



**WORKING PAPER**

**ELEVENTH SESSION OF THE STATISTICS DIVISION**

**Virtual, 4 to 8 April 2022**

**Agenda Item 3: Long-term air traffic forecasts**

**ICAO LONG-TERM TRAFFIC FORECASTS AND POST-COVID-19 SCENARIOS**

(Presented by the Secretariat)

**EXECUTIVE SUMMARY**

This working paper reports on activities in the area of forecasts and planning in accordance with Assembly Resolution A40-9, which requested the Council to update the single set of long-term traffic forecasts (LTF) from which customized and/or more detailed forecasts can be produced. The LTF has been updated with 2018 baseline and the post-COVID-19 forecast scenarios were developed through the Multi-Disciplinary Working Group on Long-term Traffic Forecasts (MDWG-LTF). At the occasion of its Third Meeting in June 2021, the Aviation Data and Analysis Panel (ADAP) approved the updated forecasts and the post-COVID-19 forecasts scenarios developed by the MDWG-LTF. This working paper further discusses the need for and the methodology to increase the update frequency of the forecasts by integrating data reported under the ICAO Statistics Programme with big data sources such as the Automatic Dependent Surveillance — Broadcast (ADS-B) and Market Intelligence Data Transfer (MIDT).

Action by the Division is indicated in paragraph 4.

<i>References:</i>	Doc 10140, <i>Assembly Resolutions in Force (as of October 2019)</i> A40-WP/19-EC/4, ICAO Statistics Programme and Big Data Analytics A40-WP/20-EC/5, Report on the Updated Long-term Traffic Forecasts <i>Report of the Third Meeting of the Aviation Data and Analysis Panel (ADAP/3, Yellow Cover)</i>
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**1. INTRODUCTION**

1.1 Since the development of the first ICAO single set of long-term traffic forecasts (LTF) in 2016, the Secretariat has been regularly updating the forecasts in accordance with the Assembly Resolution A40-9, through working with the Multi-Disciplinary Working Group on Long-term Traffic Forecasts (MDWG-LTF) under the Aviation Data and Analysis Panel (ADAP).

1.2 The LTF presented to the 40th Session of the Assembly had used year 2015 as a baseline (A40-WP/20-EC/5 refers). As a follow up to A40-9, and in response to the request of the Committee on

Aviation Environmental Protection (CAEP), it was updated in early 2020, using year 2018 as a baseline and extending the forecast period to 2050 (hereinafter referred to as pre-COVID-19 LTF). Because of the significant impact of the COVID-19 pandemic, further update was made in early 2021 to account for both the estimated traffic decline and recovery paths during the pandemic years as well as their impact on long-term projection (hereinafter referred to as post-COVID-19 LTF). The updated forecasts were approved by the Third Meeting of the ADAP held in June 2021.

## 2. UPDATE OF THE LONG-TERM TRAFFIC FORECASTS WITH POST-COVID-19 SCENARIOS

2.1 Detailed specification of the pre-COVID-19 LTF models for passenger and freight is provided in Appendix A. Using the estimated coefficients in the forecast models and economic outlook data provided by the International Transport Forum at the Organisation for Economic Co-operation and Development (ITF-OECD), annual revenue passenger kilometres (RPKs) value for each route group and annual freight tonne kilometres (FTKs) value for each region were calculated from 2019 to 2050.

2.2 According to this pre-COVID-19 estimation, for the 32-year projection, global passenger traffic and global freight traffic were expected to grow at 4.2 per cent and 3.5 per cent annually from 2018 to 2050, respectively.

2.3 Due to the impact of the COVID-19 pandemic, it is now certain that these traffic forecasts developed prior to the crisis will no longer be used as a reference. Given the high uncertainties revolving around the recovery, the Secretariat, working with the MDWG-LTF and members from CAEP, has produced post-COVID-19 scenario forecasts by route group from 2018 to 2050. Three scenarios, i.e. mid, high and low, were structured as indicated in Appendix B.

