

# Impact of Digitalization in the Ports Sector



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## **Acknowledgements**

This report was undertaken with the support of the Friedrich Ebert Stiftung-India Office. We also thank the International Transport Workers' Federation and the NMGKS: New Maritime General Kamgar Sangh for their inputs and facilitation.

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August, 2019

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**List of Abbreviations**

AI: Artificial Intelligence  
BRI: Belt and Road Initiative  
BOT: Build Operate and Transfer  
CIMC: China International Marine Containers  
CEZ: Coastal Economic Zone  
CFS: Container Freight Station  
CTPAT: Customs Trade Partnership Against Terrorism  
DPD: Direct Port Delivery  
EDI: Electronic Data Interchange  
EXIM: Export-Import  
GDPR: General Data Protection Regulation  
GST: Goods and Services Tax  
GDP: Gross Domestic Product  
IMO: International Maritime Organisation  
IWLU: International Longshore and Warehouse Union  
ITF: International Transport Workers' Federation  
IoT: Internet of Things  
JNPT: Jawaharlal Nehru Port Trust  
LPI: Logistics Performance Index  
MCA: Model Concession Agreement  
NMGKS: New Maritime General Kamgar Sangh  
PCS: Port Community System  
RFID: Radio Frequency Identification  
RTI: Right to Information  
RTG: Rubber Tyred Gantry  
SME: Small and Medium Enterprise  
SPV: Special Purpose Vehicle  
TNC: Trans National Corporation  
UNCTAD: United Nations Conference on Trade and Development  
VMT: Vehicle Miles Travelled

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# Impact of Digitalization in the Ports Sector

## 1. Introduction

The 2018 season of the international pop culture phenomenon, Doctor Who, devotes an episode to tackling a not so far away scenario—the travails of workers in a giant e-commerce warehouse that occupies an entire planetary moon—shipping items to space and beyond.<sup>1</sup> In its light and campy signature style, the British sci-fi show serves up a plot line replete with references to unprecedented automation (90 percent automated, with a 10 percent legally mandated quota for human workers), sentient algorithms and sinister robots working away at the heart of the giant warehouse and tech-enabled 360 degree worker surveillance, all of which lead one employee down an ill-fated revenge path. Upon release, the episode became discussion fodder on the internet, with several online reviews quick to point out the analogies between the plot line and Amazon’s massive warehouse operations.

Making allowances for the outlandish elements, the exaggerated premise of this show is rooted in many real world concerns of the present. The evolution of Artificial Intelligence (AI) and its ability to funnel large volumes of data into optimising solutions has meant that in work-flows, the place for human oversight is being taken up by algorithms. The tide of automation poses a real threat to jobs across sectors. This restructuring of economic activity through AI and consequent loss of jobs, has been the subject of much discussion under the rubric of the Future of Work. As e-commerce has exploded in the recent decade, it has had a cascading impact on the giant, but largely invisible force that facilitates the flows of global trade---logistics. As Thrift has noted, “the rise of continuously computed environments has made logistics perhaps the central discipline of the contemporary world, though one curiously unsung.”<sup>2</sup>

In 2016, Jack Ma, the founder of the e-tail giant Alibaba, noted how the next 10 to 20 years will see the rise of New Retail; the integration of offline and online enterprises with modern logistics, thanks to the power of AI.<sup>3</sup> As digital solutions based on machine learning, Internet of Things (IoT) and robotics are being integrated into various layers of the logistics chain, a paradigmatic change that underpins the very organisation of economic activity is well underway.

This paper explores the transformations in the Indian ports and logistics sector on account of economic restructuring at global to local levels, concurrent with the advent of digital automation, datafication and digital intelligence. It also examines the nature of these shifts in the sector and resultant outcomes for local livelihoods and labour. For the purposes of this paper, the following definitions have been used:

- **Digitisation:** the process of moving from systems that are manual or paper based to computerised

systems that organise information into units called data.

- **Datafication:** social phenomenon in which all aspects of our lives become commodified through big data and digital intelligence, and can therefore be realised as a new form of value.
- **Automation:** creation and application of technology for performing tasks or executing processes with minimal to zero human assistance, intervention or oversight. Intelligent automation used in contemporary robotics is linked to digitisation and datafication.
- **AI:** an area of computer science devoted to developing systems that can be taught or learn to make decisions and predictions within specific contexts.<sup>4</sup>
- **Digital intelligence:** the cognitive capabilities of computerised systems that are programmed to use data to learn and solve problems adaptively. Also, a significant dimension of value creation in the economy today.

## 2. The evolution of modern global logistics

Logistics, according to Thrift, “a set of knowledges synonymous with movement, effectively the science of moving objects in an optimal fashion”, has its origins in warfare and tactical planning from the 18<sup>th</sup> and 19<sup>th</sup> centuries.<sup>5</sup> This once highly militaristic paradigm of operations, which centred around the ability to take calculated decisions about the movement of objects, increasingly began to find wide-spread application post the second World War as global trade came to rest on the efficacy of reliable and interlinked systems of transportation.<sup>6</sup> The movement of goods, once a precarious, high risk proposition, became a central node of the commerce process, to be perfected, streamlined and optimised for maximum efficiency and gains, in and of itself.

The advent of containerisation—a system of intermodal freight transport where standardised shipping containers can be used across different forms of freight transport—sea, rail and road for transportation marked the beginning of this phase of logistics, linked to growing global trade. Container based logistics is universally recognised as one of the seminal innovations in the sector.<sup>7</sup> It reduced costs in transportation many times over and increased productivity manifold (within five years of containerisation, trade among nations increased 320 percent and within 20 years, by 790 percent).<sup>8</sup> Containerisation also eased congestion at ports and port hubs and virtually eliminated the need for breaking bulk i.e., the process of manually handling cargo in portions for transfer from one point to the next.

Automation was the next step and eventually, with digitisation, logistics induced changes led to ripple effects in the global economy, making it possible for businesses to dramatically restructure their manufacturing processes. Container shipping facilitated Just-in-Time manufacturing and off-shoring key drivers of early globalisation, not only expanding the geographies of economic activity, but bringing new complexity and



interdependent arrangements to trade.

Global logistics, today, may be understood as a thick web; a “network space, constituted by infrastructures, information, goods, and people.”<sup>9</sup> On an everyday basis, a highly transnational, interconnected and multi-tiered chain of private, state and multilateral actors, spread across vast and distant geographies come together to make possible the movement of goods and materials.<sup>10</sup> As Cowen notes, “even the simplest purchase relies on the calibration of an astonishing cast of characters, multiple circulations of capital, and complex movements across great distance.”<sup>11</sup>

Ports are at the heart of these transversal networks. Figures provided by the International Maritime Organisation (IMO) suggest that over 90 percent of the world’s trade today is carried out by sea.<sup>12</sup> Ports, regardless of the specific structures of their ownership, serve a critical public utility function and are key to national economic growth. They are a key node in ensuring competitive and agile economic activity. Table 1 provides an overview of the key actors in maritime logistics.

