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A TEMPLATE FOR BUILDING AN INTEGRATED MULTISECTOR SMART LOGISTICS ECOSYSTEM

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A TEMPLATE FOR BUILDING AN INTEGRATED MULTISECTOR SMART LOGISTICS ECOSYSTEM

1. INTRODUCTION

The logistics industry is facing an era of unprecedented change, driven by the effects of COVID-19, rapid growth in e-commerce, a global economic recession, trade wars, changing customer expectations, climate change, and rapid digitalization. During the COVID-19 pandemic, we have witnessed massive delays in the movement of goods and surges in logistics costs, resulting in shortages of medical supplies, food, and other necessities worldwide. With the increasingly complex, cascading, and overlapping impacts of natural disasters, economic and political crises, and epidemics, there is an urgent need for a **resilient and sustainable smart logistics ecosystem**.

It needs to be **resilient** to be able to recover quickly from crises and disasters and function optimally to deliver essential supplies and basic necessities, particularly to those most vulnerable living in rural and remote areas. It needs to be **sustainable** such that the optimal functioning of the logistics ecosystem does not jeopardize the well-being of people and the environment, which means ensuring that jobs in the logistics industry are decent and safe, using clean energy, and eliminating pollution and greenhouse gas emissions across the logistics supply chain. **Smart** implies effectively leveraging digital technologies for improved resilience and sustainability of logistics systems. For example, the use of industrial Internet of Things, blockchain, and dashboards can provide real-time visibility and transparency of order status, sourcing practices, and environmental impact, and enable faster response to unforeseeable disruptions.

In this paper, logistics involves the management of the flow of goods, resources, and information between the point of origin and the destination. It is the process of planning, optimizing, and implementing the transportation of goods by air, rail, road and/or sea, and the warehousing, which includes receiving and recording goods from different suppliers, storing goods at appropriate locations, retrieving and picking goods when they are needed, and preparing shipment to customers. Logistics is a subset of supply chain management, which focuses on the physical movement of goods and the relevant information flow.[1]

[1] Xu Sun et al., "The application of Industry 4.0 technologies in sustainable logistics: a systematic literature review (2012–2020) to explore future research opportunities," *Environmental Science and Pollution Research International*, vol. 29, no. 7 (2022), https://www.ncbi.nlm.nih.gov/pmc/articles/PMC8664234/.

This paper is part of a five-part series of papers on integrated multisector smart logistics. This paper focuses on best practices and guidelines for ensuring resilient and sustainable food supply chain systems during crises and emergencies.

2. PLAYERS IN THE SMART LOGISTICS ECOSYSTEM

Players in the smart logistics ecosystem are becoming increasingly diverse. They can be divided into six key categories: (1) governmental and intergovernmental institutions; (2) logistics infrastructure and equipment providers; (3) logistics service providers; (4) resources for the logistics industry; (5) new players in the logistics ecosystem; and (6) logistics users. Each of these categories is discussed next.

2.1. GOVERNMENTAL AND INTERGOVERNMENTAL INSTITUTIONS

Government regulations, trade agreements, and global rules and guidelines of the International Maritime Organization (IMO), United Nations Conference on Trade and Development (UNCTAD), World Customs Organization (WCO), and World Trade Organization (WTO) play an important role in influencing the growth and strategies of logistics players in the ecosystem and the flow of trade within and across borders.

For example, during the COVID-19 pandemic, we have witnessed the hoarding of vaccines and essential medical supplies through export restriction policies that have resulted in those most vulnerable without the means to protect themselves from the virus. On the other hand, incentives and tax relief can accelerate digitalization and promote collaboration among competitors to develop solutions to logistical challenges, and governments' commitment to climate action can promote a more environmentally friendly and sustainable logistics system.

Government policies and strategies are important in directing investments in air, road, rail, and port infrastructure, developing logistics parks and hubs, climate-proofing logistics infrastructure against extreme weather and seal-level rise to build their resilience, and decarbonizing the logistics supply chain by promoting the use of renewable energy and electrification of rail and vehicles.

The efficiency of customs and border management clearance is also important in facilitating the flow of goods across borders. Excessive and opaque procedural requirements and repeated inspections of goods by multiple

agencies can lead to significant delays and affect the competitiveness of countries and the ability to trade internationally. This is further discussed in the second paper in the series.

2.2. LOGISTICS INFRASTRUCTURE AND EQUIPMENT PROVIDERS

Logistics infrastructure providers are the air freight companies, rail companies, truck companies, and ocean freight companies that own or lease their fleets to transport goods by air, rail, road, and sea, respectively.

Air freight companies transport goods with dedicated air freight carriers or using the belly hold capacity of passenger aircraft. Rail companies transport goods and containers across the rail network on specialized locomotives and carriages. Truck companies transport shipping containers or other cargo on trucks or trailers. Ocean freight companies transport shipping containers on container vessels.

