'* Era *in* China*: an* Analysis *of* China's Smart Grid Development" *LekChina, Volume XX, Issue 5.*

OECD (2015), "Data-Driven Innovation: Big Data for Growth and Well-Being", October.

Lewis et al, (2001), "US productivity growth, 1995–2000", McKinsey Global Institute

Poikola Antti, Kai Kuikkaniemi, and Harri Honko. 2015 “MyData – A Nordic Model for human-

centered personal data management”, https://github.com/okffi/mydata

UNCTAD, Trade and Development Report (2017), " Beyond austerity: Towards a global new deal", United Nations.

UNCTAD, Trade and Development Report (2016), "Structural transformation for inclusive and sustained growth", Chapter VI, Industrial Policy Redux, United Nations