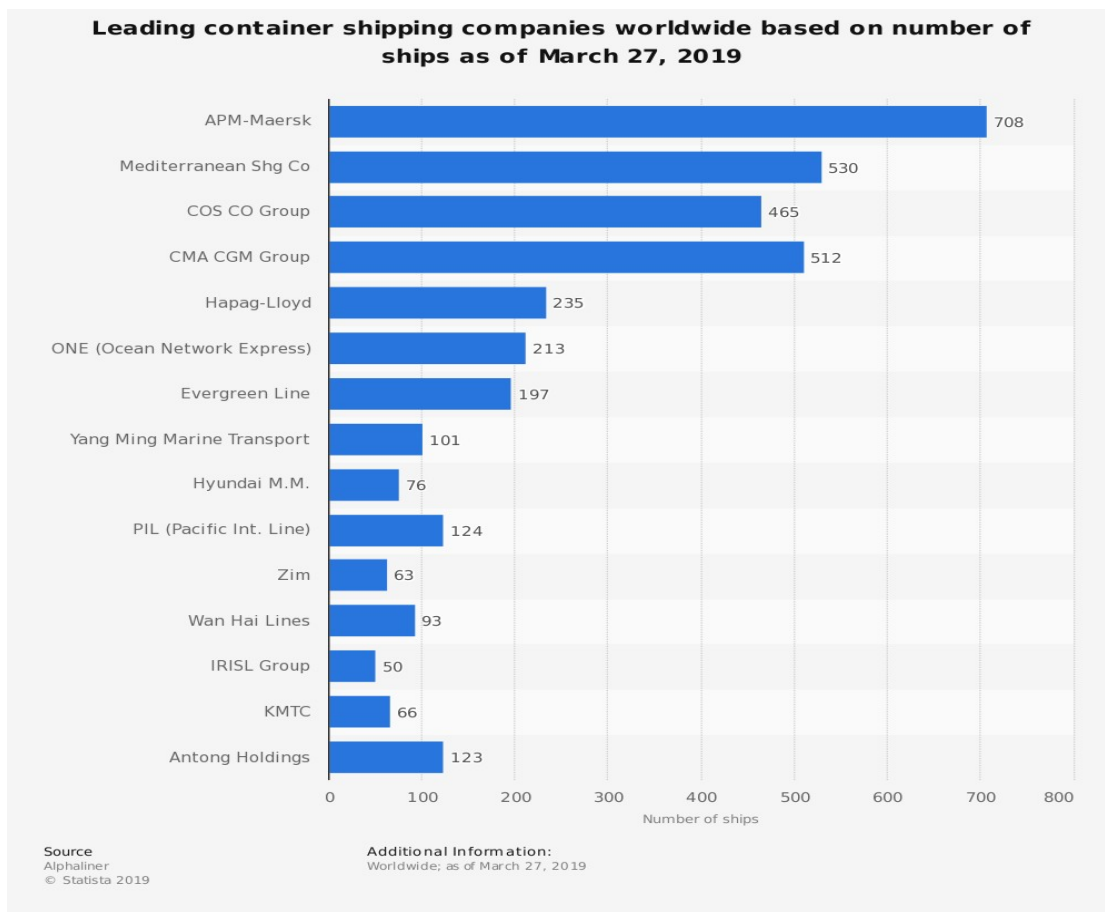
**Table 1. Key actors in maritime logistics<sup>13</sup>**

<b>Actor</b>	<b>Function</b>
Maritime shipping companies/lines	Companies that move freight on sea routes between major markets
Port terminal operators	Companies that control and operate infrastructure within large container ports for logistics support
Port authorities	Trusts that manage and plan port infrastructure and govern the ecosystem. These are often public sector agencies with direct/indirect government involvement
Trucking companies	Companies that offer short and medium freight transportation on the landside.
Third party logistics providers	Actors who offer managerial and organisational skills including brokerage services between operators and shipping liners
Freight forwarders	Facilities that consolidate or deconsolidate freight shipments once deliveries are made from/to ports

According to the United Nations Conference on Trade and Development (UNCTAD) 2018 Review of Maritime Transport, key trends in maritime logistics include; 1. the cascading impact of digitalisation and e-commerce; China’s Belt and Road Initiative (BRI) and rising Chinese interest in the sector; 2. liner shipping consolidation through mergers and acquisitions (See Figure 1 for leading container shipping companies by

fleet size) and consequent potential for market power abuse and negative impacts on smaller players and; 3.the relative importance of cutting edge technological upgrades in shipping, rather than scale alone.<sup>14</sup> Table 2 lists the top 10 leading port terminal operators, demonstrating the high degree of consolidation between global liners and terminal operators by way of mergers and major/minor stake holdings.

**Figure 1. Major container shipping containers**



(Statista 2019)<sup>15</sup>

**Table 2. Leading Global Port Terminal Operators**

Rank	Port Terminal Operator	Integrated with Shipping Liner Business
1	Cosco Shipping Ports	Cosco Shipping
2	Hutchison Port Holdings	No
3	PSA International	Ocean Network Express
4	DP World	Unifeeder
5	China Merchant Port Holdings	No
6	APM Terminals	Maersk

7	Yilport Holdings	No
8	Shanghai International Port Group	Cosco shipping
9	International Container Terminal Services Inc	No
10	Terminal Investment Limited	Mediterranean Shipping

Source: Lloyd's List 2018<sup>16</sup>

Also, evident from the data, is the emergence of China as a key global player in maritime trade. On the liner shipping connectivity index computed by UNCTAD, China scores a very high 167.5.<sup>17</sup> With a strong shipbuilding and container industry, huge export business and continued expansive acquisitions in the liner and terminal operator businesses through its state owned enterprises and the BRI, China has established its dominance in the sector, with a view towards consolidating its trade as well as geopolitical and naval advantages. In the age of data, Chinese companies now seek to further their competitive edge through investments in digital innovations. An example of this includes the collaboration between China International Marine Containers (CIMC) and Siasun Robot & Automation on “intelligent manufacturing”.<sup>18</sup>

### 3. AI in global ports-logistics: present and future applications

Globally, the port sector was among the first to informatise its operations and processes. As early as the late 1970s, information sharing platforms, such as Electronic Data Interchange (EDI) based Port Community Systems (PCS) had been created in Europe.<sup>19</sup> Today, PCSs are being harnessed and optimised to better facilitate trade, including digitised Single Window and e-Trade programmes.<sup>20</sup>

Global port centres, terminal operators, shipping lines and logistics providers are also investing in data based innovations at the capturing/harvesting and analysis ends. The ability to offer/integrate value added digital intelligence solutions is a critical component of staying relevant for every actor and node in the logistics chain. Indeed, for port ecosystems, soft digital infrastructure has become on par with physical infrastructure as an economic priority. Nearly half of all new port projects in the next five years will become partially or fully automated, as per a 2017 survey undertaken with industry experts by McKinsey.<sup>21</sup> Fully automated port terminals are already a reality, Rotterdam in Netherlands being a case in point.<sup>22</sup> Research to make unmanned ships a viable option is steadily gaining momentum.

