

International Civil Aviation Organization

ICAO

WORKING PAPER**Asia and Pacific (APAC)
Twelfth Meeting of the Meteorological Requirements
Working Group (MET/R WG/12)**

Bangkok, Thailand, 02 to 05 May 2023

Agenda Item 3: Review of follow-up from previous meetings**SURVEY OF STATE METEOROLOGICAL INFORMATION SUPPORTING AIR TRAFFIC
MANAGEMENT**

(Presented by Australia on behalf of the Ad-hoc Group)

SUMMARY

This paper presents the results of the survey on the provision of current and future meteorological (MET) information services by States to support Air Traffic Management (ATM), in particular Air Traffic Flow Management (ATFM) conducted in Dec 2021.

1. INTRODUCTION

1.1 The Tenth Meeting of the Meteorological Requirements Working Group (MET/R WG/10), 24 – 28 May 2021, approved and made a decision to circulate a survey questionnaire to APAC States to inform ICAO (and States) of the provision of current and future meteorological (MET) information services by States specifically to support Air Traffic Management (ATM), in particular Air Traffic Flow Management (ATFM).

1.2 As a follow up, a survey was conducted by the Asia/Pacific Regional Office in October/December 2021. The States were urged to complete the online survey questionnaire at: <https://www.surveymonkey.com/r/5XLX97H>. For ease of reference, a copy of the survey questionnaire was attached to the State letter. (State letter Ref.: T 4/3.2.7 – AP170/21 (MET) refers).

2. DISCUSSIONSurvey Questionnaire

2.1 The survey asked several questions to solicit input from the MET and ATM communities and Airspace Users in the APAC Region with the following terms of reference regarding the initiative and objective of the survey:

- To identify current and future meteorological requirements, in terms of the provision of MET information and communication methods, to support ATM;
- To identify the types and importance of MET information for ATM;

- To identify the gaps between the existing MET information services and the requirements of ATM community and Airspace Users;
- To identify challenges faced by States/Administrations regarding the provision of MET information to support ATM, in particular ATFM;
- To identify other guidance and education material required to support States/Administrations in implementing MET information to support ATFM; and
- To remind States/Administrations of the existence of Asia Pacific Regional Guidance for Tailored Meteorological Information and Services to Support ATM Operations document.

2.2 The survey results are expected to assist MET/R WG with the following tasks:

- Understand States/Administration current status and requirements of MET information to support ATM, in particular ATFM;
- Explore opportunities and enhance MET-ATM integration in APAC States/Administrations;
- Facilitate a coordinated approach for further improvement of MET services in support of ATM, especially ATFM in the APAC Region; and
- Seek further input from States/Administrations on other guidance or education material required to assist the implementation of MET information service to support ATFM.

2.3 To collect input from BOTH the MET and ATM communities in the APAC Region, each State/Administration were requested to provide at least **2 separate survey returns**, one from each of the MET and ATM communities.

2.4 State/Administrations were also encouraged to invite additional survey returns from their State-based Airspace Users such as airlines, for some of the specific questions indicated in the Questionnaire.

2.5 The survey closed on 15 December 2021.

2.6 A preliminary analysis of the survey was conducted and presented at the 2022 MET/ATM Webinar and MET/R WG/11 Meeting. However, to fully achieve the survey objectives, MET/R WG/11 requested further analysis of the results [Decision MET/R/11/03: *Further analysis of ICAO APAC Regional Survey on the provision of MET services to support ATM and ATFM and Follow-up Actions* refers].

Survey Results

2.7 The results of the survey on the provision of current and future meteorological (MET) information services by States to support Air Traffic Management (ATM), in particular Air Traffic Flow Management (ATFM), is presented in this paper.

2.8 A total of 50 responses to the survey were received from Twenty-Three (23) States/Administrations, namely: Australia, Bangladesh, Bhutan, Brunei, India, Indonesia, Japan, Hong Kong China, LAO PDR, Macao, Malaysia, Maldives, Myanmar, New Zealand, Pakistan, Papua New Guinea, Philippines, Republic of Korea, Singapore, Sri Lanka, Thailand, USA and Vietnam. Number of responses and participating organizations are available in Table 1. Work nature of the respondents is provided in Figure 1.

States/Administration	Number of responses	Stakeholder Community	Organisations
Australia	2	ATM and MET	• Airservices Australia (ATM);

			<ul style="list-style-type: none"> • Australian Bureau of Meteorology (MET)
Bangladesh	1	MET	<ul style="list-style-type: none"> • Bangladesh Civil Aviation Authority
Bhutan	2	ATM and MET	<ul style="list-style-type: none"> • Bhutan Civil Aviation Authority
Brunei	1	MET	<ul style="list-style-type: none"> • Brunei Darussalam Meteorological Department
India	1	ATM	<ul style="list-style-type: none"> • Airports Authority of India
Indonesia	2	ATM and MET	<ul style="list-style-type: none"> • BMKG (Badan Meteorologi, Klimatologi, dan Geofisika) • DGCA (Directorate General of Civil Aviation (Indonesia))
Japan	4	Airline, ATM and MET	<ul style="list-style-type: none"> • Japan Airline (<i>note, no data provided</i>) • Fuji Dream Airline • Japan Civil Aviation Bureau • Japan Meteorological Agency
Hong Kong China	2	ATM and MET	<ul style="list-style-type: none"> • Hong Kong Civil Aviation Department • Hong Kong Observatory
LAO PDR	2	ATM and MET	<ul style="list-style-type: none"> • Lao Air Navigation Service • Lao Department of Meteorology and Hydrology
Macao	2	ATM and MET	<ul style="list-style-type: none"> • Macao Civil Aviation Authority • Macao Meteorological and Geographical Bureau
Malaysia	1	MET	<ul style="list-style-type: none"> • Malaysian Meteorological Department
Maldives	2	ATM and MET	<ul style="list-style-type: none"> • Maldives Civil Aviation Authority
Myanmar	1	Met	<ul style="list-style-type: none"> • Myanmar Department of Meteorology
New Zealand	1	ATM	<ul style="list-style-type: none"> • Airways Corporation of New Zealand
Pakistan	2	ATM and MET	<ul style="list-style-type: none"> • Pakistan Civil Aviation Authority • Pakistan Meteorological Department
Papua New Guinea	2	ATM and MET	<ul style="list-style-type: none"> • Civil Aviation Safety Authority of Papua New Guinea • PNG National Weather Service
Philippines	3	Airline, ATM and MET	<ul style="list-style-type: none"> • AirAsia Philippines • Civil Aviation Authority of the Philippines • PAGASA (Philippine Atmospheric, Geophysical and Astronomical Services Administration)
Republic of Korea	2	ATM and MET	<ul style="list-style-type: none"> • Korea Air Traffic Control Centre • Korea Meteorological Administration/Aviation Meteorological Office
Singapore	2	ATM and MET	<ul style="list-style-type: none"> • Civil Aviation Authority of Singapore • Meteorological Service Singapore
Sri Lanka	1	ATM	<ul style="list-style-type: none"> • AASL (Airport & Aviation Services (Sri Lanka) Limited)
Thailand	8	Airline, ATM and MET	<ul style="list-style-type: none"> • THAIPA Airline • AEROTHAI • Civil Aviation Authority of Thailand (4 surveys, including ATM and MET) • Thailand Airport Operations (AOC/JAL) • Thai Meteorological Department
USA	3	ATM and MET	<ul style="list-style-type: none"> • Federal Aviation Administration (2 surveys, one each for ATM and MET) • National Weather Service
Vietnam	1	ATM	<ul style="list-style-type: none"> • Northern Region Air Traffic Service Company

