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Consolidated Report on the AMDAR Kenya Knowledge Sharing Consultation Workshops held at South Africa Weather Services on 23 -24 October 2017 and 2-3 November 2017

SUMMARY

The South African Aviation Weather Centre with the support of its Chief Executive Office, Mr. Jerry Lengoasa, hosted Kenya Airways (KQ) personnel on the 23-24th October and the Kenya Meteorological Department (KMD) on the 2-3rd November 2017, on the occasion of Knowledge-Sharing Workshops of the Aircraft Meteorological DATA Relay (AMDAR) Programme in Kenya (Kenya AMDAR). (Annex 1: Workshop Programmes)

The information sharing workshops were convened to seek the assistance and advice of South African Weather Service (SAWS) and South African Airways (SAA) on developing ideas, strategies and plans for undertaking and implementing the Development of Forecasting Applications and Products for Aviation and other sectors. This activity builds on the implementation of the AMDAR Programme and on resulting data availability to enhance KMD forecasting and services capabilities. It is also expected to help improve Kenya Airways' operations and efficiencies.

During the workshops, SAWS presented the history and evolution of the programme and its benefits to the meteorological community. Several other presentations were made on the overview of the programme, the applications of AMDAR from the forecasting operations, the use of AMDAR from the research perspective and on the AMDAR and ICT protocol. SAA presented technical requirements from the airline's perspective for the AMDAR implementation and highlighted some of the key benefits of AMDAR.

The KQ delegates were taken on-site on a tour to SAA Technical, where they viewed the sensors on SAA aircrafts and got to watch a demonstration on the utilization of AMDAR data towards improving flight safety as a result of weather conditions. KMD personnel during their mission visited various departments at the SAWS Head Office in Pretoria where they engaged in capacity building and information sharing with the following departments: Regional Training Centre (RTC-Pretoria), National Forecasting Centre, Research Department, ICT Department and Climate Services Department.

AMDAR is a priority initiative of African Ministerial Conference on Meteorology (AMCOMET) and is a project funded by the UK Department for International Development (DFID) under the WISER Programme - Weather and Climate Information Services for Africa.



WORKSHOP OBJECTIVES

1. Discussions on the benefits of AMDAR to NMHS and Aviation Transport Industry(ATI)
2. Demonstration of products and services benefiting from AMDAR
3. Discussions on airline participation and benefits from changes to flight operations
4. Brainstorming on ideas and issues to implement the best practices
5. On-site Visits to institutions

WORKSHOP OUTCOMES

1. Understand the data chain from the observation, transmission to NMHS & GTS, processing, analysis, display and archival
2. Determine the infrastructural requirements of an AMDAR programme and operational costs involved.
3. Understand measures that SAWS implemented to sustain the recurrent operational cost for the project sustainability.
4. Determination of new products and applications developed based on AMDAR availability.
5. AMDAR Data Assimilation into NWP models at SAWS

WORKSHOP PARTICIPANTS from KQ and KMD

1. KMD - E.O. Bukachi
2. KMD – P. Mutai
3. KMD - D.N. Muchemi
4. KMD - J.G. Mungai
5. KQ – Patrick. Muisyo
6. KQ – M. Oduma

DAY 1: SUMMARY OF KEY TOPICS

Presentation 1: A Brief overview of the SAWS AMDAR Programme

Ms Esther Gaborekwe - Senior Manager Aviation

Currently SAA is the only airline participating in the provision of AMDAR data. SAWS entered a Pilot Project with AMDAR in 2004 and this has developed into a full programme for upper air observation. The use of AMDAR is seen as critical for the reduction of errors in their Numerical Weather Prediction (NWP) forecast models. The more AMDAR observation data fed into the prediction models, the better the output or performance in terms of accuracy. Research has shown that AMDAR observations generally improve forecasting skill and accuracy in NWP by contributing to 15-20% of the total error reduction attained from all observing systems.