In terms of applications for automation and intelligent systems, the ports sector presents an ideal scenario (Table 3 presents some AI applications in the sector). Port ecosystems are structured and predictable environments with repetitive activities and sequences. The network-based nature of this industry, along with the highly informatised process of logistics operations makes it an ideal fit for the implementation and scaling of AI technologies.<sup>23</sup>

**Table 3. Indicative list of AI and data-based applications in ports-logistics**

<b>What is it?</b>	<b>How it works?</b>	<b>Who is working on it?</b>
Integrated Trade Platform	Transport Integrated Platform that connects to landside containerised supply chain. Enables all actors in the supply chain to securely exchange information in real-time about shipment events across borders and trading zones using blockchain and cloud-based technologies	Port of Singapore Authority (PSA), IBM-Maersk
Smart ports	Fully AI powered autonomous ports with IoT, big data and 5G, facilitating advanced analytics and decision making for autonomous workflow management	Port of Rotterdam Authority
AI based disaster management	Data based modelling to determine how vessels can be rerouted in the event of a port closure or natural disaster	Maana <sup>24</sup>
ForSee (Predictive analytics for vessel arrival/exit)	Through a database of every route offered by the world's 30 biggest carriers combined with five years of Automatic Identification System (AIS) vessel movement data, this system can predict in real-time if a vessel is likely to arrive on schedule	CargoSmart <sup>25</sup>
Smart Vehicle Booking Systems (VBS)	Through AI, VBS can manage containers with high degrees of sophistication, identifying and unlocking container space, assist with truck pickups and drop offs and eliminate queues altogether	Maersk
Drone ships	Cargo vessels that don't need a crew and can be controlled remotely	Rolls-Royce
Robotics (unmanned cranes, warehouse robots)	The use of automated machinery and robots to undertake tasks that are labour intensive, repetitive and/or are dangerous.	DHL

It is to be noted that while datafication of different components of port ecosystems is a global trend and there are real instances of autonomous, self-optimising port terminals, such ventures call for high capital investment, but with low returns. For instance, it was found in one survey by McKinsey that contrary to industry expectations pegged at 25 to 55 percent, operating expenses in fully automated port terminals reduced only between 15 to 35 percent. In fact, productivity fell by 7 to 15 percent. Capacity deficits, especially in finding highly specialised human resources, lack of structured data sets in port community systems and siloed operations of the sector, have been noted as some obstacles that need to be addressed as part of making AI work for port ecosystems.

In its 2017 outlook on the future of port automation, McKinsey notes that if done successfully, port automation could result in an overall productivity rise of up to 35 percent and move ports-logistics towards a new paradigm, "Port 4.0, the shift from asset operator to service orchestrator." However, traditional models

where terminal operators usually make front-load investments are seen to be unlikely to work in the new paradigm.

#### **4. Economic restructuring of the ports-logistics sector in India**

In the case of India, 95 percent of trade is handled by a total of 212 ports (12 major and 200 non-major).<sup>26</sup> However, the domestic shipping industry in India is not a major international force to reckon with. India currently only scores 52.9 on the UNCTAD liner connectivity index, with a combined fleet ownership of 22,665. This is far lesser than industry leaders, such as China (165,430) and Germany (112,028). Major shipping companies in the country include Essar, Mercator, Great Eastern and the Shipping Corporation of India, which is a public sector undertaking. However, a majority of the companies' business is the transportation of wet and dry bulk and not so much container freight. In 2018, the domestic shipping industry made a revenue of 121.4 million US dollars registering a flat revenue growth of 0.7 percent.<sup>27</sup> Government data indicates that employment in the ports sector (including major and non-major ports) declined from about 87,300 in 2001 to 46,100 in 2015.<sup>28</sup> The data does not include unregistered, informal workers.

The logistics sector in the country contributes between 13 to 14 percent to India's Gross Domestic Product (GDP) and is a 160 billion US dollar industry, employing close to 22 million people.<sup>29</sup> Early attempts to make the sector more competitive included allowing up to 100 percent Foreign Direct Investment (FDI) under the automatic route for constructing and maintaining ports and harbours through the Build Operate and Transfer (BOT) model. Free trade and warehousing zones were also introduced in 2004 through a policy of the Government of India to enhance barrier-free trade infrastructure in the country.

The current government, which came into power in 2014, has made logistics a focus of high-priority economic reforms, with an aim to tackle some core issues, including easing congestion at logistics hubs and eliminating barriers to trading goods and services. Some major efforts made in this direction have included:

The *Sagarmala* project is an ambitious undertaking of the Indian government, purporting the concept of "port-led development". The project, which was approved by the union cabinet in 2015 and put to action through a National Perspective Plan in 2016, is aimed at the following objectives.<sup>30</sup>

- Reducing cost of transporting domestic cargo through optimising multi-modal transportation
- Lowering the logistics cost of bulk commodities by locating future industrial capacities near the coast
- Improving export competitiveness by developing port-proximate discrete manufacturing clusters
- Optimising time/cost of Export-Import (EXIM) container movement

Broadly, the *Sagarmala* project includes the following components; 1. Port modernisation and new port development, 2. Port connectivity enhancement to the hinterland, 3. Port linked industrialisation through the development of port-proximate industrial clusters and Coastal Economic Zones (CEZs) and 4. Coastal community development through skill development and livelihood generation activities.

A major move under the *Sagarmala* project has been the introduction of Direct Port Delivery (DPD) systems at major ports. DPD allows for import containers to be directly delivered to pre-approved clients from the port instead of having to be handled via a Container Freight Station (CFS) facility.

**b. Legislative and regulatory reform.** The Major Port Authorities Bill was tabled in 2016 and approved by the cabinet.<sup>31</sup> It aims to replace the Major Port Trust Act (1963). The Bill accedes more autonomy to port authorities and future public-private partnership operators in being able to fix tariffs and scales of rates for port services and assets, based on market conditions. In addition to simplifying board compositions, it also absolves them from seeking government approval for raising loans, appointing consultants, executing contracts and creating service positions. If passed, this law would in effect privatise the major ports of India and reduce government oversight to a large extent.