The equipment providers manufacture, own, or lease the containers and other assets needed to transport goods.

Logistics infrastructure providers also include airport terminals and ocean port operators, warehouses, and distribution centers where goods are sent, received, handled, processed, and managed for onward logistics. One example would be an ocean port where products are transferred from a container ship to trucks for onward transport to warehouses.

Some countries are investing in logistics parks and hubs to enhance efficiency and reduce logistics costs for companies. They are designed for storage, management, distribution, and transportation of goods within which logistics service providers collaborate to offer value-added services by sharing assets.

2.3. LOGISTICS SERVICE PROVIDERS

There is a wide range of logistics service providers that administer and manage goods as they flow along the supply chain. They may provide services for all or part of the supply chain.

The most well-known logistics service providers are the international express incumbents such as DHL, FedEx, and UPS. They are also known as international freight forwarding companies that organize shipments for individuals and corporations. These companies enter into contracts with the logistics infrastructure providers

and arrange the movement of goods. For example, the freight forwarding companies may arrange to have goods moved from a plant to an airport by truck, flown to the destination city, and then moved from the airport to a customer's building by another truck. International freight forwarding companies typically have expertise in preparing and processing customs documentation and performing activities pertaining to international shipments.

In many countries, there are also domestic freight forwarding companies that arrange both domestic and international shipments. Recently, postal operators are transforming, particularly to meet the needs of the e-commerce market in last-mile delivery, shifting from letters to parcels. Postal operators in most countries are trusted intermediaries with legal standing and often are required to serve all citizens. They have large physical infrastructure and, often, personnel assigned to remote locations. This structure means that the only delivery provider for these remote areas is often the postal service.

In India, for example, Amazon uses India Post's network of over 150 000 post offices. More than 125 000 post offices are in rural areas servicing over 25 000 pin codes, thereby vastly expanding Amazon's delivery reach and reducing its need to create a separate distribution infrastructure, particularly for hard-to-reach areas.[2]

In addition, there are logistics service providers that handle the movement of goods such as the loading and unloading of shipping containers between planes, railways, trucks, and ships, or they may specialize in specific aspects of the supply chain such as order management, inventory management, cold storage, packaging, or reverse logistics.

3. RESOURCES FOR THE LOGISTICS INDUSTRY

This broad category of stakeholders provides support to ensure a resilient and sustainable smart logistics ecosystem. The stakeholders include training institutions and universities that supply the human resources as well as support the reskilling and upskilling of logistics personnel, financing institutions that support capital flow in the logistics ecosystem, insurance companies that support risk mitigation, and tech providers that deliver digital solutions. Most of the new entrants to the logistics industry are startups; therefore, it is more important than ever to enable and nurture a robust startup ecosystem to enhance the competitiveness of the logistics

[2] Ankur Huria, "Facilitating Trade and Logistics for E-Commerce: Building Blocks, Challenges and Ways Forward," World Bank, December 2019, https://openknowledge.worldbank.org/handle/10986/33174.

industry. Toward ensuring and maintaining quality services, security, safety, and ethical conduct in the logistics industry, standards organizations, and industry alliances and associations play key roles.

3.1. HUMAN RESOURCES: TRAINING INSTITUTIONS AND UNIVERSITIES

At the international level, there is the association for supply chain management that offers a range of globally recognized training programs and certifications, including the APICS certification for logistics, transportation, and distribution.[3] The Chartered Institute of Logistics and Transport (CILT)[4] provides six levels of qualification with courses that can be accessed through classroom teaching, distance learning, and e-learning formats. In 2021, CILT conducted a Digitalization and Industry 4.0 campaign to raise awareness of the digital transformation of the logistics industry.[5] There is also the Institute for Supply Management's Certified Professional in Supply Management Programme[6] and the International Society of Logistics' Certified Professional Logistician Programme.[7] At the national level, universities, training institutions, and vocational schools offer logistics-related courses. According to a PwC survey,[8] there is a lack of training in logistics companies, and a shortage of human resources across the logistics supply chain has been reported. This is further discussed in the second paper, entitled Framework for Integrated Multisector Smart Logistics.

3.2. FINANCIAL RESOURCES: BANKS, FINANCIAL INSTITUTIONS, AND FINTECH COMPANIES

Logistics companies, like all companies, require financing. In particular, asset-based transportation companies incur considerable capital expenses due to the fleet and related equipment they purchase or lease. Traditional banks and financial institutions together with a growing number of venture capital firms, accelerators, and incubators for logistics startups, as well as lending platforms powered by fintech, are helping to grow the logistics industry. The lending platforms increase access to loans, particularly for smaller players, and often provide more

[3] Association for Supply Chain Management, "Learning and Development," https://www.ascm.org/learning-development/.
[4] CILT, "International Courses," https://ciltinternational.org/education-development/international-courses/.
[5] CILT, "Digitalisation and Industry 4.0 Bulletin 2021," https://mailchi.mp/ciltinternational/cilt-covid-19-bulletin-4910493.
[6] Institute for Supply Management, "Certified Professional in Supply Management," https://www.ismworld.org/certification-and-training/certification/cpsm/.
[7] International Society of Logistics, "The Certified Professional Logistician Program," http://www.sole.org/cpl.asp.
[8] PwC, "Shifting Patterns: The future of the logistics industry," 2016, https://www.pwc.com/sg/en/publications/assets/future-of-the-logistics-industry.pdf.

flexible loan repayment options.