2.4 Updating the passenger LTF to account for both the short-term impacts of the COVID-19 pandemic and eventual long-term recovery requires a combination of updated macroeconomic data and estimates of the demand shock (measured in changes to RPKs) to the aviation industry. The following steps were taken to combine the updated information to produce post-COVID-19 scenario forecasts:

- 1) **Incorporating updated macroeconomic data.** Country-level economic data forecasts pre- and post-COVID-19 pandemic were sourced from IHS Markit to measure the COVID-19 pandemic-related changes in real gross domestic product (GDP) and population<sup>1</sup>. These values were aggregated to the route group level and the difference in the growth rates between the pre- and post-COVID-19 pandemic outlooks was calculated for each year up to 2050. This percentage change was applied to the pre-COVID-19 ITF-OECD economic data by forecast scenario, i.e. mid, high and low economic outlooks. The passenger LTF was then re-processed using the updated economic inputs while holding constant the model coefficient values.
- 2) **COVID-19 RPK adjustment factors.** In quantifying the near-term impact of the COVID-19 downturn on air traffic and potential recovery paths, region based RPK forecasts were aligned to match the International Air Transport Association (IATA) assumptions that traffic will return to 2019 levels in 2024 (mid case). The passenger LTF is re-processed using the updated economic inputs, and these adjustment factors

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<sup>1</sup> The pre-COVID-19 LTF (2018 baseline) was estimated using economic data sourced from ITF-OECD, however, updated ITF-OECD macroeconomic data was unavailable for the post-COVID-19 forecasts.

are applied as a post-estimation process to guide the scenario RPK forecasts (mid/high/low) during the COVID-19 pandemic impact period. Depending on the scenario, the forecasted growth rates determined by the updated economic data are allowed to resume after the defined COVID-19 pandemic impact period.

2.5 The freight LTF was re-estimated in a similar manner to the passenger forecasts by using the ICAO LTF models from the 2018 baseline with updated economic forecasts, the extent of the 2020 downturn, and near-term recovery guided by input from the MDWG-LTF and information from IATA.

2.6 Results of passenger scenario forecasts are presented in Appendix C. The first table provides a comparison of the Compound Annual Growth Rates (CAGRs) between the pre-COVID-19 pandemic passenger LTF with 2018 baseline and the three post-COVID-19 scenarios. The second table presents the comparison of 32-year CAGRs by route group for the three scenarios. The global 32-year mid CAGR is at 3.6 per cent, compared with 4.2 per cent for the pre-COVID-19 LTF. This reduction is expected to translate into a loss of ~40 trillion USD to global economies and a ~100 trillion reduction in seat capacity (measured in Available Seat-Kilometres) over the 2020-2050 period.

2.7 Results of freighter scenario forecasts are presented in Appendix D. The first table provides a comparison of CAGRs between the freight LTF with 2018 baseline and the three COVID-19 scenarios. The second table presents 32-year CAGRs comparison by region for the three scenarios. The global 32-year mid CAGR is at 3.5 per cent, similar to the pre-COVID-19 LTF.

### 3. MODERNIZATION OF THE FORECASTING WORK

3.1 The updated traffic forecasts are critical to effectively deliver the results of all ICAO's Strategic Objectives, including but not limited to: estimation of future trends of noise, emissions and particulate matter; conduct of business case, cost-benefit analysis, economic impact analysis and cost-effectiveness analysis in developing aviation infrastructure programmes and plans, as well as the Aviation System Block Upgrades (ASBUs); and establishment of evaluation and monitoring frameworks in alignment with the Global Aviation Safety Plan (GASP), the Global Air Navigation Plan (GANP), the Global Aviation Security Plan (GASeP) and adequate oversight system.

3.2 Given the ever-changing market conditions and high traffic volatility during the recovery phase, it is imperative that Member States and aviation stakeholders can access more regularly updated forecasts to meet their post-pandemic planning and implementation needs. The more frequent update to the LTF will enable Member States and stakeholders to better align capacity with expected demand, thus reducing the risk associated with the uncertainties. It is also essential to narrow the gap of the base year to generate the future forecasts, for example, the year 2020 could be used as a baseline to generate a new set of forecast in 2022.

3.3 To meet all these needs, ICAO will update the traffic forecasts, utilizing official reported traffic data in its Statistics Programme, as well as from big data sources, i.e. Automatic Dependent Surveillance — Broadcast (ADS-B) and Market Intelligence Data Transfer (MIDT) (STA/11-WP/3 refers). These data will be used in conjunction with macro-economic data (such as GDP, oil price and population) obtained from external sources. The integration of these different data repositories with the econometric models of the LTF will form the basis of the quarterly updates to the forecast which in turn will result in significantly reducing the lag between the current year and the start year of the forecasts.