In 2017, logistics was recognised as an infrastructure by the Finance ministry. The Indian government also set up a dedicated logistics division within the Ministry of Commerce under a Special Secretary for cross cutting policies and coordination and ensuring complementarity with new Goods and Services Tax (GST) regime. More recently, the Logistics division of the Department of Commerce brought out a Draft National Logistics Policy, which at the time this paper was being written, was tabled for public consultation (2019).<sup>32</sup> The policy's relevant takeaways include:

- Creating a National Logistics e-marketplace as a one stop marketplace to simplify documentation for exports/imports, digitise customs processes involving regulatory, certification and compliance services
- Creating a logistics Center of Excellence
- Creating and managing an Integrated National Logistics Action Plan
- Doubling employment in the logistics sector by generating additional 10–15 million jobs, focussing on enhancing skills in the sector and encouraging gender diversity
- Identifying, implementing and monitoring technology based interventions, such as e-tolling, electronic document flow, rationalisation of checkpoints, digital verification, etc.
- Improving PCS databases and their integration with customs for faster processing
- Setting up a big data enabled logistics data hub and analytics centre
- Setting up a startup acceleration fund to incubate startups in the logistics sector

The Economic Advisory Council to the Prime Minister also constituted a Logistics Development Committee,

which was given the task to assess key challenges in logistics development and make policy recommendations aimed at improving ease of trade. This committee brought out its report in 2019 with key recommendations for reducing rail freight tariffs, especially on port corridors connecting to the capital, creating an independent logistics department within the commerce ministry for development of long term national logistics plans and incentivising the trucking industry with greater formalisation and unified road permit and taxation systems. The report has also advocated that creation of “a fully automated paperless trade environment” that can through a single window digital portal, integrate all stakeholders and monitor major trade gateways.<sup>33</sup>

**c. Incentives for private and international actors.** In 2016, the Government of India rolled out a revised Model Concession Agreement (MCA) as a way of incentivising private sector players to get involved with ports and making the sector investor friendly.<sup>34</sup> These included updated tariff guidelines and discounted revenue shares, and a 10 year tax holiday for companies that help maintain and operate ports.

**d. Development of a national benchmark.** Following the lines of the Logistics Performance Index (LPI) brought out by the World Bank, the Indian government also introduced in 2018, a subnational LPI tool to assess and evaluate the performance of various states and the logistical support they provide to promote trade. The aim of the tool is to identify bottlenecks and help improve logistics infrastructure in underperforming regions.<sup>35</sup>

In the 2016 World Bank LPI report, India moved up by 19 places, coming in at the 35<sup>th</sup> rank as compared to 54 in 2014, a statistic that was widely touted as a positive result of these reforms.<sup>36</sup> However, in 2018, India once again slipped in the rankings, moving down to 44. The progress of *Sagarmala* has been slow.<sup>37</sup> A Right to Information (RTI) query filed in 2018 revealed that in three and half years of rollout, less than a fifth of the project has been completed.

The government think tank NITI Aayog in its Dun & Bradstreet 2018 report on Port Logistics: Issues and Challenges in India, has noted five key issues affecting port performance.<sup>38</sup> These include: 1. Port congestion, 2. Customs clearance, 3. Shipping line issues and charges, 4. Documentation and paperwork and 5. Regulatory clearance. In its assessment of 14 ports, the NITI Aayog designed a Port Performance Index on which only four ports—Mundra Port, Jawaharlal Nehru Port Trust (JNPT), Ennore Port and Visakhapatnam Port Trust—received a “Good” score. Cochin, Kandla, Paradip, Chennai, Mormugao, New Mangalore and V.O. Chidambaranar Port Trust, received an “Average” score while three ports, Haldia, Kolkata and Mumbai Port Trust (MbPT) received a “Poor” score. The report has noted that a significant issue in the ports-logistics sector was the lack of standardisation of processes and unpredictable time and costs in respect of the different functions. This, the report emphasised, was “an unacceptable level of variation across ports as well as within an individual port.” The report also observed that certain critical targets for ports, such as processing 40 percent of imports via DPD by 2016 were not achieved.

## 5. The case of JNPT

The Nhava-Sheva region of India, located east of Mumbai in Uran, Raigarh, is home to the country's biggest container port, JNPT. The port, established in 1989, and its associated industrial hub of CFS warehouses, is responsible for over 50 percent of total container traffic handled in India. JNPT has four operational container terminals one operated by the port authority and three built and operated by private operators under the BOT model, including PSA, DP World and APM-Gateway Terminals of India (GTI).

JNPT is one of the top performing ports in the world, ranking 28<sup>th</sup> on Llyod's list (as part of the top 30) in 2018.<sup>39</sup> It is part of the Western Freight Corridor project of the Indian government. A six lane express highway and CEZ (owned by DP World) are also being developed in the Uran area to enhance the performance and competitiveness of the region as a whole.

For this research paper, a team from IT for Change undertook interviews and focus group discussions with port workers and union representatives in the JNPT region. We also interviewed management personnel at two container freight stations in the region and conducted an on-site visit of the port and warehouse facilities.

### 5.1 Digital and data based operations

JNPT has been the focus of many technological innovations and reforms in the past few years and can be said to be on a sure path to automated management, with greater digitisation and data based operations. Notably, these include the following.

#### a. Gate automation systems

Electronic, radio frequency identification technology gate operating procedures with reader and cameras at checkpoints are in place at all terminals in the port. This enables entry and exit to be automated to a great extent, reducing necessary manpower, from on average four personnel to one, as per estimates provided by port workers. DP World, one of the terminal operators started the process in 2005, when it set up a paperless gate module — Smart Gate.<sup>40</sup>

#### b. Container traceability

Container traceability through Radio Frequency Identification (RFID) chips has become common place. The easy identification and traceability made possible through the tagging of containers has made inventory management easier and less manually intensive. It has also allowed for end-to-end real time traceability of containers through the logistics chain (from ship to CFS, to trucks and delivery point).



**c. Monitoring movement and activity**

Cameras to monitor movement and activity are part of port and CFS operations. These are deployed everywhere in port, terminal and warehouse facilities to monitor port operations.

**d. Rubber tyred gantry (RTG) cranes**

RTG cranes are semi-autonomous/autonomous equipment that can lift and stack containers from vessel to truck/rail and vice-versa. JNPT has a fleet of electrically powered RTG cranes that are used for cargo stacking in the various terminals. These massive machines, which can handle a volume of 40–50 tonnes can be operated by one person, where earlier 10 operators would be required.

