

Description of the new data sources for the LPI 2023

This appendix introduces the data sources on shipment tracking data. To construct new sets of indicators for the 2023 Logistics Performance Index (LPI), the World Bank collaborated with several external data providers. The data comprise the following micro-logistics high-frequency datasets: deployment of liner shipping service from MDS Transmodal, air cargo tracking from Cargo iQ (supported by the International Air Transport Association), flow of international letters and parcels from the Universal Postal Union (UPU), granular high-frequency information on consignment activities (container data) from TradeLens, and worldwide container ship port calls from an Automatic Identification System (AIS) data provider (MarineTraffic). For the first time, LPI data were not collected entirely in-house. This appendix covers the origin of the data, the country coverage, and the variables used for the processing of the key performance indicators.

MDS Transmodal

MDS Transmodal is an independent consultancy focusing on the international freight transport sector, including shipping, ports, road, rail, logistics, and distribution. It collects and aggregates several types of transport-related data and maintains databases related to freight transportation. A dataset of aggregates for country pairs and countries for January–June 2022 was derived from MDS Transmodal's Containership Databank, which covers shipping schedules and volumes offered on liner shipping routes.

Indicators available as part of the partnership agreement with MDS Transmodal include

the number of services, number of operators, number of alliances, and average annual frequency of shipping service, as well as statistics (average, maximum, minimum) on the number of deployed ships, ship sizes, and ship ages. Under MDS Transmodal's definition, two economies (or ports) are connected if there is a shipping service between them. As shipping services operate in loops, not point to point like aviation, connections are counted irrespective of the actual port sequence.

Cargo iQ

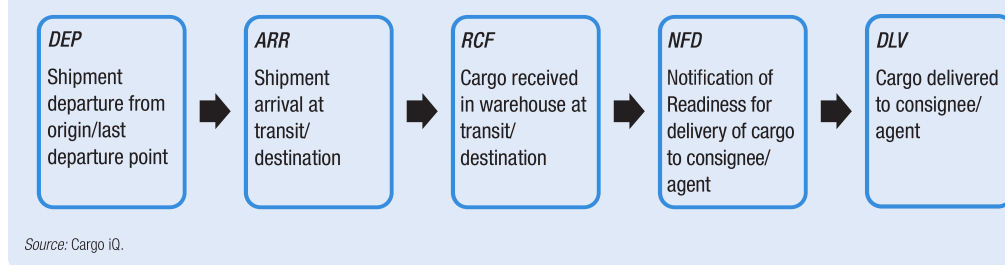
The air cargo dataset was provided by Cargo iQ, a nonprofit interest group created in 1997 by the International Air Transport Association to develop a system of shipment planning and performance monitoring for air cargo based on definitions of common business processes and milestones.¹ Cargo iQ is a pioneer in digitalization efforts in the air cargo industry, focusing on transparency, visibility, and quality improvement.

Cargo iQ brings together more than 60 participants, including forwarders, air carriers, ground handling companies, road carriers, and airports, to define the standards for shared processes and planning to control and evaluate performance of cargo shipments. Cargo iQ collects more than 110 million data lines a year, 12 million of which are airport-to-airport shipments. These records, covering information for about 650 airports in 184 countries and accounting for 45 percent of global air freight volume, were used to construct the aviation pillar of the 2023 LPI.

Cargo iQ's event recording follows a similar Electronic Data Interchange (EDI) protocol as the UPU, with a similar logical ordering of

1. See <https://www.cargoIQ.org/value-proposition>.

Figure A4.1 Cargo iQ milestones



supply chain events. A shipment, commonly identified through an electronic airway bill is tracked through the system from the point of departure of the flight with cargo (DEP in figure A4.1) through its arrival (ARR) and check-in to a warehouse at a destination airport (RCF), followed by the advisory to the consignee of the freight's arrival (NFD), and the consignee's final collection of the freight from the carrier at the destination airport (DLV).