3.4 The planned first update to the traffic forecasts is June 2022, where the baseline will be moved from year 2018 to 2021. The data sourced from non-official sources (MIDT and ADS-B) will be

continuously replaced with reported data from States and the traffic forecasts updated on a quarterly basis. In June of each year, the baseline will be advanced by one year and the cycle of replacing non-official data with reported data along with the quarterly updates to the traffic forecasts will be repeated. The process of integration different data sources, replacement with official data and quarterly updates is illustrated in Appendix E.

3.5 The updated forecasts along with all operational and traffic parameters i.e. flights, seats, passengers and freight tonnes carried at a granular level, ranging from airports, cities, countries to route-groups will be made available to Member States through the ICAO Civil Aviation Data Solutions (iCADS) platform at: <https://data.icao.int/icads>.

#### 4. ACTION BY THE DIVISION

4.1 The Division is invited to:

- a) note the work of ADAP in the development of LTF;
- b) support more frequent updates of LTF and reducing the lag between baseline and current year through the integration of official reported data and big data sources; and
- c) encourage Member States to access the continuously updated traffic forecasts through the iCADS platform to meet their post pandemic planning and implementation needs.

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## APPENDIX A

### DATA AND MODEL SPECIFICATION FOR LTF

#### Passenger Forecasts

Demand for passenger air travel is measured by Revenue Passenger-Kilometres (RPKs). The historical time-series data set of RPKs by city-pair and carrier was extended from 1995–2015 to 1995–2018 for both international and domestic operations.

The compilation of the data sets includes following sources:

- a) actual traffic data reported by States to ICAO through the Air Transport Reporting Forms A, B and C, the coverage of which was over 90 per cent of passenger traffic and 95 per cent of freight traffic;
- b) actual origin and destination passenger traffic data collected through the Market Intelligence Data Transfer (MIDT) big data (STA/11-WP/3 refers); and
- c) estimated traffic data based on the airline schedules published in the Official Airline Guide (OAG) and Automatic Dependent Surveillance—Broadcast (ADS-B) big data (STA/11-WP/3 refers), which were used to fill the gaps.

Similar to the previous LTF, passenger traffic data were segmented into 40 international and 10 domestic route groups. The 50 route groups were also assigned to six different “tiers” according to the income level and market maturity in the same manner as previous forecasts. The income thresholds to segregate the tiers were updated from the most recent World Bank data of low, lower-middle, upper-middle and high-income economies.

After reviewing the original econometric model with a series of diagnostic tests, it was decided to use the same model which captures the main economic and demographic drivers of air traffic demand and best fits the input data. The model examines how passenger demand (passenger traffic in RPKs) is affected by real Gross Domestic Product (GDP) per capita and cost of travel (airfares), and predicts annual change in RPKs for each route group. The passenger forecasts model is as the following:

$$\Delta \log \widehat{RPK\_PC}_{rt} = \sum_{i=1, j=1}^6 \beta_i (T_j * \Delta \log GDP\_PC_{rt}) + \beta_{oil} \Delta \log_{rt} Oil_{rt} Year\ Indicators$$

i: Tier Coefficient Index, j: Tier Index, t: Time, r: Route Group

Economic and demographic data were sourced from the International Transport Forum at the Organization for Economic Co-operation and Development (ITF-OECD). This includes real GDP per capita in 2011 constant USD, which varies from the data in 2005 constant USD used for the previous forecasts. As there is no coherent methodology to obtain specific airfare costs, oil prices were used as a proxy for cost of travel, consistent with recent literature on this topic.

## Freight Forecasts

Demand for freight is measured by Freight Tonne-Kilometres (FTKs). The historical time-series data set of FTKs at the regional level were extended from 1995–2015 to 1995–2018 for both international and domestic operations. The data sets were compiled from the similar sources as for the passenger forecasts with the exception of MIDT data.