**e. Vehicle management systems**

Vehicle Miles Travelled (VMT) screens installed in trucks allow for GPS enabled navigation within a terminal through a centralised system for work assignment. Truck drivers are allotted assignment numbers and work queues through the dashboard, and then given step by step instructions on picking up and dropping of cargo within the port facilities. This was a process that was earlier done through manual intervention at every stage and is now entirely an automated work process.

**f. Direct port delivery**

DPD instituted at JNPT allows clients to directly receive their shipments from the port without having to store them at CFS facilities while processing customs clearance. DPD allows for all paperwork and clearance of cargo to be done online and thus, eliminates intermediate movement of cargo, cutting down close to six to seven business days in the logistics chain.

**5.2 Impacts of digitisation and datafication****a. How local actors in the JNPT ecosystem have adapted**

Processes such as DPD have forced CFS operators, once critical nodes in the ports sector, to rethink and reinvent their business proposition in a bid to stay relevant, or simply transition to a renting-out model. In the past two years, smaller CFS operators in the JNPT area, who have traditionally operated in a more informal, small scale manner, have gradually shut shop and begun to lease warehouses to e-commerce companies, such as Flipkart and Amazon. The Union vice-president of the New Maritime General Kamgar Sangh (NMGKS) described this as “a take-over spree of CFS and warehouses,” noting that the introduction of GST has played a part in this, making the CFS model unfeasible for those who cannot meet new compliance standards. Earlier, there were 38 CFS operators in the JNPT region, employing a workforce of about 30,000, he observed, adding that in the past two years alone, the numbers have nearly halved.

Other CFS operators, with corporate backing, are coming up with more and more value added services. Digital integration via apps, real time tracking for clients, etc., are now part and parcel of the business of these outfits. There is also an effort to develop data and analytics/AI-based solutions in-house to further streamline operations, cut costs and stay competitive. Hind Terminal, a CFS facility for instance, is currently working on an image recognition AI technology that can capture container damage upon receipt. This is consistent with scholarship that suggests that value generation and accumulation within the supply chains rests now with economic actors who can bring in pre-production value chain integration and digital intelligence layers to their operation.<sup>41</sup> The World Economic Forum's Digital Transformation Initiative has also predicted that to survive in the digitalised economy, enterprises need to embrace data based processes. Staying viable in these times means being able to stay ahead in the digital game and carve out a place in the increasingly networked, platform-based ecosystem.

#### **b. Labour and livelihoods in the new logistics ecosystem**

Automation and economic restructuring of port operations have had a direct bearing on livelihoods in the JNPT ecosystem, with redundancies and lay-offs widespread across sectors. Containerisation by itself, as previously discussed, has virtually eliminated the need for jobs such as those of the *mathadi* dock workers who used to manually load and unload cargo. Apart from this, various job roles, including supervisors, surveyors, licensors, inventory keepers, gate entry personnel, have been rendered superfluous. Administrative functions, such as housekeeping, have also been downsized as a result of these cuts. Port workers we interviewed pegged the number of jobs lost at anywhere between 40 to 50 percent, and income loss of up to 50 percent, over a 15 year time frame. In the past year alone, we were told, 85 percent of *mathadi* workers have lost their jobs.<sup>42</sup>

One worker, underscoring the significance of gate automation to jobs pointed out, “where four people were previously working, now it is only one, because a new system came in. So, now three people have to sit at home because of the technology...”

The reduction of CFS operators in the region and the introduction of DPD has been a major cause of job losses in the sector. According to a union representative, when Allcargo CFS changed its business model from a traditional CFS to leasing its facilities to Amazon, it resulted in over 100 lay-offs of staff, including labourers, surveyors and housekeeping staff. While field work was underway for this research, another CFS, Maharashtra State Warehousing Corporation, had also served a termination notice to its employees, intending to close from November 2018.

Unions in the sector, such as the NMGKS, which have been established to protect worker rights, are

consumed with the task of easing this precarity on a near everyday basis, leaving them little, if any, resources to negotiate on other issues. One of the union members elucidated this point in a group discussion, “It’s been 14 years of working here. Everyone is on contract. No one takes us in offices [referring to formal recruitment]. The income we should be getting, we don’t get. We’re not getting our bonus. We keep going to the union to tell them our difficulties...It’s an everyday thing.”

The person, who is a member of housekeeping, was also quick to make the connections between larger economic trends in export-import and the impact on labour. “Imports have come down, but the cleanup workload is the same. The company says that they got less income, so in turn, the contractor gets less. This affects everyone. If there were once 100 labourers, now even 50 is too much.”

### **c. Dataveillance and the gaming of productivity**

The technological integration and increased datafication of the port ecosystem has resulted in heightened worker surveillance and micro management at different levels. Excessive deployment of CCTV cameras in and around the port facilities and warehouses ensures that workers are always under watch, and can be censured for slacking on the job or taking what is perceived to be an undue break, or even being where they are not supposed to be.

GPS tracking on trucks, phones and containers has meant that anytime a truck driver makes an unscheduled stop, an automatic message is relayed to the client/owner who can then log in and track the status of their shipment. The union vice-president explained an instance of how this plays out, “when the driver is driving the vehicle, which container has to go to which location, the number, all the readings, come on his screen, and he has to follow the instructions. And even the time duration for this is displayed; ‘such and such a task is to be done in 2 or 3 minutes.’ If the driver does not complete the task in this set duration, he is notified with a Non-compliance Report (NCR). An NCR is filed against him and a penalty is deducted. The penalty is charged to the contractor who passes it on to the worker.”

The surveillance of workers also extends to monitoring their interactions outside of work with other workers. Facebook feeds of workers are often monitored for ‘signs of trouble’ and there have been instances of physical assault and retribution by contractors against any form of disruptive resistance by the workers.

In our interviews with national office bearers of the International Transport Workers’ Federation (ITF), it was revealed that workers in other Indian ports and warehouse hubs, such as Bhiwandi, are assigned wearables to measure productivity and incentivised to increase their outputs per hour. Similarly, RTG operators are encouraged to work in longer stretches to avoid a disruption in the operation (as it is time intensive to alight

and board-the RTG equipment). Data on performance is thus constantly collected and funneled back into an endless strive for efficiency and performance.

While digital means become an easy way of disciplining the work force, it is pertinent to note that digital tracking is carefully avoided so that the contractor is able to continue with easy hire and fire. Gate passes, which are crucial to gain entry into the port, continue to be issued on paper and for arbitrary periods of time (between three days to one month) to workers, as per the wishes of the contractor. By not affording the convenience of digital identification system, informal work arrangements continue to be reinforced.