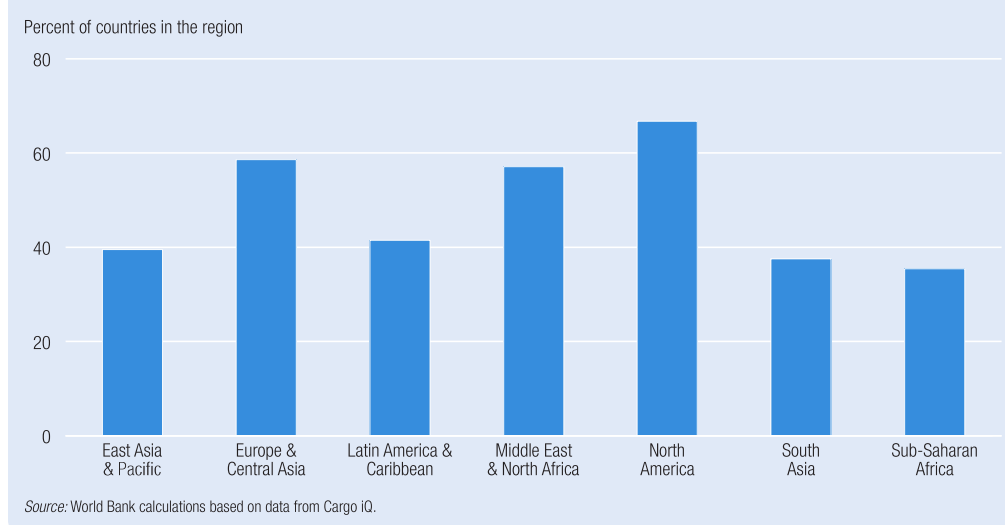
For all five milestones, it is the carriers' responsibility to enter the data in the system in a timely, consistent, and accurate manner. The time differences between the milestones provide information on the various aspects of the reliability and performance of individual carriers, freighters, and operators and (at the aggregate level) of airports and countries.

To avoid revealing commercially sensitive information for specific carriers, trade lanes

with certain characteristics are excluded from the dataset. They are bilateral lanes representing more than 80 percent of total shipments to target countries with three or fewer carriers; these excluded 46 countries from the final set of key performance indicators, resulting in 141 countries in the 2023 LPI aviation pillar.

The data from Cargo iQ's system are based on a pair of milestones: advisory to the consignee of the freight's arrival to the consignee's final collection of the freight from the carrier at the destination airport. In other words, the time elapsed between the two events was computed for each electronic airway bill recorded in the system at a destination country given the validity of the time difference (meaning that both timestamps exist and the time difference between them is positive). The choice of this indicator was based on two considerations: best apparent quality of data and country coverage

Figure A4.2 Country coverage of Cargo iQ dataset, by World Bank region



and interpretability. This indicator represents how fast air cargo shipments move at the destination, which is the equivalent of import dwell time. Future editions of *Connecting to Compete* may consider additional delay indicators.

Low-income countries have the lowest coverage: data are available for 25 percent of these countries. The East Asia and Pacific, South Asia, and Sub-Saharan Africa regions all have about 35–40 percent coverage (figure A4.2). Geographical coverage is lower for Cargo iQ than for the UPU.

Universal Postal Union

Most cross-border e-commerce depends on postal parcel services provided by UPU members or global express operators (for example, DHL, FedEx, and UPS). UPU members handle two-thirds of letter-parcel deliveries (up to 2 kilograms) across borders.² Therefore, information collected by UPU is a source of comprehensive data for more than 190 member countries and probably the best unified source of information on e-commerce trade.

UPU maintains technical standards and EDI message specifications used in the exchange of electronic information between postal services. To exchange information between members' postal services, UPU maintains EDI databases with records on volumes, frequencies, key cross-border activities, and other tracking data of postal items. This information is available via the Express Mail Service Events messaging standard, which is used to track parcels (packages up to 30 kilograms), letters (letter-post items and packages up to 2 kilograms), and express mail flows in the UPU network (table A4.1).