Economic data was taken from the same source as the passenger traffic forecasts and aggregated by region to preserve the relatively large heterogeneity amongst the different regions in terms of the relationship between FTKs and real GDP. Forecasting model remains similar to previous freight forecasts. The freight forecasts model is as the following:

$$\log FTK_{Rt} = \widehat{\alpha} + \beta \log GDP_{Rt}$$

t: Time, R: Region

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**APPENDIX B**

**POST-COVID-19 FORECAST SCENARIO ASSUMPTIONS**

**Passenger LTF Assumptions**

<b>Commercial Passenger Market</b>							
<b>Scenario/Assumption</b>	<b>Vaccine</b>	<b>Global Economic Activity</b>	<b>Regional Variation</b>	<b>Route Variation -- Domestic/International</b>	<b>Business Travel Demand</b>	<b>Return to 2019 RPKs</b>	<b>Return to pre-crisis Trend (levels)</b>
<b>High</b>	Announced early 2021 Available/wide spread use mid/late 2021	V-shaped recovery -- back to 2019 levels in early 2021	--Solid and sustained global recovery --Asia (China) pick-up quickly in 2021 --Recovery in traffic tracks economic growth (NA/EUR follow Asia)	--Domestic traffic responds quickly particularly in U.S./Europe/Asia (China) --International lags somewhat (2022) --solid income growth drives leisure travel	-- Business Travel growth resumes late 2021 --Returns to normal levels in 2022 -- Drives solid recovery in both markets (B2B and conferences)	2023	Yes -- around 2030
<b>Mid</b>	Announced mid-2021 Available/wide spread use early/mid 2022	Return to 2019 levels in late 2021/2022 (running behind the optimistic outlook)	-- Recovery lags economic growth (some behavioral changes/lower incomes) -- Resumption in domestic traffic first -- International lags --China/Asia leads the recovery, followed by NA and EUR	--Domestic traffic growth resumes in 2022 U.S./Europe/Asia (China) --International lags (2023) -- Lower incomes reduce leisure travel	--Business Travel growth resumes in late 2022/2023, but never fully returns to normal levels (i.e., some permanent reduction due to substitutes -- Zoom, etc.)	2024	No -- permanent shift due to substitution of online technologies for business and changes in household vacation/travel patterns

Commercial Passenger Market							
Scenario/Assumption	Vaccine	Global Economic Activity	Regional Variation	Route Variation -- Domestic/International	Business Travel Demand	Return to 2019 RPKs	Return to pre-crisis Trend (levels)
Low	Announced early 2022 Available/wide spread use late 2022/early 2023	Return to 2019 levels by 2023/2024	--Recovery lags economic growth -- resumption in domestic traffic slow to gain traction --International lags further behind --China/Asia and developing nations lead recovery. NA and EUR lag.	--Domestic traffic resumes growth in 2024 Asia (China) --International lags (2025) -- Lower incomes reduce leisure travel	--Business travel does not fully recover --Permanent and sustained loss in domestic/international travel as a result.	2027	No -- permanent shift due to substitution of online technologies for business and changes in household vacation/travel patterns

**Freighter LTF Assumptions**

Freighter Market					
Scenario/Assumption	Vaccine	Economic Activity	Regional Variation	Return to 2019 RTKs	Return to pre-crisis Trend (levels)
High	Announced early 2021 Available/wide spread use mid/late 2021	V-shaped recovery -- back to 2019 levels in early 2021	Regional variation will depend upon differences in regional economic activity -- Pacific/Asia & Asia/Middle East will lead, followed by North America/Europe	2021	Yes
Mid	Announced mid-2021 Available/wide spread use early/mid 2022	Return to 2019 levels in late 2021/2022 (running behind the optimistic outlook)	Regional variation will depend upon differences in regional economic activity -- Pacific/Asia & Asia/Middle East will lead, followed by North America/Europe	2022	Yes
Low	Announced early 2022 Available/wide spread use late 2022/early 2023	Return to 2019 levels by 2023/2024	Regional variation will depend upon differences in regional economic activity -- Pacific/Asia & Asia/Middle East will lead, followed by North America/Europe	2023	Dependent upon economic forecast

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APPENDIX C

POST-COVID-19 PASSENGER LTF

Global CAGR RPK Comparison

	10 Year (2018-2028)	20 Year (2018-2038)	30 Year (2018-2048)	32 Year (2018-2050)
COVID-19 : Low	1.2%	2.4%	2.8%	2.9%
COVID-19 : Mid	2.6%	3.3%	3.5%	3.6%
COVID-19 : High	3.6%	4.1%	4.2%	4.2%
2018 LTF	4.2%	4.2%	4.2%	4.2%