- SAWS-SAA have 42 participating aircrafts in the AMDAR Programme
- SAWS pays for the AMDAR Data Communication cost to the service provider (SITA) estimated at ZAR 80,000 per month (South African Rands).
- SAWS is still interested in the development of the WVSSII humidity/water vapor sensors but due to budgetary constrains it is difficult at this stage to engage in this development.
- SAWS has MOU with Lufthansa and British Airways for additional AMDAR Data.

- SAWS/SAA are the only ones participating in AMDAR Programme in Africa.
- The need to pursue the other African airlines to participate in the AMDAR is the initiative of the WMO
- The Workshops are a follow-up on the AMDAR Regional Implementation programme for Africa, which seeks to drive the implementation of AMDAR in a form of partnership between national airlines and meteorological departments across the African continent.

Presentation 2: Applications of AMDAR at SAWS Forecasting Desk

Mr. Luthando Masimini - Senior Forecaster presented the Applications of AMDAR at SAWS Forecasting Desk

The AMDAR Program delivers a wide range of economic, social and environmental benefits to Agriculture, Health Environment and Disaster Risk Reduction.

Benefits of AMDAR data to SAWS

- Improved NWP model prediction accuracy by 10-20%
- Improved surface and upper air forecasts of wind and temperature
- Fog formation, location and duration
- Validation/verification of model vertical profiles with winds and temperature
- Detection of areas of turbulence location and intensity (SIGWX/AIRMET/SIGMET);
- Enhanced availability of upper air data at higher frequencies both temporal and spatial;
- Socio-economic benefits in reduction of CO2 emissions;
- Identification of temperature inversion, determination of cessation of fog;
- Improved wind forecasts at low levels and near airports (TAF and Take-Off Data);
- Forecasting of wind shear (location and intensity for warnings and advisories)
- Forecasting of convective cloud, e.g. Cloud base height;
- Determination of freezing level in order to get icing potential, snow or hail formation;
- Forecasting of mountain waves which are hazardous to aircrafts;
- Analysis of weather conditions for the compilation of aircraft accident reports;
- Used for now-casting;
- Use of AMDAR data to generate SIGMETs, ARMETS and SIGWX charts
- Compiling audit reports research activities and case studies.
- Short-comings: humidity data not available on AMDAR. Each sensor costs USD35,000 and the airlines are not willing to foot the bill since they do not need humidity for their operations.

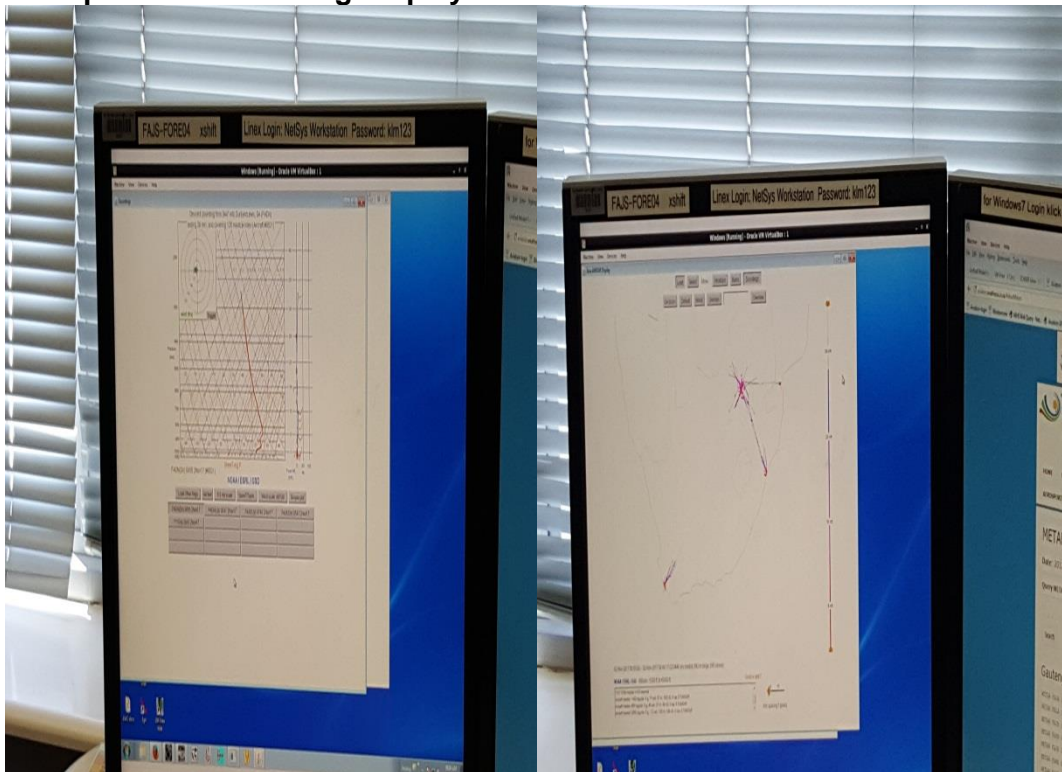
Accessing, Processing, Monitoring and Archival of AMDAR data;