#### **d. Worker and management responses to changes induced by digital technologies**

While dismayed about the job losses and shrinking opportunities in the area and the extreme surveillance they were subject to, workers noted that the introduction of some technologies has made their jobs easier and more structured and highlighted these as positive impacts. For instance, truck drivers felt that the introduction of VMT screens had reduced room for error and saved them the work of driving around for instructions. Similarly, gate automation and digitised documentation has meant that wait time within processes has reduced considerably.

At every level, from international unions such as the ITF to local unions such as the NWGKS and dockworkers themselves, our interviews point to a recognition among workers of the new wave of change. This does not mean that AI-led models are fully understood, but the shifting ground towards automation has been an enduring theme in their negotiations for job security and fair work, including upskilling and reskilling, with the management. The president of the NWGKS expressed this candidly, “Technology and automation will come. We have to change along with that. Because there is no other way...You can call this a flow. You can't divert it anytime, and it should come.”

Management perspectives similarly, reiterated the need for reskilling and upskilling. Managers from Hind Terminals and J.M. Baxi and Co reported that they were working to upgrade the skills of workers whose jobs were likely to be automated. Given the complexity involved in ports-logistics and the need for a workforce that understands the particulars of working in customs bonded facilities, the view of management actors interviewed for this research was that it was in their interest to retain the present workforce, to the extent they could. A staff member at a CFS operator also pointed out that “automation doesn't come cheap” and that “where labour is cheap, automation will take a second seat.”

## **6. Findings and Conclusions**

The current context of economic reorganisation in the world, emerging out of the big data revolution, is

structured by algorithmic protocols, the digital intelligence deciding and directing economic activity across scale. If world trade in the 20<sup>th</sup> century was tied to the strategic value of logistics-based innovation, the AI revolution is likely to cement this connection further, reallocating value to geographies that are able to harvest the gains of datafication.

Our research about the Indian context indicates that the country has a long way to go on this road, but the policy impulse does reflect high ambition. Juxtaposed against this wider reality, the JNPT case study points to the urgent need for a focus on the politics and ethics of the current AI-driven economic model that emboldens Trans National Corporations (TNCs) to become bigger and cannibalise small actors and is ruthless in its exploitation of labour. Concerted action on the policy front to ensure that the power of AI is used for building ports-logistics ecosystems that promote human-centred development, livelihood guarantees and the promotion of worker rights is urgently needed.

The study leads us to the following findings and conclusions.

**a. In the Indian context, digitisation is restructuring several aspects of the ports-logistics ecosystem, but efforts are slow and patchy, and the digital infrastructure is not yet integrated.**

A whole host of technologies—convergent trading and data platforms, inventory management systems, intelligent robotics, automated control protocols—are implicated in the data-driven reorchestration of the ports-logistics sector globally. This has made it possible to eliminate once essential processes such as on-site customs clearance, improve productivity, enhance omni-channel distribution and even model for anticipatory logistics, where future supply and demand of goods can be efficiently managed.

In the Indian context, from the most basic processes of digitisation such as gate automation in ports, to data-based analytics (using GPS and image-recognition) for optimal work flows, robotisation, increasing datafication of labour arrangements and the growing influence of e-commerce giants, the ports-logistics ecosystem seems to be witnessing restructuring at multiple levels. Read along with policy pronouncements, our observations point to a future where global trends in digitisation are bound to be reflected at the national level. However, it is still unclear, given the rather fragmented current scheme of things, whether and how soon a seamless, AI-led, integration in the ports-logistics sector will materialise and what economic pathways and drivers will lead towards this goal post.

Currently, the policy priority seems to be somewhat skewed in terms of national strategic interests. On the heels of China's Belt and Road initiative, India has attempted to make the first inroads into transnational port expansion through the Chabbar trilateral transit agreement with Iran and Afghanistan. This deal, which was signed in 2014, involves the creation of freight corridor and port development. In December 2018, India

assumed formal control over the operations of the Shahid Beheshti port of the Gulf of Oman in Iran through the Special Purpose Vehicle (SPV), India Ports Global Limited. The move has largely been seen as India establishing a naval counter to China's presence in Pakistan's port of Gwadar.<sup>43</sup>

Systematic automation is an important survival imperative for Indian ports. NITI Aayog's survey results with 700 port users (stakeholders/actors) across 14 ports revealed that dissatisfaction among the port users on account of the quality of digital infrastructure is high.<sup>44</sup> If containerisation was the definitive paradigm that moved the ports-logistics industry through the millennial turn, AI and data are poised to be the revolutionising elements of the industry in the 21<sup>st</sup> century. The lack of a roadmap for and investments into development-oriented digitisation in the sector can prove to be costly for the country's economic progress.

**b. Shifts towards digitisation in the ports-logistics ecosystem in India is mostly guided by neo-liberal globalisation; this benefits big TNCs and developed countries.** The know-how that kick-started early automation in the ports-logistics sector was ushered in by global players, such as Maersk, DP World, PSA, etc. This trend continues in the age of big data, with non-traditional players Amazon, IBM, etc., entering the fray. The AI startup ecosystem has already been subsumed by bigger players, Maersk's startup accelerator program, OceanPro, being a case in point.<sup>45</sup> Indian startups like Zasti are partnering with Maersk to run a pilot in Chennai to track containers for damage through computer vision. In another such partnership, LinkedDots uses IoT to geo-fence the route map for connecting Maersk's order management systems and vendors.

A significant number of major port terminals in India have been built and operated by private sector-led BOT models. Many of them are foreign players. With digitisation, the data that powers the platformisation of port infrastructures will remain captured by these TNCs. While the legal frameworks in India for data governance are moving towards personal data protection, policies and laws to address concerns about data ownership and who will benefit from the value generated through data-based, digital intelligence are yet to be tackled.

The Logistics Bill does invoke the language of data and analytics. But how the new data and AI infrastructure will be built and what kinds of norms and rules will underpin these systems is unclear. The vision and outlook of the Ministry of Commerce and the expert committee constituted for improving India's logistics sector has adopted a techno-managerial approach to data that foregrounds ease of business. This is myopic and sidesteps the vital issues of data infrastructure sovereignty.

The push for digitisation has also come from multistakeholder international collaborations, such as the Customs Trade Partnership Against Terrorism (CTPAT) that enforce certain mandatory digitisation criteria, including gate automation (while voluntary, this accreditation is a widely accepted pre-requisite for being

able to do business with US and European actors).<sup>46</sup> Similarly, trade regulations also play a role in forcing CFS operators to update their data practices (stipulations in the General Data Protection Regulation (GDPR) of the EU being a case in point) which may present compliance burdens for smaller players, and impact their viability.

So far, the evolution of the logistics sector has followed a *laissez faire* logic, and foreign e-commerce giants have been able to exploit the policy vacuum to their advantage. The lack of transparency about their data and AI practices also poses a huge challenge for worker and consumer rights.