Table 1: Survey responses provided by States/Administrations

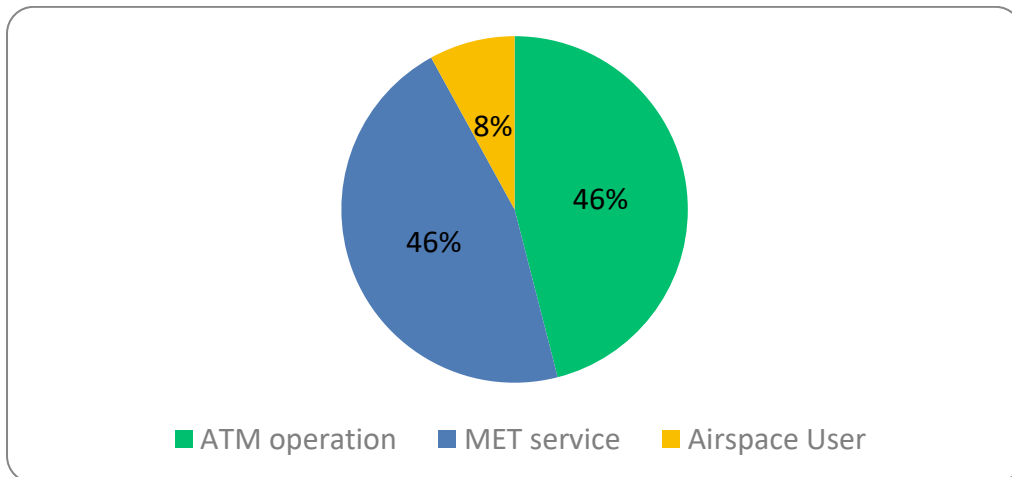


Figure 1: Work nature of survey respondents

2.9 13% of the respondents indicated that their States/Administration doesn't have any primary legislation and/or supporting regulations, such as any regional air navigation agreements, to implement MET service in accordance with ICAO Annex 3 - Meteorological Service for International Air Navigation.

2.10 Approximately 96% of the respondents indicated their State/Administration have a written agreement in place between the air traffic authority/service and the meteorological authority/service defining roles and responsibilities and the MET information to be provided in accordance with ICAO Annex 3 and ICAO Doc.9377 – Manual on Coordination between Air Traffic Services, Aeronautical Information Services and Aeronautical Meteorological Services.

2.11 80% (of the 25 respondents) indicated that their States/Administrations have implemented ATFM, while the other 20% indicated their States/Administration are intending to implement ATFM in the near future.

2.12 Respondents indicated the following meteorological information/services (top 5) are required to support ATFM. Figure 2 provides full assessment of specific MET information/services required to support ATFM.

1. Aerodrome meteorological report, routine/special (METAR/SPECI) (95.45%);
2. Aerodrome forecast (TAF) (93.18%);
3. SIGMET information (86.36%);
4. Trend forecast (TREND) (84.09%); and
5. Local Report, routine/special (79.55%)
(percentages are out of 44 respondents)

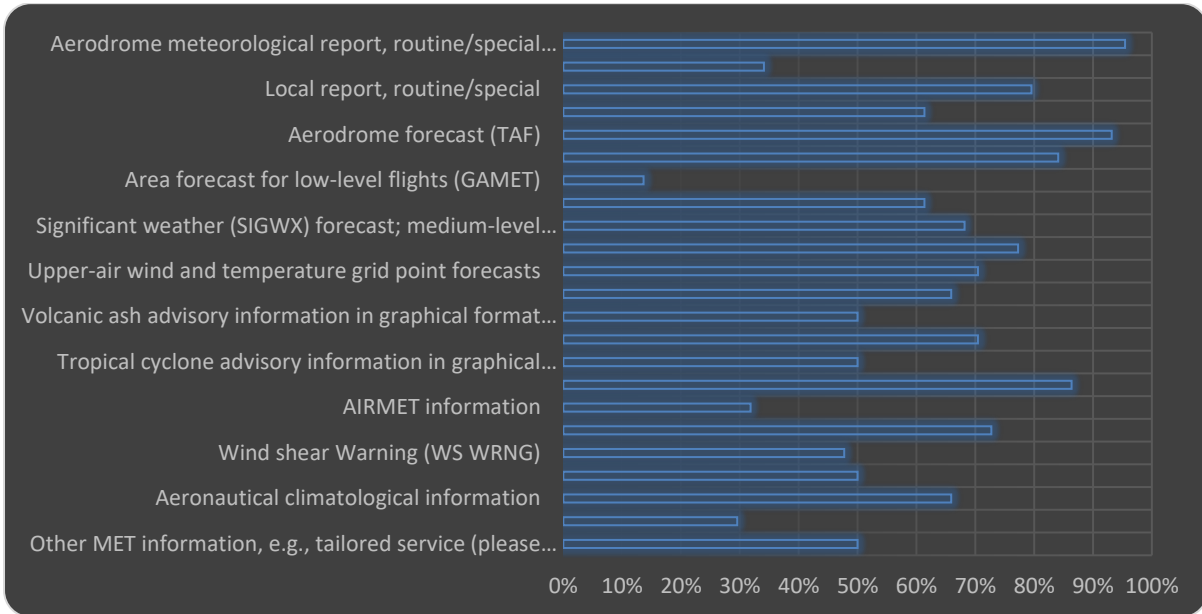


Figure 2: Requirements for specific Met information/services to support ATFM

2.13 Other tailored meteorological information services currently provided by some of the States/Administrations to support ATFM are as follows:

- Lightning Advisories;
- Weather Radar and Satellite Images
- Significant convection monitoring and forecast;
- Categorical forecasts of TS over critical watch area;
- Windshear prediction information; and
- ATM tailored information and services based on States requirements.