For an e-commerce item, after a consumer places an order, the shipper hands the item over to the origin post (event A in table A4.1). The post inducts the item into its domestic network, where it passes through several handling, sorting, and transport processes (event B). At the origin Office of Exchange, the item is assigned to a receptacle for international dispatch to the

Table A4.1 The postal sequence of tracking messages

Message ID	Event description
<i>Exporting events</i>	
A	Posting/collection
B	Arrival at outwards office of exchange
C	Departure from outward office of exchange
<i>Importing events</i>	
D	Arrival at inward office of exchange
E	Held by import customs
F	Departure from inward office of exchange
G	Arrival at delivery office
H	Attempted/unsuccessful delivery
I	Final delivery
J	Arrival at transit office of exchange
K	Departure from transit office of exchange

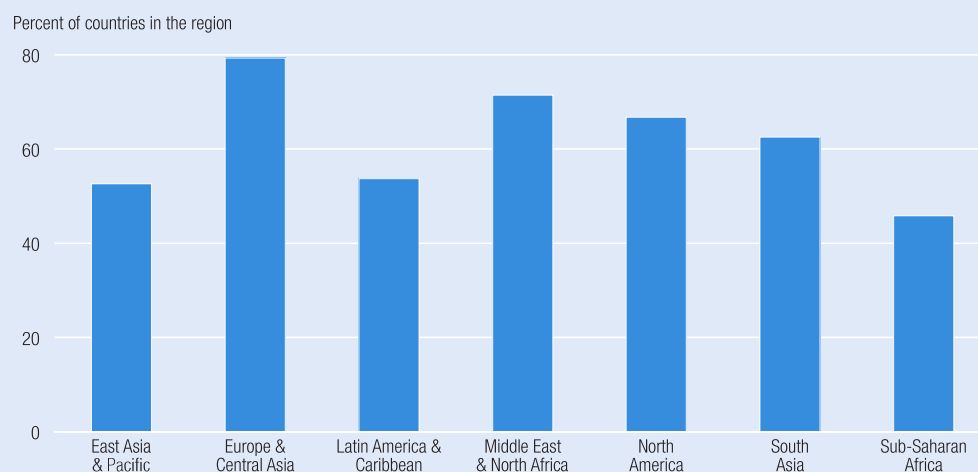
Source: Universal Postal Union.

destination Office of Exchange, in which it departs from the country-of-origin (event C). After a few potential transiting events (events J–K), the item arrives at the destination (event D), where it is unloaded and handed over to the destination post. Event E describes the process of separating different items from the bundle (receptacle) that they were shipped in, retrieving the items, and clearing them through customs. Finally, the destination Office of Exchange inducts it into their domestic network for processing and potential relocation to the delivery office, from which a final delivery to the customer happens (event I). Unsuccessful deliveries are recorded using event H. The focus of the LPI has been on the performance at the destination, making the delay between events D and H/I the primary key performance indicator assessing postal logistics, covering the quality of postal infrastructure and speed of delivery.³ The delivery events have also been found to have the most consistency and country coverage.

The dataset was constructed for the entire calendar year of 2019. The sample comprised countries with more than 100 inbound unique parcel shipments; this included 132 countries from all World Bank regions and income groups. After data cleaning, 40 percent of

2. Beretzky and others 2022.

3. Boffa 2015.

Figure A4.3 Country coverage of the Universal Postal Union dataset, by World Bank region

Source: Universal Postal Union.

low-income countries were represented in the postal dataset, 50 percent of Sub-Saharan African countries were represented, and Europe and Central Asia had a representation of 79 percent (figure A4.3).