32-Year CAGR RPK Comparison by Route Group

Route Group	2018 LTF	COVID- 19: High	COVID- 19: Mid	COVID- 19: Low
Africa	5.3%	5.0%	4.5%	4.0%
Africa - Asia/Pacific	5.1%	4.9%	4.3%	3.5%
Africa - Middle East	5.6%	5.2%	4.6%	3.8%
Africa - North America	2.7%	3.1%	2.5%	1.7%
Africa & Middle East - Central America/Caribbean	5.5%	4.8%	4.3%	3.6%
Africa & Middle East - South America	5.0%	4.7%	4.1%	3.3%
Central America/Caribbean	4.1%	3.9%	3.2%	2.8%
Central America/Caribbean – Europe	3.7%	3.8%	3.2%	2.6%
Central America/Caribbean - North America	3.3%	3.7%	3.0%	2.1%
Central America/Caribbean - South America	4.2%	3.9%	3.3%	2.6%
China – Europe	4.2%	4.0%	3.4%	2.7%
China - Middle East	4.7%	4.5%	3.8%	3.0%
China - North America	4.3%	4.2%	3.5%	2.7%
China & South West Asia - North Asia	6.7%	6.3%	5.5%	4.4%
China & South West Asia - Pacific South East Asia	6.1%	5.9%	5.2%	4.4%
China/Mongolia	4.7%	5.0%	4.3%	3.4%
Europe	3.0%	3.1%	2.7%	2.3%
Europe - Middle East	3.3%	3.3%	2.7%	2.2%
Europe - North Africa	4.3%	4.4%	3.8%	3.1%
Europe - North America	2.9%	3.2%	2.6%	2.1%
Europe - North Asia	2.9%	3.0%	2.5%	2.2%

<b>Europe - Pacific South East Asia</b>	4.0%	4.1%	3.5%	2.8%
<b>Europe - South America</b>	3.3%	3.3%	2.7%	2.2%
<b>Europe - South West Asia</b>	5.0%	5.0%	4.4%	3.7%
<b>Europe - Sub Saharan Africa</b>	2.6%	2.8%	2.3%	1.9%
<b>Intra Africa</b>	5.3%	5.0%	4.5%	4.0%
<b>Intra Central America/Caribbean</b>	4.1%	3.9%	3.2%	2.8%
<b>Intra China &amp; South West Asia</b>	5.0%	4.8%	4.2%	3.4%
<b>Intra Europe</b>	3.0%	3.1%	2.7%	2.3%
<b>Intra Middle East</b>	4.0%	3.6%	3.0%	2.5%
<b>Intra North America</b>	2.7%	3.1%	2.5%	1.8%
<b>Intra North Asia</b>	2.5%	2.6%	2.2%	1.8%
<b>Intra Pacific South East Asia</b>	5.2%	4.9%	4.3%	3.6%
<b>Intra South America</b>	3.4%	3.2%	2.7%	2.2%
<b>Latin America/Caribbean – China</b>	4.7%	4.5%	3.9%	3.1%
<b>Latin America/Caribbean - North Asia &amp; Pacific South East Asia</b>	4.2%	3.9%	3.3%	2.7%
<b>Middle East</b>	4.0%	3.6%	3.0%	2.5%
<b>Middle East - North America</b>	3.0%	3.3%	2.6%	1.8%
<b>Middle East - North Asia &amp; Pacific South East Asia</b>	4.0%	3.8%	3.2%	2.5%
<b>Middle East - South West Asia</b>	8.7%	8.1%	7.3%	6.2%
<b>North America</b>	2.7%	3.1%	2.5%	1.8%
<b>North America - North Asia</b>	2.7%	3.0%	2.4%	1.8%
<b>North America - Pacific South East Asia</b>	3.9%	4.2%	3.5%	2.5%
<b>North America - South America</b>	3.1%	3.3%	2.6%	1.9%
<b>North America - South West Asia</b>	5.2%	5.3%	4.6%	3.5%
<b>North Asia</b>	2.5%	2.6%	2.2%	1.8%
<b>North Asia - Pacific South East Asia</b>	4.3%	4.2%	3.6%	2.9%
<b>Pacific South East Asia</b>	5.2%	4.9%	4.3%	3.6%
<b>South America</b>	3.4%	3.2%	2.7%	2.2%
<b>South West Asia</b>	6.8%	6.4%	5.8%	4.9%
<b>World</b>	4.2%	4.2%	3.6%	2.9%