3.3. STARTUP ECOSYSTEM: VENTURE CAPITAL FIRMS, ACCELERATORS, AND INCUBATORS

The logistics industry has seen an increasing number of accelerators, incubators, and entrepreneurship programs emerge for startups and entrepreneurs to gain exposure, become more productive and make connections. It is still hard for logistics startups to get noticed by venture capital firms, but these programs are proving to be extremely useful for startups looking for capital and other help,[9] and there has been a dramatic increase in funding for logistics startups over the past few years.[10]

3.4. RISK MITIGATION: INSURANCE COMPANIES

Insurance companies are important in helping logistics companies mitigate risks. Logistics insurance products offer protection to logistics companies involved in the transport, storage, or arrangement of such activities.

3.5. DIGITAL SOLUTIONS: TECH PROVIDERS

The number of tech providers for logistics companies is growing. Digital solutions range from those provided by tech giants like Google Cloud for supply chain and logistics,[11] IBM's suite of supply chain products,[12] Microsoft's Dynamics 365 supply chain management solutions,[13] and SAP's supply chain logistics management solutions[14] to many tech startups offering a diverse selection of systems, applications, and platforms for improving logistics planning, operations, and decision-making.[15] Generally, digital solutions help to enhance efficiency, transparency, and real-time visibility.

3.6. INDUSTRY STANDARDS: STANDARDS ORGANIZATIONS, INDUSTRY ALLIANCES, AND ASSOCIATIONS

[9] A list of accelerators and incubators in the logistics industry across the global is available at https://www.failory.com/startups/logistics-accelerators-incubators.
[10] McKinsey & Company, "Startup funding in logistics: New money for an old industry?" February 2020, https://www.mckinsey.com/industries/travel-logistics-and-transport-infrastructure/our-insights/startup-funding-in-logistics.
[11] Google Cloud, "Google Cloud for supply chain and logistics," https://cloud.google.com/solutions/supply-chain-logistics.
[12] IBM, "Supply Chain," https://www.ibm.com/supply-chain.
[13] Microsoft, "Dynamic 365 Supply Chain Management," https://dynamics.microsoft.com/en-us/supply-chain-management/overview/.
[14] SAP, "Supply Chain Logistics," https://www.sap.com/sea/products/supply-chain-management/supply-chain-logistics.html.
[15] Inbound Logistics, "2022 Top 100 Logistics IT Providers," https://www.inboundlogistics.com/cms/top-100-lit/.

Standards organizations like ISO set international standards to ensure quality services (ISO 9001), environmental sustainability (ISO 14001), and business continuity (ISO 22301) in the logistics industry. Standards are also important for ensuring the interoperability of digital systems and enabling data exchange across different systems. In light of the increased digitalization of the logistics industry, ISO has developed or is developing the following standards:[16]

- **ISO 23354:2020**—Business requirements for end-to-end visibility of logistics flow.
- **ISO/DIS 23355**—Visibility data interchange between logistics information service providers.

The Institute of Electrical and Electronics Engineers Standards Association (IEEE SA) has also developed a suite of standards for logistics and supply chain management such as the IEEE Standard for the Use of Blockchain in Supply Chain Finance (IEEE Std 2418.7™-2021)[17] and the IEEE Standard for Logistics Operation Process in a Smart Factory (IEEE Std 2934-2022).[18]

In addition, logistics-related industry alliances and associations are developing new standards for digitalization. One example is the Blockchain in Transport Alliance established in 2017 that has grown into one of the largest commercial blockchain alliances with 500 members from the freight, transportation, and logistics industries.[19] Another example is the Digital Container Shipping Association (DCSA) established in 2019 to create common digital standards in the shipping industry, which has created standards for electronic bill of lading,[20] cybersecurity, booking and documentation process, Internet of Things devices (including smart containers), and tracking and tracing.[21] Recently, DCSA in collaboration with the BIMCO Shipping Association, FIATA International Federation of Freight Forwarders Associations, the International Chamber of Commerce, and Society for Worldwide Interbank Financial Telecommunication (SWIFT)[22] formed a Future International Trade Alliance to standardize the digitalization of the wider logistics industry.[23]