TradeLens

TradeLens was a highly secure data and document sharing platform aimed at simplifying and speeding trade workflows for all participants of the supply chain ecosystem. A collaboration between IBM and GTD Solution (a division of shipping conglomerate Maersk), the platform operated between 2018 and the first quarter of 2023. TradeLens used IBM Blockchain Platform, a permissioned blockchain system that offers immutability, privacy, and traceability of shipping documents. TradeLens brought together more than 1,000 major entities involved in the global supply chain, including more than 200 ports and terminals and more than 15 customs authorities, and by mid-2022, it was facilitating the information exchange of about 60 percent of containerized trade.⁴ Its interoperability was supported through the adaptation of a data model and access control schema that were aligned with the Supply Chain Reference Data Model of the United

Nations Centre for Trade Facilitation and Electronic Business (figure A4.4).

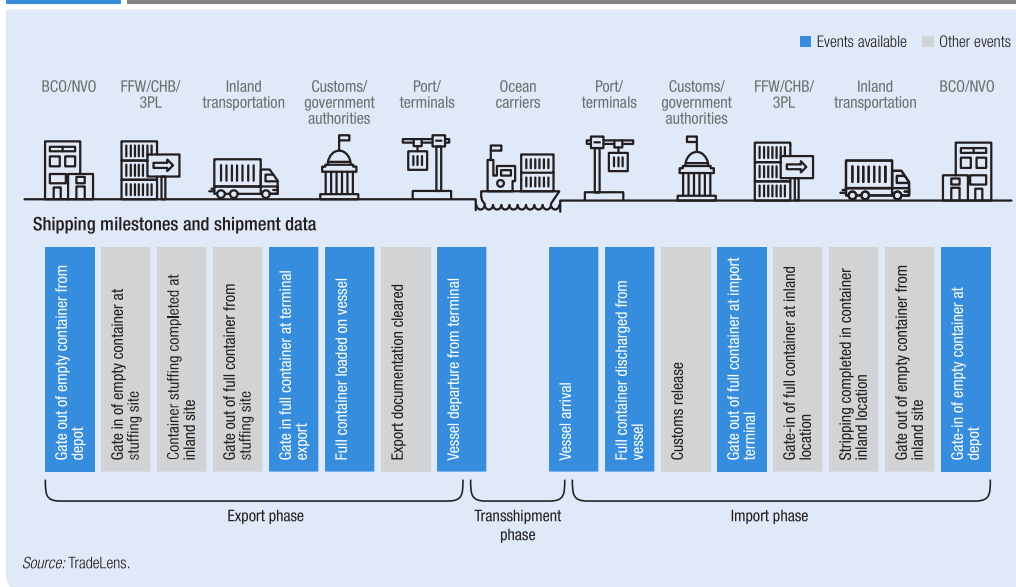
TradeLens used a simple, logical data model with three related classes: consignments, transport equipment, and shipments. The main purpose of this model was to track consignments, transport equipment (containers), and shipments while managing the identifiers and relationships between them. The platform allowed a consignment to be in multiple pieces of transport equipment, along with other consignments. It also allowed transport equipment to be part of multiple consignments.

The dataset extracted by TradeLens for the World Bank covers May 1–October 31, 2022. The sample contained timestamps for 11 events for four transport modes (ocean, road, barge, and rail) and two load statuses (full or empty), associated with more than 3 million unique tracked consignments and more than 30 million observations in total. The dataset covers more than 11,000 distinct United Nations Code for Trade and Transport Locations (UNLOCODE), including destinations, origins, and live locations (locations of specific event timestamps). On average, about 9.8 events are associated with each consignment.