2.14 Only 48% (of 21 ATM respondents) indicated that their State/Administrations' ATM/ATFM system(s) utilise automated processing of gridded MET information (e.g. World Area Forecast System (WAFS) information) to support flight planning.

2.15 Only 16 States/Administration MET Agencies indicated that they provide gridded MET information (e.g. World Area Forecast System (WAFS) information) to ATM supporting flight planning. Some of these States/Administrations also provide met data from their local Numerical Weather Prediction Models. Figure 3 shows the gridded MET information provided (or not) by these State to support flight planning.

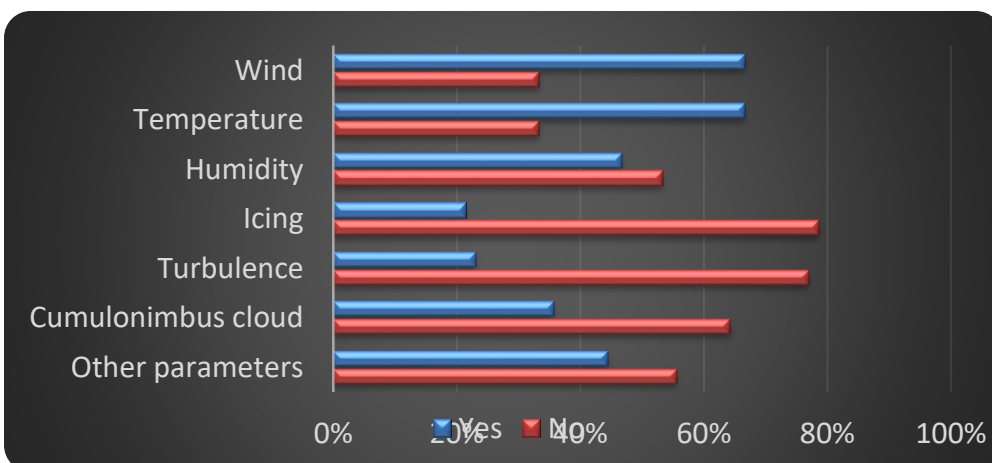


Figure 3: Gridded Met INFO provided to the States/Administration to ATM to support flight planning

2.16 The aerodrome meteorological information that are considered to be most useful for ATM and ATFM decision making process are wind (including cross wind, windshear, strong wind/ strong tail wind leading to runway changes), aerodrome visibility/runway visibility (RVR), QNH and significant phenomena such as tropical cyclone, thunderstorm or heavy precipitation (heavy showers, rain, snow, etc). Similarly, these met factors were considered as most impactful for ATM/ATFM operations. See Figures 4 and 5 for the ratings provided by the States/Administrations ATM and Airspace users.

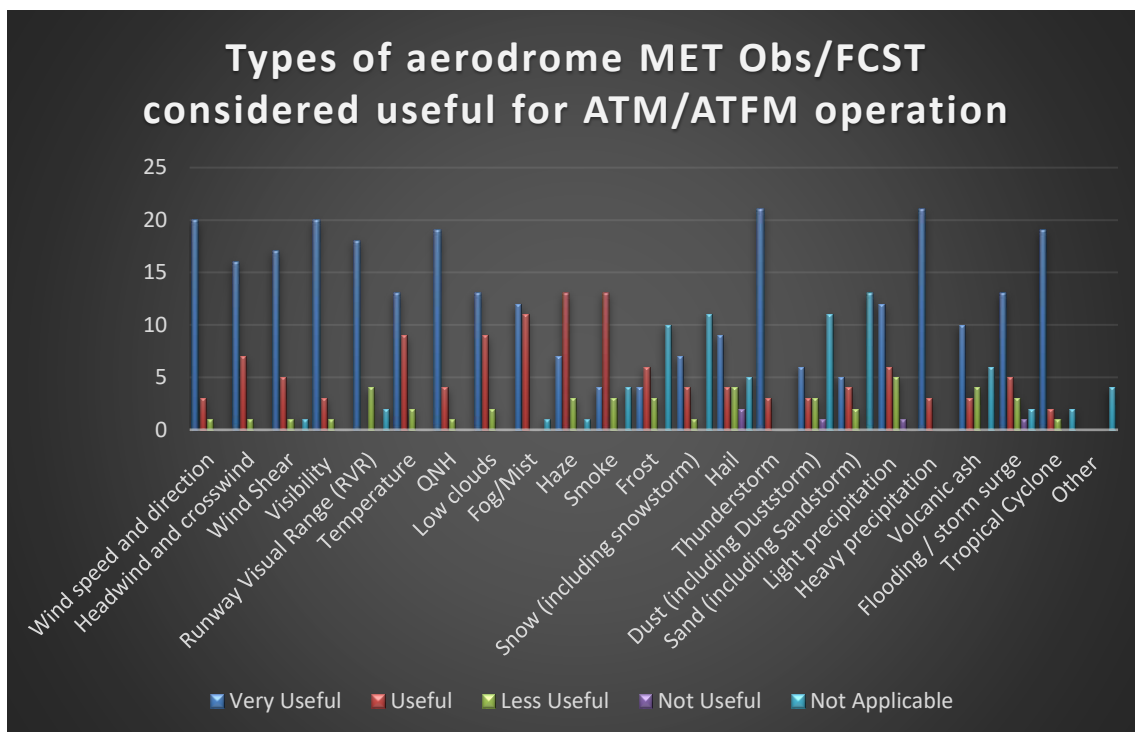


Figure 4: Aerodrome MET information considered to be most useful for ATM/ATFM operations