4. DIGITAL TRANSFORMATION—NEW PLAYERS

[16] Roxanne Oclarino, "Keeping up with Logistics," ISO, 30 November 2021, https://www.iso.org/news/ref2767.html.
[17] IEEE SA, "IEEE 2418.7-2021: IEEE Standard for the Use of Blockchain in Supply Chain Finance," 28 October 2021, https://standards.ieee.org/ieee/2418.7/7447/.
[18] IEEE SA, "IEEE 2934-2022: IEEE Approved Draft Standard for Logistics Operation Process in a Smart Factory," 16 June 2022, https://standards.ieee.org/ieee/2934/10371/.
[19] Blockchain in Transport Alliance, https://www.bita.studio/.
[20] Bill of lading is a document issued by a carrier (or their agent) to acknowledge receipt of cargo for shipment.
[21] DSCA, "Standards," https://dcsa.org/standards/.
[22] The SWIFT standard developed by the banking industry makes it possible for banks worldwide to execute transactions between customers of different banking systems.
[23] Thomas Bagge, "The Future International Trade Alliance explained," DCSA, https://dcsa.org/newsroom/resources/the-future-international-trade-alliance-explained-thomas-bagge/.

The COVID-19 pandemic has accelerated growth in e-commerce—pushing millions of people online to purchase goods and services for the first time.[24] E-Commerce has expanded business-to-consumer logistics services. Many retail stores have also launched online ordering options during COVID-19, increasing the need for last-mile delivery services to end customers. However, the pandemic has disrupted global supply chains and logistics networks, which has impacted trade and the distribution of essential goods, preventing effective crisis response and recovery.

The pandemic and rise of e-commerce have together triggered transformations across multiple dimensions of the logistics and supply chain ecosystem, and have driven new logistics entrants, particularly in the last-mile delivery market to meet the surge in last-mile logistics demands from e-commerce growth.

This rise of e-commerce and the entrance of new players have created new types of jobs, changed the nature and conditions of work, altered skills requirements, and affected the functioning of labor markets. For instance, within the **gig economy**, online crowd-shipping platforms are engaging ordinary people in the delivery of parcels and has fostered a pool of casual, part-time logistics workers for last-mile deliveries. While there is evidence that e-commerce, the logistics ecosystem, and gig economy can boost job creation and generate new flexi-work opportunities,[25] they have also come under scrutiny for low wages, unfair terms of work, and lack of clarity about the employment status of the workers associated. The COVID-19 pandemic has underscored the urgency of securing labor guarantees for workers.

4.1. E-COMMERCE GIANTS

e-Commerce giants like Amazon[26] and Alibaba[27] have been expanding their own in-house logistics operations—Amazon Logistics and Cainiao Smart Logistics Network, respectively. They are building their own containers and warehouses, and connecting with transport hubs and warehouses in different countries, as well as with local last-mile delivery providers to build their global logistics network. For example, “fulfilment by Amazon” allows micro-, small-, and medium-sized enterprises (MSMEs) to store their products in Amazon warehouses in various locations around the world. The company will then take care of the whole order process and distribution and will manage the last-mile delivery. To handle last-mile delivery, Amazon is developing Prime Air, the drone service to deliver parcels under 2 kg, and Amazon Scout autonomous delivery vehicles/robots. There is also Amazon Flex, a platform that uses on-demand contract drivers (gig workers) for its one-day delivery program.

[24] United Nations, “Global e-commerce jumps to $26.7 trillion, fuelled by COVID-19,” 3 May 2021, https://news.un.org/en/story/2021/05/1091182.
[25] World Bank, “E-Commerce Can Boost Job Creation and Inclusive Growth in Developing Countries,” 23 November 2019, https://www.worldbank.org/en/news/press-release/2019/11/23/e-commerce-can-boost-job-creation-and-inclusive-growth-in-developing-countries.
[26] Michael Sheetz, “Watch out, UPS. Morgan Stanley estimates Amazon is already delivering half of its packages,” CNBC, 12 December 2019, https://www.cnbc.com/2019/12/12/analyst-amazon-delivering-nearly-half-its-packages-instead-of-ups-fedex.html.
[27] Gavin van Marle, “Two new moves in Alibaba’s bid to build a global logistics network,” The Load Star, 19 October 2020, https://theloadstar.com/two-new-moves-in-alibabas-bid-to-build-a-global-logistics-network/.

4.2. LOGISTICS STARTUPS

The number of **logistics startups** is growing rapidly—according to PwC, most of the new entrants to the logistics industry are startups, and many leverage digital technologies to enter the industry.[28] Many startups in the logistics industry have emerged recently offering digital solutions for improved end-to-end logistics management such as sensors and asset tagging and tracking, inventory management systems, blockchain for greater visibility and security in the supply chain, logistics analytics, fleet management, smart warehousing, enterprise resource planning, e-commerce logistics, autonomous vehicles and drones, and innovative last-mile delivery services.[29]

4.3. RIDE-HAILING STARTUPS

Ride-hailing startups such as Grab and Uber, Gojek in Indonesia, and Gokada in Nigeria that started with transporting passengers have also ventured into last-mile food and goods deliveries, particularly during the COVID-19 lockdown when food and grocery deliveries flourished.[30] Ride-hailing startups are also partnering closely with e-commerce platforms for last-mile deliveries.