To create the key performance indicators, the World Bank team focused on time

4. See <https://www.tradelens.com/network>.

Figure A4.4 TradeLens data model

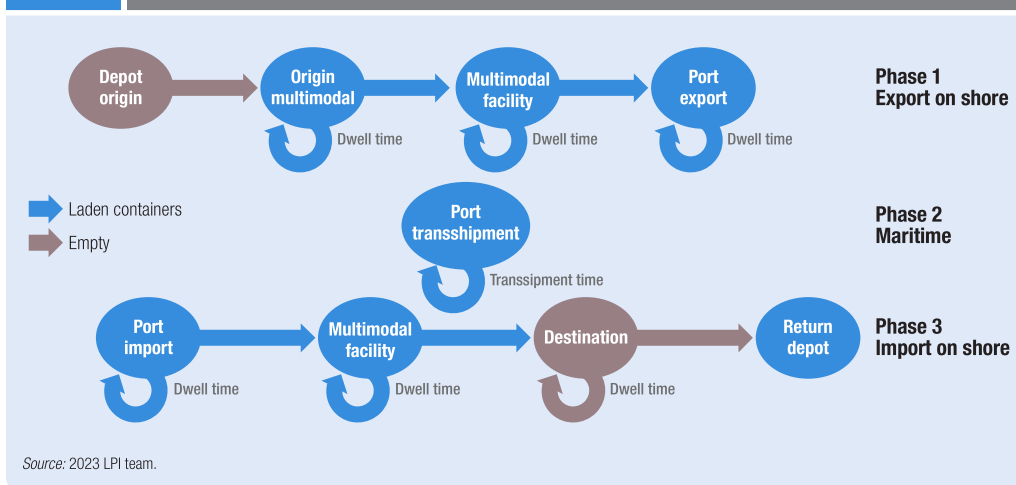


differences or lead time between subsequent events. Events can happen between different locations—for instance, on multimodal corridors or in shipping. Subsequent events may also occur at the same location, and the time that containers stay at the same place is typically referred to as dwell time. Data processing consisted of splitting container trips into a succession of transitions between subsequent events at the same or different locations. Key performance indicators were constructed by aggregating the lead time or dwell time for UNLOCODE or lead time between pairs of UNLOCODE. To facilitate interpretation, the global container supply chain is

broken into three phases: export on shore, shipping and transshipment, and import onshore (figure A4.5).

The tracking data cover the responsibility of international logistics operators, not that of shippers upstream or consignees downstream. Supply chain practices by the latter may vary. But container data include information on the movement of empty containers, which proxies the time taken to stuff export containers or deliver full import containers at the destination. Information on repositioning and return of empty containers may lead to more meaningful indicators in the future.