**c. With imminent Amazonification of ports-logistics systems, the sector is likely to see a further consolidation.** With the expansive growth of e-commerce, the future of logistics is not only poised to become more and more integral to global value chains, but also metamorphose into the new modalities of omni-channel distribution. Today, market leaders are working to maximise consumer satisfaction—increasing proficiency across all channels in the supply chain, engaging with consumers and personalising the shopping experience, using AI for improved inventory management, flexible fulfilment options and end-to-end visibility that enables greater control over risk mitigation and performance (See Box 1). This movement towards an ‘amazonification’ of the logistics ecosystem through a modularisation and seamless integration of operations marks a new point of departure for the ports-logistics sector. With AI, a large, complex, planet-wide system is now transforming into a sophisticated platform infrastructure that connects national and international trade regimes.

#### **Box 1. AI-led Logistics as the New Handmaiden of E-commerce**

The links that make up the traditional logistics sector may give way to a new modality that connects production, distribution and consumption. The future is about a modularised approach in the platform ecosystem, through which big firms refashion logistics. Consider the case of Amazon. From personalised recommendations; patented one-click ordering, anticipatory shipping that already ‘knows’ what the customer is likely to buy, when and from where and price optimisation that draws from consumer activity, competitors’ pricing, product availability, expected profit margins, it has perfected the art of the sale. Amazon’s AI prowess for supply chain optimisation can figure out the closest warehouse between the vendor and customer, the best delivery schedule and route and product groupings that can further reduce shipping expenses.

What this means, is that going forward, the ports-logistics sector is likely to see two broad trends. The entry of digital players, such as Amazon, Alibaba, etc., who in a bid to perfect their value proposition will be able to encompass more and more logistics functionalities, extending to the ports sector. Amazon is already seen

to be disrupting the shipping and container business.<sup>47</sup> With its big data prowess and a vast and expanding array of patented algorithms, Amazon could rise to become a new titan straddling port operations and land side logistics, acquiring legacy businesses along the way. The other trend being that the major traditional players in the international ports-logistics sector, including the likes of Maersk and DHL, will add newer components based on AI to their operations, thus striving to maintain their competitive advantage. In both of these scenarios, the push to consolidation is inevitable.

**d. AI-led restructuring of the ports-logistics sector impacts workers and smaller players negatively; however, workers are yet to organise strategically.** In Nhava-Shewa and Bhiwandi, e-commerce led logistics has transformed warehouse and trucking operations and normalised hyper-traceability as an operational principle. Workers seem to be caught in the never ending demand for efficiency, which works hand in hand with dataveillance tactics, fearing loss of livelihoods and resigning themselves to the lack of bargaining power. We noted cases of worker intimidation, and also, surveillance of their social interactions. World-wide, large players in the digital economy have insisted on workers signing away their right to unionisation, thus foreclosing any possibility for fair treatment. This is further exacerbated in the creation of territories such as free trade zones and special economic zones that afford corporates impunity from fair treatment of labour.

The steady decline of public sector labour force with guarantees and benefits, the rise of contracting and sub-contracting and intensification of informalisation have been the standard trend for over two decades, across sectors. The advent of platform-based business models deepens such precarity and has come to be a taken-for-granted feature of jobs for the majority. A steady roll back of many of the victories of the labour movement is imminent. Workers will need to organise around the specific brand of exploitation in this new phase of automation led by AI and its discontents.

While the promise of new jobs through digitisation is yet to be realised, realignments in the micro-local economy of ports-logistics in India suggest the increasing last-mile presence of transnational logistics players and an edging out of smaller, independent firms in what has hitherto been a more heterogeneous sector. Smaller players in the JNPT context, including CFSSs, have had to adapt per force; some have leased out their facilities to bigger players and others have attempted to keep pace through in-house AI initiatives. Some are shutting shop rapidly. While engaging human labour continues to make business sense for some of the actors in the ecosystem, the big leap towards automation is bound to follow, as future ports-logistics systems are taken over by global players.



## 7. Way forward

### 7.1 An inclusive path to smart ports

If the port system of any country is only as good as its logistics, and logistics today, only as good as the AI masterminding it, ports and logistics policies need considerable policy attention. Much like containerisation relegated many of the global harbours to obsolescence and created entirely new hubs of commerce (Levinson 2005), AI is poised to remake the global value system of logistics on the basis of data competitiveness. To not be in the reckoning is to essentially cede the sector to other players. Stemming automation or the datafication of port ecosystems is neither practical nor desirable. However, the trajectory of these innovations needs to be shaped by thoughtful forward-looking policy that does not handover key national resources such as major ports and the data generated within their ecosystems to value capture by TNCs.

Instead of empowering Port Authority Trusts and allowing them to be more agile in driving domestic need based innovations, the impending Ports Bill, which does not even articulate a vision for the digital paradigm, only seeks to privatise it. This is serious short-sightedness when we consider how well-placed public agencies embedded within the port system are to implement future looking roadmaps for datafication, as put forth by the National Logistics Bill. Consider the example of the Rotterdam Port Authority Trust (see Box 2), a world leader in port innovation, which not only is a public sector company, but in fact is owned largely by the city municipality itself (at 70 percent). Such kind of localised ownership of public infrastructure not only ensures better accountability towards the region and its denizens, but can also enhance community patronage, investment and linkages and ensure creation and distribution of value within the local economy rather than just an outward flow.

Aspirations about datafication are also part of the *Sagarmala* project of the Ministry of Shipping, which recommends the creation of convergent data systems, centres for data analytics and making logistics in India more intelligent and data-based towards interlinked port systems. It is vital that these disparate policies and laws are implemented through an integrated and synergistic vision and action plan to maximise data value for local development and livelihoods. A new policy body – Policy Council for Integrated Ports and Logistics, will go a long way for cross departmental collaboration towards digitisation of major ports.

As a long term vision, India will need to think of reconfiguring its current top-down national framework for governing ports—taking care of national security imperatives at a centralised level—but devolving more autonomy and innovation capital to local nodes in the system.

**Box 2. Port of Rotterdam**

The Port of Rotterdam is the largest port in Europe, handling over 461 million tonnes of cargo and more than 140,000 vessels annually. It has one of the most automated terminals in the world powered by unmanned RTG cranes. The port has been at the forefront of the automation and AI wave including developing its own suite of smart port-specific software tools, Port Forward.

With IBM, Port of Rotterdam has embarked on a project to digitise its 42 kilometre stretch from land to the North Sea, through sensors and host connected ships, through a centralised dashboard application.<sup>48</sup> The sensors and ships will gather multiple real-time data streams on tides, currents, temperature, wind speed/direction, water levels, berth availability and visibility. This will then be analysed through an IoT platform and help the Port Authority make decisions that reduce waiting times; determine optimal times for ships to dock, load and unload and enable more ships to dock into available spaces; and predict arrival and offloading times, eventually.