In Viet Nam, for example, Be Group, a local ride-hailing company, launched beExpress and beDelivery. beExpress targets enterprise clients and is serviced by well-trained staff working full-time. beExpress has entered into a partnership with Lazada, a major e-commerce platform, to deliver the goods ordered on the platform. beDeliver, on the other hand, targets MSMEs and individuals and is serviced by existing beBike drivers.[31]

Another example is Uber that is leveraging digital technologies to compete in the logistics space. Applying its model for passenger transport, Uber developed two applications for logistics—Uber Rush and Uber Freight. Uber Rush is for last-mile delivery, similar to Amazon Flex mentioned above, that uses their network of Uber drivers to deliver parcels. Uber Freight directly connects businesses with truck drivers and shipping companies. Uber has also been investing in technologies for autonomous (driverless) deliveries.

According to McKinsey & Company, around $11.1 billion has been raised by startups offering last-mile delivery services to retailers and individuals. Most of the analyzed last-mile startups rely on unconventional delivery

[28] PwC, "Shifting Patterns: The future of the logistics industry," 2016, https://www.pwc.com/sg/en/publications/assets/future-of-the-logistics-industry.pdf.
[29] CB insights, "From Tracking Food To Last-Mile Delivery, 125+ Startups Disrupting The Supply Chain & Logistics Industry," 30 August 2018, https://www.cbinsights.com/research/digitizing-supply-chain-logistics-market-map/.
[30] Tage Kene-Okafor, "Gokada to launch ride-hailing service in two Nigerian cities as part of super app plans," TechCrunch, 1 June 2021, https://techcrunch.com/2021/06/01/gokada-to-launch-ride-hailing-service-in-two-nigerian-cities-as-part-of-super-app-plans/.
[31] Hiep Cong Pham et al., "Last Mile Delivery as a Competitive Logistics Service: A Case Study," 9th International Conference on Operations and Supply Chain Management, Vietnam, 2019, https://journal.oscm-forum.org/journal/proceeding/download_paper/20191207215658_OSCM_2019_paper_107.pdf.

modes, e.g., using crowdsourced delivery, drones, autonomous vehicles, and shipments to parcel lockers.[32] But there are also startups offering last-mile delivery services using traditional modes such as bicycles, scooters, vans and trucks, and even boats, canoes, rickshaws, and tricycles.

5. LOGISTICS USERS

Logistics is needed across all sectors and industries to transport materials and products developed for businesses and consumers, and the demand for logistics services is increasing. This calls for an integrated multisector framework that considers the logistics needs of all sectors and industries to create synergies and partnerships for mutual benefits.

During COVID-19, the key supply chains that have received the most attention include the agriculture, food, and beverage supply chain due to rising food insecurity, as well as the health and medical supply chain to transport essential medical supplies such as masks and personal protective equipment, and later, vaccines. For instance, in 2021, close to 193 million people were acutely food insecure and in need of urgent assistance across 53 countries, surpassing all previous records, according to the Global Report on Food Crises.[33] This represents an increase of nearly 40 million people compared to the previous high reached in 2020.

Building the resilience of these supply chains is critical in preparation for future crises and emergencies. United Nations agencies such as UNICEF and the UN Refugee Agency, as well as humanitarian and relief agencies such as the International Federation of Red Cross and Red Crescent Societies, are also key logistics users during crises to ensure that essential supplies reach those most vulnerable.

This section provides four case studies featuring governments, logistics incumbents, and startups, and how they have contributed and impacted the smart logistics ecosystem, from which lessons can be drawn in creating an integrated multisector smart logistics framework, which is discussed in the second paper in this series.

5.1. GOVERNMENT OF MALAYSIA

Enhancing the competitiveness of the transport and logistics industry is one of four policy priorities in the Twelfth

[32] McKinsey & Company, "Startup funding in logistics: New money for an old industry?" February 2020, https://www.mckinsey.com/industries/travel-logistics-and-transport-infrastructure/our-insights/startup-funding-in-logistics.
[33] Global Network Against Food Crises, "2022 Global Report on Food Crises," 2022, https://www.fsinplatform.org/sites/default/files/resources/files/GRFC%202022%20Final%20Report.pdf.

Malaysia Plan 2021–2025[34] to improve national productivity, facilitate economic growth and improve the well-being of its people.