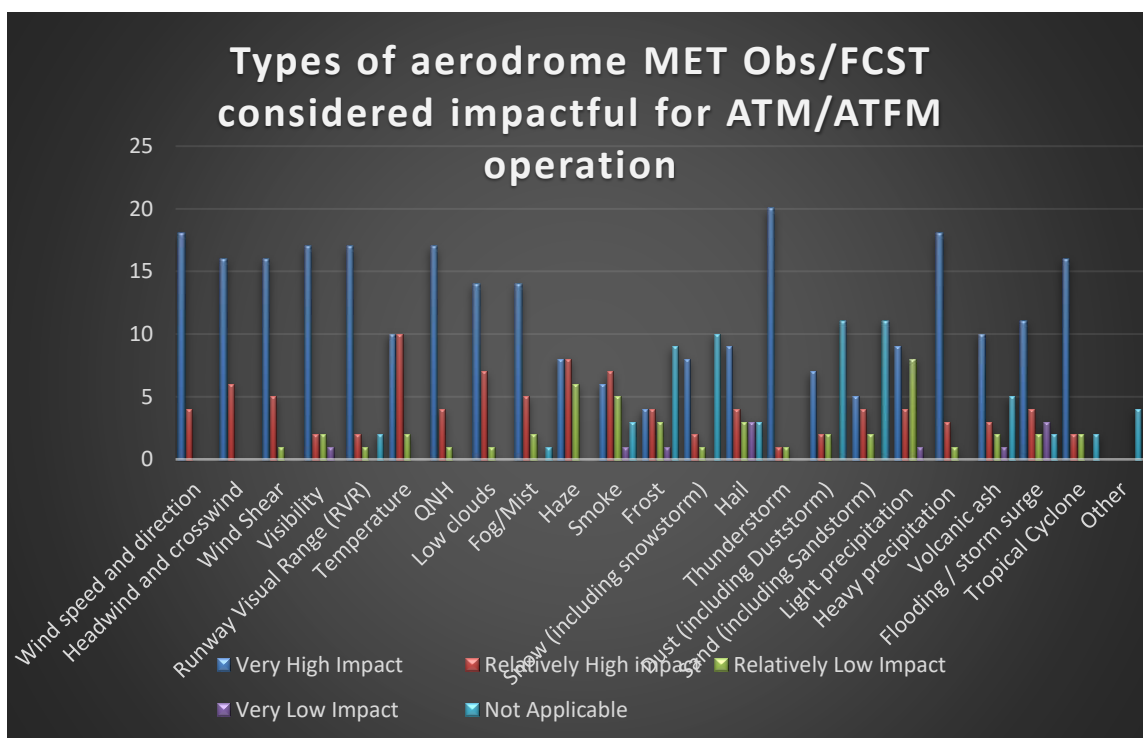


Figure 5: Aerodrome MET information considered to be most impactful for ATM/ATFM operations

2.17 For en-route flight operation, significant factors affecting aircraft are considered to thunderstorm, including convective cloud, tropical cyclone and wind factors, including turbulence. See Figures 6 and 7 for the ratings provided by the States/Administrations ATM and Airspace users.

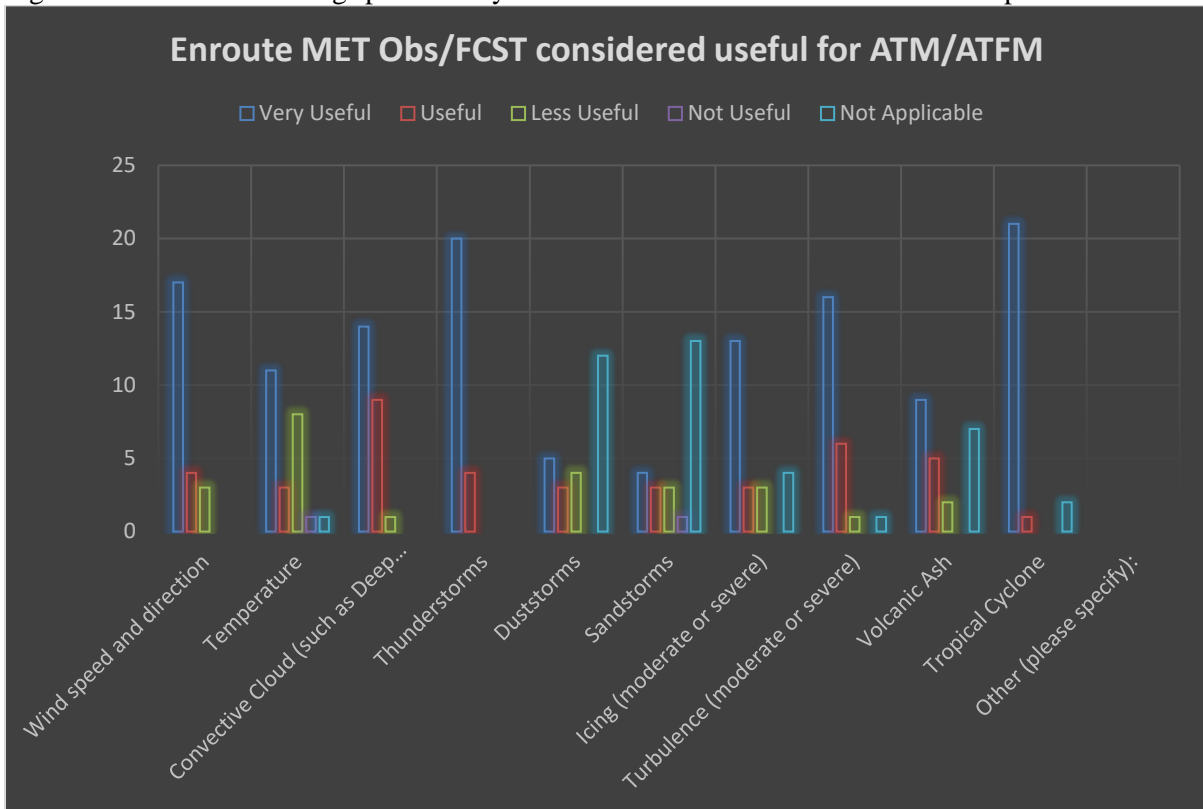


Figure 6: Enroute MET Observations and forecasts considered to be useful for ATM/ATFM