Figure A4.5 The three phases of container trips

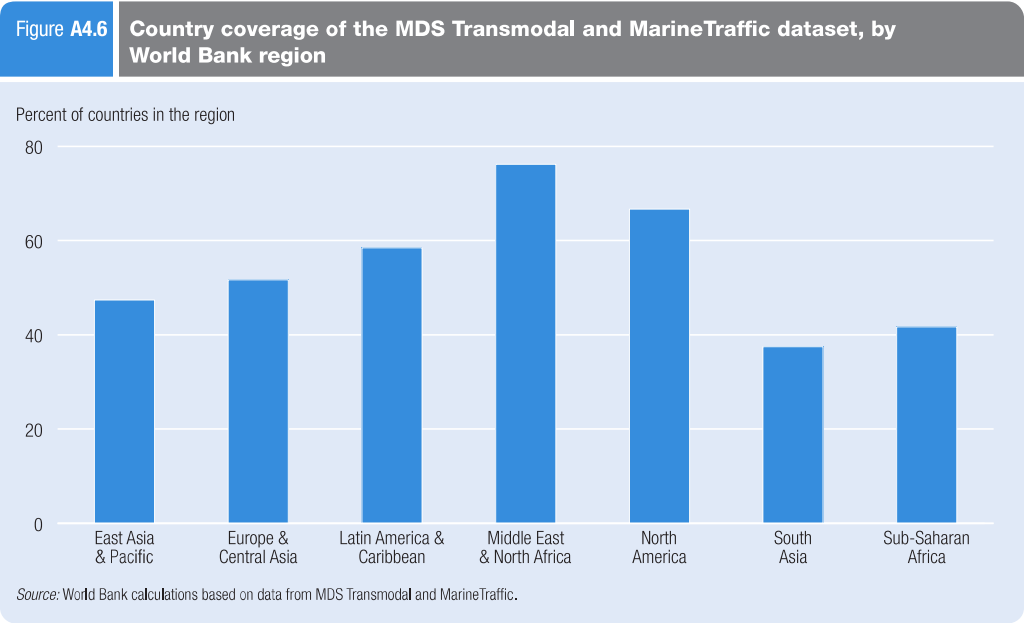


MarineTraffic

The port call dataset from MarineTraffic is a collection of records, processed from Automatic Identification System messages and enriched with proprietary information on ports and ship datasets sourced from the International Maritime Organization registry. Ship types ranging from small feeders with capacity up to 1,000 twenty-foot equivalent units to ultra large container vessels with capacity starting at 14,501 twenty-foot equivalent units. The information available includes timestamps of port arrivals and departures reported through Automatic Identification System signals via terrestrial and satellite receivers.

The dataset was prepared using MarineTraffic data on port calls that covered more than 5,000 container ships calling at more than 800 ports worldwide during the first two quarters of 2022. Based on estimated time differences between recorded arrivals and departures to port facilities, an indicator of turnaround time per port was constructed.

The data from MDS Transmodal and MarineTraffic cover 52 percent of World Bank members (figure A4.6). The United Nations Conference on Trade and Development uses the same sources when producing the Liner Container Shipping Connectivity Index and its own indicator of turnaround time.⁵



5. UNCTAD 2021b.

Table A4.2 List of key performance indicators derived from tracking data

Source	Indicator	Definition	Period	Why it matters
MDS Transmodal	Number of services	Total number of maritime services (operated through liner shipping companies on a predefined rotation) between the two countries.	Second quarter of 2022	Availability of services and frequency of connection.
	Number of alliances	Count of the number of alliances per destination country.	Second quarter of 2022	Competition between services.
	Number of partners (countries)	Count of distinct number of country partners per destination country.	Second quarter of 2022	Shipping connectivity metric.
Cargo iQ	Number of partners (countries)	Average number of partner countries	First and second quarters of 2022	Air cargo connectivity metric.
	Aviation dwell time (days)	Time difference between notification of readiness for delivery of cargo and cargo delivered to consignee at destination country. Median and quartiles are provided.	First and second quarters of 2022	Efficiency of handling and clearance and notification to consignee.
Universal Postal Union	Number of partners (countries)	Average number of country partners.	2019	Postal connectivity.
	Postal delivery time (days)	Median time difference between arrival at inward office of exchange and unsuccessful delivery or final delivery to recipient at the destination country. Median and quartiles are provided.	2019	Efficiency of clearance and postal logistics at destination.
TradeLens	Import and export dwell time (days)	Time spent at the same location (as defined by United Nations Code for Trade and Transport Locations) since expedition and before ship loading. Two variables are produced for each country: dwell time at port of departure and consolidated dwell time (including time spent at intermediate locations). Mean, median, and quartiles are provided. The statistics are based on all container trips originating in the country, irrespective of the export and import corridor.	May 1 to October 31, 2022	Critical indicator resulting from many factors, including goods clearance, removal, and land services and to some extent terminal and multimodal performance. Export dwell time is representative of domestic logistics.
	Corridors import lead time (days)	Estimation of mean time to import for corridors serving landlocked countries based on lead time between destination and port of import.	May 1 to October 31, 2022	Representative of road or rail corridor performance excluding multimodal transfer en route which are included in dwell time.
	Export container lead time (days)	Sum of consolidated dwell time and corridor time for export and stuffing time.	May 1 to October 31, 2022	Same concept for exports.
MarineTraffic	Turnaround time (days)	Time difference between first instance of arrival and last instance of departure for consecutive repeated port visits (if any) calculated for each port call (as defined by United Nations Code for Trade and Transport Locations). Aggregated directly from port call time differences to countries over six months. This indicator excludes waiting time at anchorage.	First and second quarters of 2022	Proxy of the performance of the ship to shore interface (including handling by the terminal operator).

Source: World Bank.