According to the plan, Malaysia aims to become a transport and logistics hub in the South-East Asia region by 2025.[35] The government plans to transform the logistics industry by accelerating digital adoption to enhance efficiency, boosting the capacity of ports infrastructure and services, improving last-mile connectivity, encouraging multimodal cargo movement, upgrading the aviation system, and implementing preventive maintenance of roads and bridges.

A single-window transaction platform—Ubiquitous Customs (uCustoms)—will be fully operationalized to improve the ease of doing business by allowing logistics companies to interface with government agencies and complete customs-related paperwork on one web-based platform. In addition, a centralized database for the transport and logistics sector will be established, which comprises layered maps and statistics related to roads, rail, aviation, and maritime services, and information on greening the logistics and transport sector.

A single border agency for trade facilitation will be created, while a national regulatory framework for warehousing and the maritime economy will be formulated to ensure a resilient and competitive logistics industry and enhance international trade.

5.2. BANGLADESH LOGISTICS SERVICE STARTUP

A bottleneck of e-commerce growth, particularly in rural areas, is its poor infrastructure and lack of last-mile delivery services. Paperfly[36] is a home-grown Bangladeshi logistics service startup that leverages digital technologies to provide end-to-end logistics, warehousing, packaging, fulfillment, return management, and cash-on-delivery collection services to online businesses. It is backed by strategic investor, Ecom Express Limited, a leading end-to-end technology-enabled logistics solutions provider to the Indian e-commerce industry. Today, Paperfly employs around 2000 employees and provides nationwide delivery services through 200 points across the country.[37]

In 2020, Paperfly partnered with the e-Commerce Association of Bangladesh and the Government of Bangladesh's

[34] Government of Malaysia, "Twelfth Malaysia Plan 2021-2025: Executive Summary," 2021, https://policy.asiapacificenergy.org/sites/default/files/Twelfth%20Malaysia%20Plan%2C%202021-2025%20%28Summary%29.pdf.
[35] Malaysian Investment Development Authority, "12MP to enhance competitiveness of transport and logistics industry, governance," 27 September 2021, https://www.mida.gov.my/mida-news/12mp-to-enhance-competitiveness-of-transport-and-logistics-industry-governance/.
[36] Paperfly, https://www.paperfly.com.bd/.
[37] New Age, "Paperfly confirms another Tk102cr investment to digitise Bangladesh courier sector," 5 April 2022, https://www.newagebd.net/article/167298/paperfly-confirms-another-tk102cr-investment-to-digitise-bangladesh-courier-sector.

a2i[38] to launch the Seller One Programme to expand e-commerce to rural areas and enable rural producers to sell their products directly to customers online. Paperfly is also working closely with a2i to activate more than 4000 government digital centers as e-commerce hubs so that people living in rural areas can experience online shopping.[39]

5.3. ZIPLINE

Zipline, a U.S.-based health logistics startup, has been using drones to deliver blood, medical supplies, and vaccines in Rwanda, Ghana, Nigeria, India, and the Philippines.

Zipline started operations in Rwanda in 2016 after signing a contract with the government to deliver blood supplies from distribution centers to district hospitals and rural health centers. In Rwanda, over 80% of its population lives in rural areas where poor road infrastructure makes cold-chain delivery of medical supplies unreliable. According to the Ministry of Health, between 25% and 40% of all temperature-sensitive medical supplies sent from urban centers to rural health clinics are wasted because of the unreliable cold chain.[40] Rural clinics are often subject to stockouts, and patients in need of specialized blood, drugs, and other supplies are unable to acquire these supplies.

An independent evaluation of Zipline's operations analyzed 13 000 drone orders between 2017 and 2019 and found that half of the orders took 41 min or less to deliver by drone. On the road, that median time would be at least 2 h.[41] Also, reports of wasted blood donations dropped 67%.[42]

Zipline's success has depended on partnerships with key players in the regulation and medical procurement space in Rwanda.[43] The National Centre for Blood Transfusion (NCBT) is the key contributor to Zipline's blood supply and medical products. Zipline acquired land for its distribution centers as well as government assistance with the required technology to operate the distribution centers. The Rwandan government pays Zipline a fixed price per delivery, with a minimum volume guarantee. However, the specifics of this arrangement have not been disclosed. The Ministry of Health was closely involved with the negotiations and the development of the contract