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**APPENDIX D**

**POST-COVID-19 FREIGHTER LTF**

**Global CAGR FTK Comparison**

	<b>10 Year (2018-2028)</b>	<b>20 Year (2018-2038)</b>	<b>30 Year (2018-2048)</b>	<b>32 Year (2018-2050)</b>
<b>COVID-19 : Low</b>	2.3%	2.5%	2.6%	2.6%
<b>COVID-19 : Mid</b>	3.5%	3.4%	3.5%	3.5%
<b>COVID-19 : High</b>	4.1%	4.1%	4.2%	4.2%
<b>2018 LTF</b>	3.5%	3.5%	3.5%	3.5%

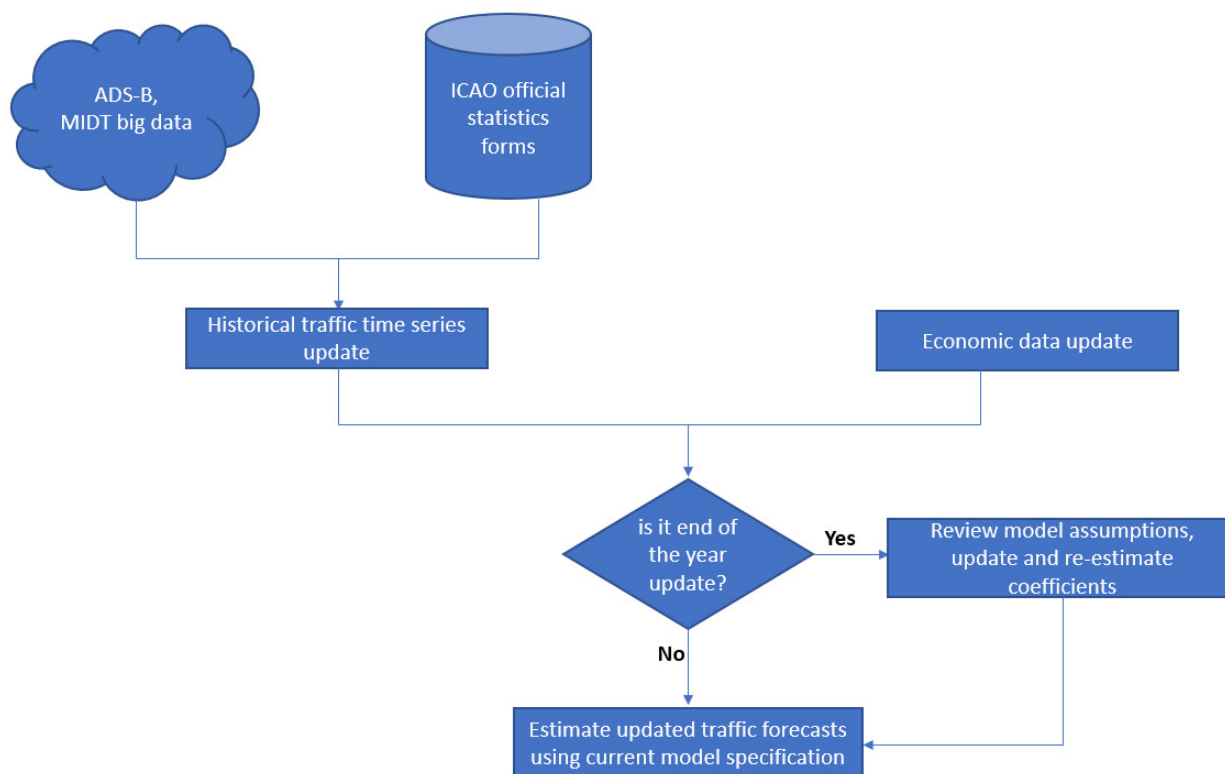
**32-Year CAGR FTK Comparison by region**

<b>Region</b>	<b>2018 LTF</b>	<b>COVID- 19: High</b>	<b>COVID- 19: Mid</b>	<b>COVID-19: Low</b>
<b>Middle East</b>	6.1%	7.2%	6.0%	4.4%
<b>Asia and Pacific</b>	3.0%	3.5%	3.1%	2.6%
<b>Africa</b>	4.1%	4.6%	3.8%	3.0%
<b>North America</b>	3.2%	3.9%	3.2%	2.1%
<b>Europe</b>	1.9%	2.4%	1.9%	1.5%
<b>Latin America/Caribbean</b>	1.2%	1.5%	1.2%	0.8%
<b>World Total</b>	<b>3.5%</b>	<b>4.2%</b>	<b>3.5%</b>	<b>2.6%</b>

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## APPENDIX E

### QUARTERLY FORECAST UPDATES PROCESS



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