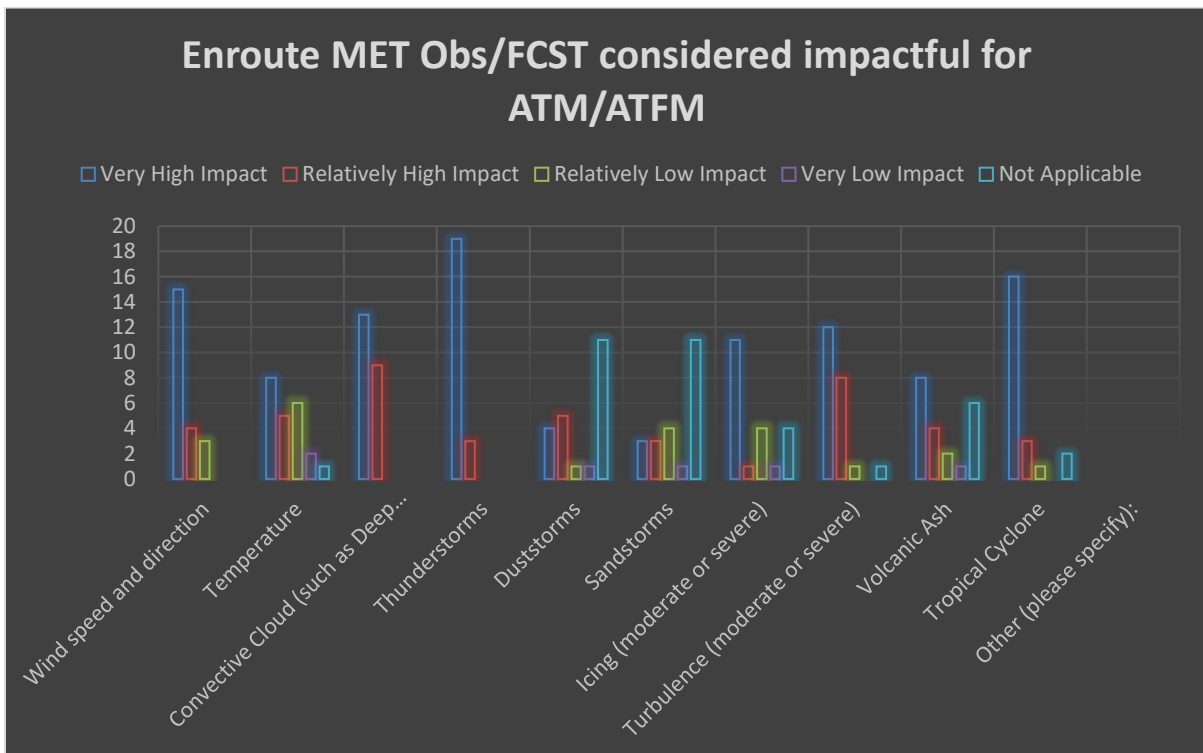


Figure 7: Enroute MET Observations and forecasts considered to be impactful for ATM/ATFM operations

2.18 The ATM and Airspace Users rated the time of issuance and validity, observed and forecast movements, forecast position and horizontal and vertical extent of phenomena as very important characteristic description for an effective and efficient ATFM. See Figure 8 for more details.

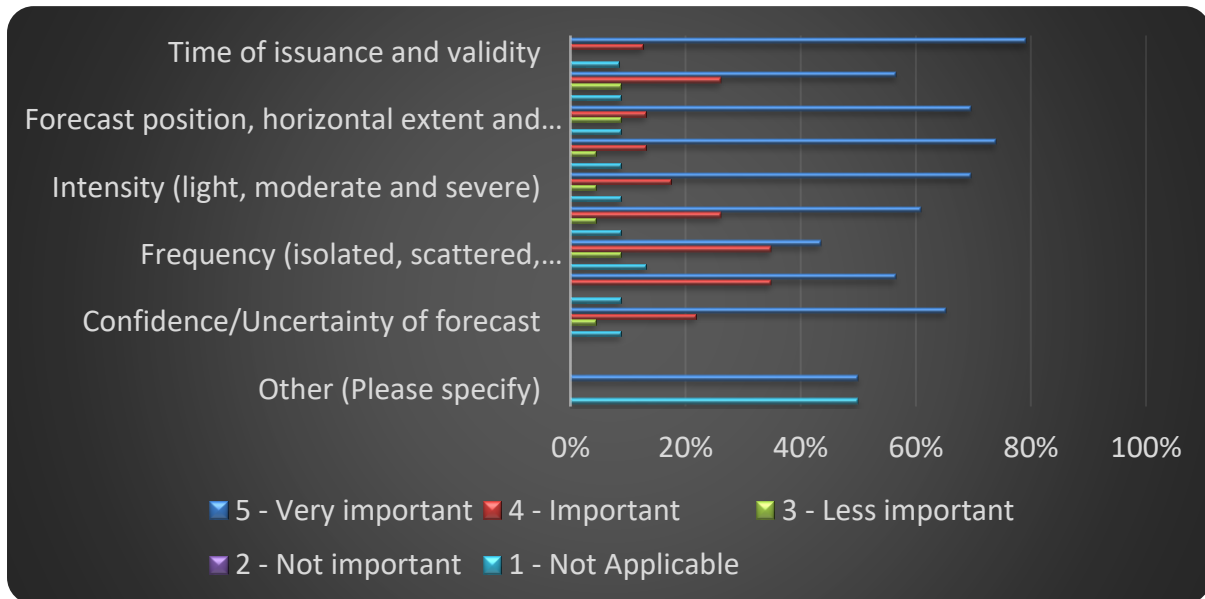


Figure 8: Importance of characteristic descriptions of MET phenomena for an effective and efficient ATFM

Some key reasons identified are:

- "Timely and detailed description on the weather cells lead to the successful of ATFM operation (in terms of planning and selection of the appropriate measure) to manage the demand and capacity situation that caused from weather phenomenon."
- "Affect the Airport Arrival Rate, Airport Departure Rate, Sector capacity, etc."
- "Trusting the forecast and issuing flow management in the area."
- "Flight planning and Flight safety"
- "...it is important to have high confidence in forecasting as this will lead to lesser last-minute changes to planned operations and lesser unnecessary delay (e.g. cancelling a planned ATFM measure halfway when airlines have already incurred delay on ground)"
- "If the forecast is not reliable then it is useless"
- "Consistency of information for forecast/observed phenomena across different jurisdiction"

2.19 Regarding the quality of MET service and MET information in ensuring effectiveness and efficiency of ATFM operation, ATM and airspace users put most importance to timeliness, such as forecast lead time and update frequency, and quality of forecast, such as accuracy and reliability. These factors are extremely important for ATM/ATFM decision making and flight planning. Another common request among MET users is the capability to translate MET constraint into ATFM impact (decision support tool).