[38] a2i is a flagship programme of the Digital Bangladesh agenda. See https://a2i.gov.bd/.
[39] BBF Digital, "Paperfly Launches 'Seller One service' partnership with e-CAB, a2i and ICT Division," 7 September 2020, https://bbf.digital/paperfly-launches-seller-one-service-partnership-with-e-cab-a2i-and-ict-division.
[40] Modestus Amaechi et al., "From A to O-Positive: Blood Delivery Via Drones in Rwanda," Reach Alliance, April 2021, https://reachalliance.org/wp-content/uploads/2021/03/Zipline-Rwanda-Final-April19.pdf.
[41] Max G. Levy, "Drones have Transformed Blood Delivery in Rwanda," Wired, 21 April 2022, https://www.wired.com/story/drones-have-transformed-blood-delivery-in-rwanda/#:~:text=In%202016%2C%20Rwanda's%20government%20signed,to%20the%20health%20care%20facility.
[42] Zipline, "Measuring our impact: A multi-year evaluation of our role in health access and equity," 30 March 2022, https://blog.flyzipline.com/measuring-our-impact-a-multi-year-evaluation-of-our-role-in-health-access-and-equity-dea06842d1d4.
[43] Modestus Amaechi et al., "From A to O-Positive: Blood Delivery Via Drones in Rwanda," Reach Alliance, April 2021, https://reachalliance.org/wp-content/uploads/2021/03/Zipline-Rwanda-Final-April19.pdf.

between Zipline and the Government of Rwanda.

Another major stakeholder is the Rwandan Civil Aviation Authority (RCAA). The flexibility of RCAA in updating its regulation to address the presence of drones in aerial space contributed to Zipline's success in Rwanda. Before medical products are launched, Zipline performs a preflight quality assurance on the drone, confirms its flight plan with RCAA, and requests flight clearance. Once the drone is catapulted, it is fully autonomous. Both Zipline and RCAA track the drone's path and can redirect it through the country's wireless network. This collaboration helps establish transparency and shares risk across actors in assuring the safety of everyday operations.

5.4. DHL

According to DHL, the last mile accounts for 53% of shipping costs and has developed a number of strategies to improve last-mile delivery, particularly for the e-commerce supply chain in urban areas. DHL focuses on localizing delivery networks and adopting digital technologies, such as crowdsourcing services and apps that connect with local delivery drivers, as well as developing autonomous vehicles, drones, and delivery robots to deliver parcels.[44] DHL is also exploring local pick-up points and storage lockers as alternative delivery options for customers and is using digital technologies to optimize delivery routes in light of traffic and weather conditions.

Globally, the DHL Group, in line with its Strategy 2025, is investing over $2 billion on digital transformation projects from 2021 to 2025.[45] To enhance overall efficiency in its operations, DHL utilizes big data and predictive analytics to monitor shipment movements, flag issues in real time, and identify alternative flight or network routes to ensure timely deliveries. DHL is also investing in smart warehouses and robots for loading, unloading, sorting, and packing parcels. In parallel, DHL is investing in the reskilling and upskilling of their employees, including building their digital literacy and skills.[46]

DHL aims to achieve zero logistics-related carbon emissions by 2050, with an interim target of operating 70% of first- and last-mile delivery services with clean transport modes by 2025, DHL has replaced about 60% of inner-city vehicle routes in some European countries with cargo bicycles and is using them in over 80 cities in 13

[44] DHL, "5 Ways to Shorten Last Mile Delivery," 22 February 2019, https://www.dhl.com/discover/en-global/business/getting-to-market/last-mile-delivery-2.
[45] DHL, "How Digitalization has Transformed DHL Express' Operations," 15 June 2021, https://www.dhl.com/discover/en-global/business/market-intelligence/digitalization-has-transformed-operations.
[46] DHL, "We, Robot: How humans and AI are working together in logistics," https://www.dhl.com/global-en/delivered/digitalization/ai-in-logistics.html.

countries globally.[47] DHL has been designing cargo bicycles over the years, starting with the Paracycle in 2015,[48] Cubicycle in 2015,[49] and the Chariot in 2021,[50] but these are mostly designed and used in cities rather than in more rugged rural conditions.

6. TEMPLATE FOR HOLISTIC MULTISECTOR COLLABORATIONS FOR SMART LOGISTICS

The logistics sector can play an essential role in the recovery from the COVID-19 pandemic, in building resilience against future shocks, and in promoting socioeconomic growth. Continued and uninterrupted land, waterborne, and air freight services are crucial to ensuring that vital medical and food supplies, agricultural products, and other goods and services reach their intended destinations in time.

The digitalization of the logistics supply chain is instrumental in strengthening its resilience and sustainability. The digitalization of the logistics industry can catalyze the integration of fragmented supply chains through the development of platforms, such as Malaysia's uCustoms platform for collecting, organizing, and managing customs-related data for all supply chains. Other benefits of digitalization include improved operational efficiency and resilience, reduced cost, end-to-end visibility and transparency, and enhanced environmental sustainability and safety.

While the technology forms the backbone of a smart logistics ecosystem, digitalization is a lengthy, multistage process that requires more than a technology push. A resilient and sustainable smart logistics ecosystem must embrace a holistic, multisector, and multistakeholder approach that engages all relevant players. To summarize, they include:

1. Governmental and intergovernmental institutions.
2. Logistics infrastructure and equipment providers.
3. Logistics service providers.
4. Resources for the logistics industry:
    - Human resources: Training institutions and universities.