The port has also set up a floating, open data, AI laboratory on a decommissioned vessel that companies, researchers and other players from around Rotterdam and elsewhere in the Netherlands can use to innovate for automation.

Ports and logistics are a vital component of national public data infrastructure. They act as critical geographies, occupying a liminal position between the global and local, enabling the recreation of vast national hinterlands as socio-economic hubs. ‘Port-led development’, a term used by the *Sagarmala* project, could act as a powerful vision statement in the digital context for new economic activity clusters that are thriving human settlements. Today, as port systems merge with new logistics, their impact can multiply through multimodal capillaries, new manufacturing units and industrial facilities, smart grids and integrated institutional infrastructure that leverage public data. But this requires an investment design and long term plan that is people-centric. Governance frameworks that address data sovereignty and control are urgently needed so that AI related gains are able to be used for local development and to promote India’s competitive edge in the global context. In a sector that is marked by hyper consolidation—involving both traditional and new players—agility in policy intervention will be essential to pre-empt abuse of market power and to ensure that the future of the ports-logistics ecosystem can bring more equitably distributed gains.

Some smaller players in the ports-logistics domain are already adapting to the forces of digitisation. Portall, is a logistics management application built by J.M Baxi, a traditional logistics company, and aims to address the documentation requirements needs of exporters, importers and other stakeholders in the logistics chain in a secure and fast way through a single window platform.<sup>49</sup> startups in the technology sector are also creating new business solutions for the ports-logistics sector. However, they need much more public policy backing.

Supporting these Small and Medium Enterprises (SMEs) through appropriate institutional frameworks to reduce transaction costs and encourage domestic innovation is vital. The integration of Indian SMEs into global networks has been recommended by the NITI Aayog as a policy priority area to boost economic development through positive externalities such as competition and innovation.

## **7.2 Policies to safeguard the rights of labour**

One of the key areas of focus in logistics reforms led by the Indian government is job creation and skill enhancement. Driven by a recognition of the restructuring of the ports and the implications for jobs, this is a welcome first step. However, while the Logistics Bill promises jobs, it is unclear how this will materialise, whether the class of engine operators can aspire to be engineers in the imminent AI-defined system and how the loss of informal livelihoods, invariably invisible, will be compensated.

Thinking through measures to tackle outcomes of future automation in terms of job loss in certain segments, such as systems of social security and investments in new industries in the ports region in order to spur job growth, is an urgent necessity. In fact, automation and the question of future of work in itself should be a cross sectoral policy priority for the government and sustained long term measures need to be devised towards this.

Recognising the new realities of labour exploitation, mired as they are in dataveillance and complex ways of gaming the digital, it is also necessary that the government put in place clear safeguards against such violations and enshrine 'data rights' for workers as part of both existing laws and policies on labour, as well as impending legislation for data protection. The "10 Principles for Workers' Data Rights" put forth by UniGlobal<sup>50</sup> is a useful framework that offers clear principles on minimising data collection, making the process transparent, allowing workers and unions more oversight and control over the data processing and most importantly, countering the ill-effects of 'traceability' tech that allows granular surveillance of workers.

In fact, the state has an imperative to go one step further and think through how intelligent systems can work to enhance the rights of labour and address issues of precarity. A concrete suggestion to this end for instance could be the introduction of digital identification systems for non-permanent port workers. Instead of a system of paper-based gate passes that are issued arbitrarily without a standardised duration leaving workers in a state of limbo, digital authentication can allow for quicker approval and smoother entry and exit to their places of work. AI based systems also need to be locally accountable, and it is vital therefore that source code access is not signed off by countries like India in global trade negotiations. Developing countries need to come together to build a shared perspective on the digital economy and its impact on their trade prospects.

### **7.3 What unions need to do**

In an era where labour power is losing ground and the right to collective bargaining is under threat, it is important for unions to reclaim the fight with new strategies at their disposal. As work precarity becomes exacerbated through digitalisation, preserving a meaningful right to collective bargaining, minimum income guarantees and other conventional protections that have been the result of long struggles will need to become a concerted focus for union actors.

As AI-enabled automation will continue to restructure port ecosystems, time tested strategies will need to be enhanced and strengthened. The question is not simply limited to automation and countering job losses, but about the new ways in which work itself is being redefined and what this will imply for worker rights.

For instance, worker rights to data and protection from dataveillance will have to be an integral part of union agendas. Unions must not only be at the table in the national and international arenas where the future of labour rights is being deliberated upon, but also engage as informed stakeholders and representatives of workers in national policy debates around data, digital intelligence and the shaping of AI.

For instance, unions will need to work for advocating a right to explanation, right to oversight and right to appeal within digitally intelligent systems of management. They will need to negotiate safeguards for workers against unfair data surveillance, treating these as not ancillary concerns but rather as foundational non-negotiables for fair work. In all of this, unions must also take care to not treat data as the enemy and invest in strategies that can harness the many positives of digital intelligence for public interest. For instance, better worker and work data can result in being able to push for better working conditions. By developing data capabilities both within their own systems and through collaborations with port authority trusts, shipping liners, logistics companies, etc, unions can drive ‘innovation for labour’ rather than innovation that eliminates labour.

Educational programmes for union members about the transformations underway in ports and logistics on account of datafication and networked intelligence, and the resultant outcomes for local livelihoods and labour are much needed. When such an endeavor is co-developed with union actors, it can be effective in strengthening their strategies.

In 1956, as dockworkers grappled with the inevitable onslaught of containerisation in the US and were embroiled in gridlocks with shipping liners along the western and eastern seaboard, the renowned union leader Harry Bridges, addressing a caucus of the International Longshore and Warehouse Union (IWLW) noted, [M]uch of our past effort has gone into a somewhat unsuccessful attempt to retard the wheels of industrial mechanisation progress. In many cases, these efforts have only resulted in our eventual acceptance

of the new device, accompanied by our loss of jurisdiction over the new work involved.”<sup>51</sup>

Bridges urged IWLU members to recognise the futility of trying to roll back containerisation and instead face the reality of change in the sector head on. This watershed breakthrough eventually led to the passage of the Mechanization and Modernization Agreement of 1960, considered one of the landmark victories for labour in the context of industry automation.

We are in the throes of another such wave, this time one that is AI-driven. As UniGlobal has noted in its Ethical AI declaration, “Just as unions established wage, hour, and safety standards during the Industrial Revolution, it is urgent that we set new benchmarks for the Digital Revolution.”<sup>52</sup>

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