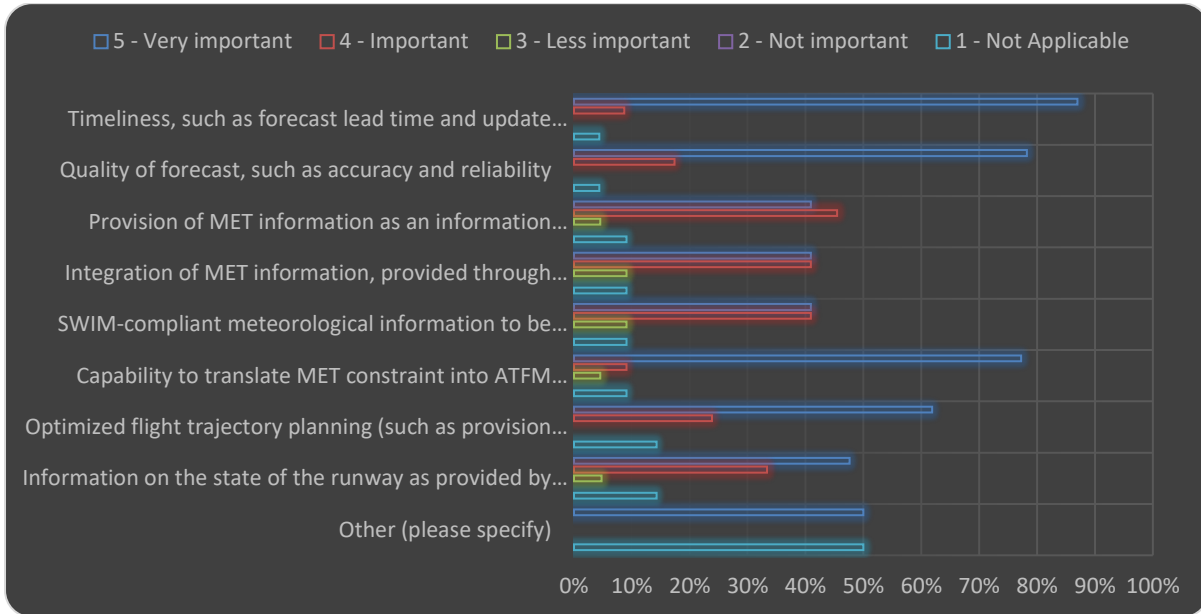


Figure 9: Important MET information for an effective and efficient ATFM

Some additional details on each of the key aspects:

- **Timeliness:**
 - "More timely information leading to better advanced planning, improve reliability and accuracy and to plan/activate appropriate ATFM measures.";
 - "Earlier lead time with greater resolution";
 - "Aids in timely runway selection – *Note: reactive updating of forecasts, when actual reported conditions vary from what was forecast (due to poor quality forecasting) can result in adverse outcomes e.g. excessive number of amended MET products being issued in extremely short time periods*".
- **Quality:**
 - "Updates are needed to improve reliability and accuracy;
 - "High quality and accurate forecasts critical for decision making of ATFM initiatives";
 - "Important to have accurate and reliable weather forecasting as basis for activation of ATFM measures resulting from inclement weather forecasts, especially for weather in the vicinity of the aerodrome (TAF). Good quality forecasts also allow airlines to utilize the info effectively for flight planning purposes";
 - "Unreliable and inaccurate forecast is useless for airspace user".
- **Provision of MET info:**
 - "Aviation Met products should be in IWXXM format";
 - "Good to exchange information based on a common info exchange model so that all consumers are connected through a same platform with expectations of a common set of data to be exchanged";
 - "Easily accessible MET information are vital for airspace user".
- **Capability to translate MET constraint into ATFM:**
 - "Met service Provider should be aware of translation of MET constraints";
 - "Weather is essential for those in charge of operation and control, so it is necessary";
 - "Important and useful if system has the capability to translate the MET constraint into ATFM impact as this will allow FMPs to act appropriately, especially if the ATFM impact can be quantified";
 - "Understanding the impact it has on ATFM is important for airspace user as it lead to well thought out decision."

2.20 Regarding the challenges encountered in development, implementation and/or utilisation of enhanced MET services to better support ATFM operation, the ATM and Airspace users rated systems integration and lack of resources as the major issues. Similar views were shared by the MET community when developing and implementing enhance MET services. See Figures 10 and 11 for details.