[47] DHL, "First Cubicycle to Electrify DHL Express Green Fleet in Taiwan," 3 July 2019, https://www.dhl.com/tw-en/home/press/press-archive/2019/first-cubicycle-to-electrify-dhl-express-green-fleet-in-taiwan.html.
[48] Transglobal Express, "DHL Express introduce parcel delivery by bicycle throughout Europe," 3 September 2014, https://www.transglobalexpress.co.uk/news/574/.
[49] DHL, "DHL introduces Cubicycle, an innovative cargo bike for urban distribution, to its Netherlands operations," 29 April 2015, https://www.dpdhl.com/en/media-relations/press-releases/2015/dhl-introduces-innovative-cargo-bike-cubicycle-netherlands.html.
[50] City Logistics, "DHL Netherlands presents their new cargo bike: the Chariot," 4 March 2021, http://www.citylogistics.info/business/dhl-netherlands-presents-their-new-cargo-bike-the-chariot/.

- Financial resources: Banks, financial institutions, and fintech companies.
- Startup ecosystem: Venture capital firms, accelerators, and incubators.
- Risk mitigation: Insurance companies.
- Digital solutions: Tech providers.
- Industry standards: Standards organizations, industry alliances, and associations.

5. New players driven by digital transformation:
    - e-Commerce giants.
    - Logistics startups.
    - Ride-hailing startups.
6. Logistics users from the public and private sector, civil society, and humanitarian organizations in multiple sectors (e.g., agriculture, food, health, etc.).

A high-level political commitment among governmental and intergovernmental institutions (the first category of logistics players) serves as the starting point to drive the change management process to digitalize and transform the logistics sector. This will require the development of a coherent, integrated logistics strategy that brings together public, private, and civil society players to collaboratively improve the logistics ecosystem. Multistakeholder partnerships have been essential to Paperfly and Zipline's success.

The second and third categories form the core of the logistics industry that supply infrastructure, equipment, and services for all or part of the supply chain.

The fourth category of players is critical in ensuring the resilience and sustainability of the logistics supply chain, particularly the human resources aspect. According to the World Bank, there is a serious shortage of human resources in logistics supply chain that needs to be urgently addressed.[51] Governmental and intergovernmental institutions have traditionally paid more attention to infrastructure and trade facilitation than to fostering the development of quality services and a skilled workforce. The case study from DHL demonstrates that digital transformation must go hand in hand with the reskilling and upskilling of employees, as well as ensuring their security, safety, and well-being. In Africa, countries are preparing to leverage the opportunities of the African Continental Free Trade Area. However, this involves major reform efforts, including digital transformation and integration of cross-border logistics and supply chain management systems to enable efficient and effective intracontinental trading of goods and services. In parallel, this requires equipping Africa's workforce, particularly youth, with the relevant skills and knowledge to harness

[51] Alan McKinnon et al., *Logistics Competencies, Skills, and Training: A Global Overview* (Washington, D.C.: World Bank, 2017), https://openknowledge.worldbank.org/handle/10986/27723.

smart technologies to boost Africa's global market position.[52]

The new logistics players (fifth category) that range from the e-commerce giants to much smaller startup companies are major contributors to the digitalization of the logistics supply chain. In the context of accelerating digitalization in logistics, governments should consider providing support for the development of digital accelerators, incubators, and early-stage funding programs. A new wave of accelerators and incubators in emerging and developing countries needs to be fostered to enable technology startups, supported by academic research, skills development and retraining, and outreach to attract talents and a new generation of digital logistics personnel in both the public and private sectors.

While digitalization is transformative and can offer tremendous opportunities, and while the pandemic has accelerated the digitalization of markets, there is a need to address the persistent digital divides such as access to affordable connectivity, trade and logistics, and digital payments options, and create an inclusive entrepreneurship and startup culture to ensure that digitalization leaves no one behind.

As illustrated in this paper, industries and sectors are increasingly interconnected. Logistics is needed across all sectors and industries to transport materials and products developed for businesses and consumers, and the demand for logistics services is increasing. The COVID-19 pandemic has spurred the growth of e-commerce, but e-commerce is highly dependent on a robust and resilient logistics infrastructure and system to deliver the goods ordered. At the same time, investment in the logistics industry, especially in rural and remote areas can boost e-commerce, as illustrated in the Bangladesh case study. The pandemic has shown that logistics users (the sixth category of players) must also be engaged to better prepare for future, large-scale disruptions.

An integrated multisector smart logistics framework will be critical for the sustainable growth of the logistics industry, and in turn for commerce and trade, and for the well-being of people and the planet.

[52] World Bank, "The African Continental Free Trade Area," 27 July 2020, https://www.worldbank.org/en/topic/trade/publication/the-african-continentalfree-trade-area.

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