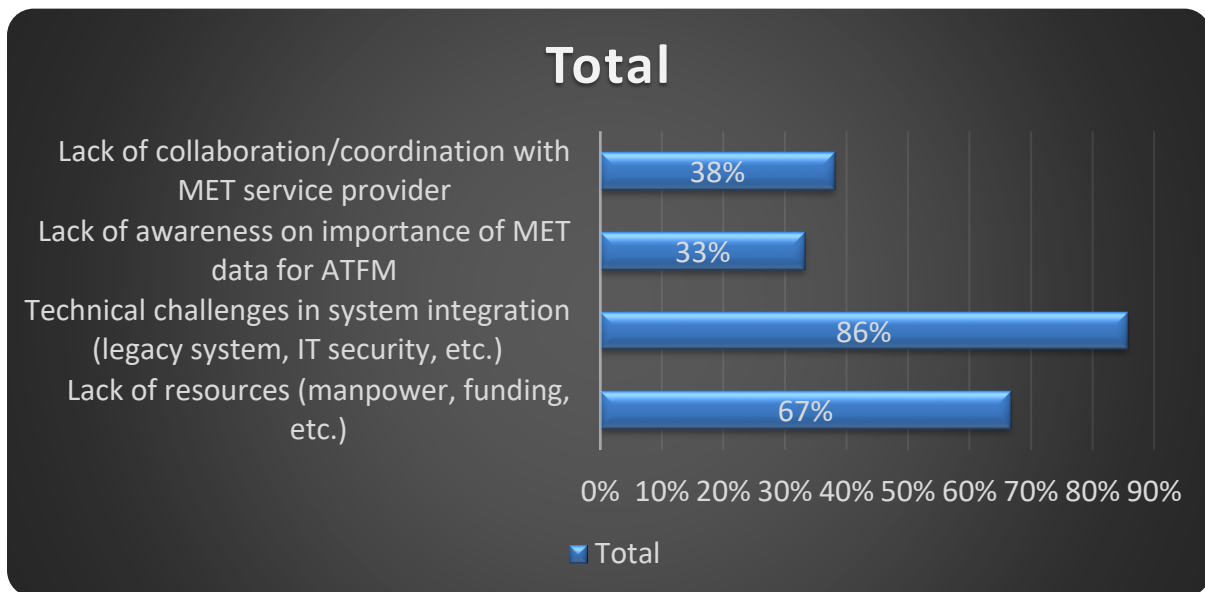


Figure 10: Challenges ATM and Airspace users face when developing, implementing and/or utilising enhanced MET services to better support ATFM operation

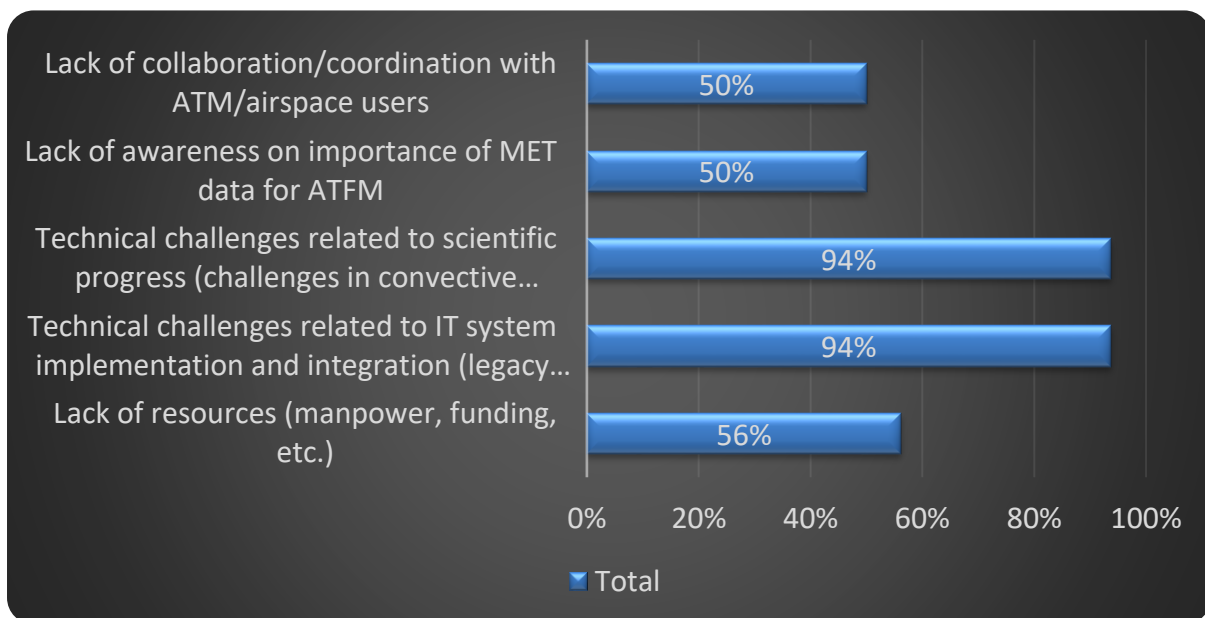


Figure 11: Challenges Met organization encounter when developing and implementing enhanced MET services to better support ATFM operation

Some comments:

- "Lack of established formal and concrete communication channel between MET service provider and ATM service provider."
- "Professional exchanges between MET and ATM experts are necessary for a better understanding of the requirements of each other."
- "Budgetary constraints, lack of technical capability for equipment maintenance"

- "From the ATM perspective, ATFM project was implemented many years ago and challenges were resolved at the time. Due to this, unfortunately we are unable to provide detail on the challenges experienced. Future systems will be upgraded as required to support new capabilities and services."
- "Managing the gaps between ATM requirements and MET current capabilities, and data sharing."
- Many more...

2.21 Figure 12 provides State/Administration current and planned initiatives and timelines to enhance MET service provision specifically in support of ATFM operations.

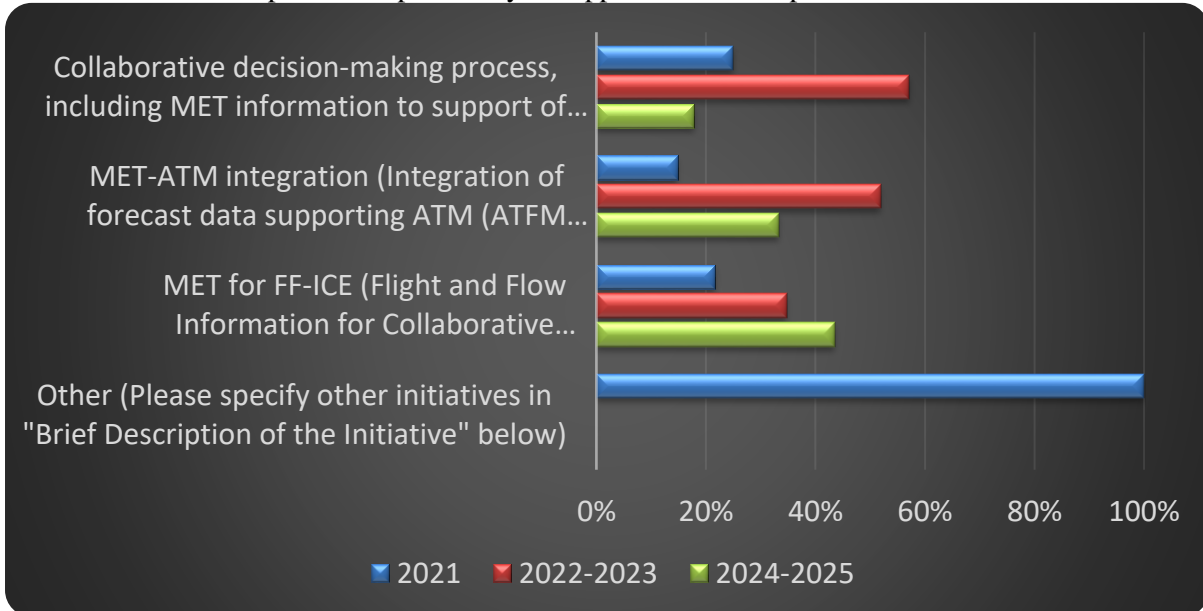


Figure 12: Initiatives State/Administrative undertake (or will undertake) to enhance MET service provision to support ATFM operations

2.22 Most of the States disseminates aeronautical MET information to ATS units, Airspace Users and other stakeholders via internet, aeronautical fixed telecommunication network (ATFN) and use telephone services to provide additional information. However, 15% of the respondents indicated that their States/Administrations still doesn't use AFTN to exchange information.

2.23 23% of the respondents are still unaware of the APAC Regional Guidance for Tailored Met Services to support ATM Operations.

2.24 Some comments on how States/Administrations can benefit from the guidance in implementation or enhancement of MET information and services for ATM and/or what other guidance or education material:

- "Webinars or presentations detailing development, implementation, benefits achieved and lessons learned of any new idea/technology that has been implemented by states/administrations";
- "Courses/ Training/ Seminars/Trainings on implementing or improving provisions of MET information and services to support effective ATFM";
- "Guidance to develop a MET data catalogue to better support ATFM, including guidance and sample scenarios on how MET data would be used and which MET data should be considered during the Demand/Capacity Balancing (DCB) process. In addition, any case study of successful ATFM implementation based on MET information would be useful";
- "Sharing more example of MET-ATM integrated system / More guidance about information sharing system / Best practices or education material on using MET information for ATFM in

future SWIM environment / lists of suppliers/developer of system related to the integration of MET information to ATM";

- "Sharing more effective examples on the ICAO e-document page. Furthermore, the ICAO Regional Office should promote these documentations from time to time via State Letters";
- "Webinar session or even creating videos to ensure it is easy for developing States to understand the process. Any additional guidance from Global MET Panel group would be beneficial";
- "Provide more guidance, effective example, best practices or education material on MET- ATM integrated system, information sharing system and/or usage of MET information for ATFM in future SWIM environment; a catalogue of suppliers/developer of system related to the integration of MET information to ATM";
- "Guidance material on the translation of MET constraints into objective, quantifiable impact on ATM operations, e.g. reduction in air traffic capacity. Any other supporting documents of WMO/ICAO that can contribute plus in-depth guidance from subject matter expert."

Conclusion

2.25 A few States/Administrations still doesn't have any primary legislation and supporting regulations to implement MET service in accordance with ICAO Annex 3. However, it is encouraging to see many States are considering MET information as an essential component for ATM. In addition, most States have now implemented ATFM and includes MET as an essential part of the process by having written agreements in place between the air traffic authority/service and the meteorological authority/service defining roles and responsibilities and the MET information to be provided in accordance with ICAO Annex 3 and ICAO Doc.9377.

2.26 Most States/Administration identified wind (including cross wind, windshear, strong wind/strong tail wind leading to runway changes), aerodrome visibility/runway visibility (RVR), QNH and significant phenomena such as thunderstorm, tropical cyclones or heavy precipitation as the key aerodrome meteorological factors impacting ATM/ATFM operations. While, for en-route flight operation, significant factors affecting aircraft are thunderstorm, including convective cloud, tropical cyclone and wind factors, including turbulence.

2.27 The key Operational Meteorological (OPMET) data, such as Aerodrome Weather Reports, Aerodrome Forecasts, remains as the most useful and impactful MET information to support ATFM. However, many States/Administrations are now providing additional tailored MET information in support of ATFM.

2.28 Most of the responding States informed that the gridded MET information, such as WAFS forecasts, are very useful and impactful in generating air-routes or flight planning. However, more precise data are obtained from States/Administrations NWP systems to provide additional support and/or to improve the quality of the WAFS forecasts.

2.29 Timeliness, such as forecast lead time and update frequency, and quality of forecast, such as accuracy and reliability are identified as extremely important for effective and efficient ATM/ATFM decision making processes. Another common factor identified is the capability to translate MET constraint into ATFM impact (decision support tool).

2.30 While it is encouraging to see most States have mutual understanding and close coordination among stakeholders, ATM, MET, and airline users, States/Administrations face challenges, such as technical challenges (systems and scientific progress), and lack of resources in developing, implementing and/or utilising enhanced MET services to better support ATFM operations.

2.31 There are still some States who are not using global standards for meteorological information exchange standard. It is encouraged to all States to be aware of global standards for

meteorological information exchange and consider establishment of agreements and procedures in order to increase safety and airspace capacity, and to improve the efficiency and flexibility of aircraft operations. This will become extremely important when ICAO makes SWIM as a standard information exchange mechanism.

Recommendations

2.32 The Adhoc Group recommends:

- a) To consider the results of this survey when:
 - i. developing future MET requirements to support ATM/ATFM;
 - ii. developing and or updating future guidance material for tailored met information services to support ATM operations;
 - iii. developing 'APAC User Requirements for SWIM-based MET Information Services Supporting ATFM'.
- b) Socialise the survey results with the ATM community, via ATFM SG and ATM SG.
- c) Promote the document titled Asia Pacific Regional Guidance for Tailored Meteorological Information and Services to Support Air Traffic Management Operations;
- d) That, the MET/R WG/12 identify any other follow-up actions for further consideration.

3. ACTION BY THE MEETING

3.1 The meeting is invited to:

- a) Note the information in the paper; and
- b) Discuss items in paragraph 2.32 and any other relevant matters as appropriate.