- NOAA AMDAR web based portal –restricted to participating members.
- Message Handling System (MHS)
- In-house developed display tool that accesses AMDAR data from MHS (Annex 2)

Monitoring data availability and compilation of monthly reports

- Global availability stats(count) is accessed from NOAA AMDAR website: Data only available was only up to the previous Sunday.
- Site provides daily amounts generated by individual aircrafts globally and allocates this information to relevant Aerodromes
- SAWS keeps a table/checklist with all participating airports and populate it using the data from the site above
- Data quality stats is accessible monitoring website:
(<http://collaboration.cmc.ec.gc.ca/cmc/data/monitoring/>)
- The monthly reports relay availability, quality stats as well as transmission problems,

Examples of Forecasting Display Tools



Presentation 3: AMDAR at SAWS NWP - Approach, status and challenges

Mr. Morwakoma Matabane – Research Scientist (NWP)

- Improved NWP model prediction accuracy ;
- 12km model at 32 vertical levels previously but now running 72-80 vertical levels;
- Demonstrated the benefits of assimilation of AMDAR into UK Unified Model at 4km and 1.5km;
- Upgrade the UK-UM model to 200-300m resolution for the OR Tambo International Airport on research mode;
- Challenges in modeling
 - Limited computational platform with 74 of the 84Nodes with 2016 cores and 5Pbyte (5000Terra Byte) are used to run the UK-UM, leaving only 10 nodes for research.Data assimilation is not operational due to limited human capacity and exhausted computation resources that compete with the operational runs

Presentation 4: Benefits of AMDAR data to SAA

Mr Kobus Olivier - SAA Technical

- Optimum planning for fuel consumption, saving cost estimated at 2 to 3 Million US Dollars per annum;
- Planning for crew scheduling, passenger notifications and comfort;
- Route planning associated with severe weather to reduce unplanned flight deviations;
- Flight level selection to optimize efficiency.

- Reduced aircraft maintenance requirements and costs;
- Optimize flight planning, CO2 emission reduction;
- Better services from informed decision making that is based on accurate forecasts

Presentation 5: ICT Section

Mr Andrew Van Der Merwe

- Provided a detailed presentation on the AMDAR data flow and Protocols.
- AMDAR messages are received at SAWS through AFTN processed using in-house developed software and transmitted in TAC format to the GTS.
- SAWS have yet to develop a BUFR interface for the AMDAR data.
- SAA AMDAR data is received from ATNS via its AFTN network.
- Data is received in Base 40 string and encoded as the scheduler (Crontab) runs every 5 minutes and calls the software which reads and decodes the message.
- SAWS are prepared to offered KMD the in-house developed AMDAR data processing Software.
- SAWS have developed an in-house web-based tool to decode the AMDAR data into TAC ASCII format,

KMD Delegation at OR TAMBO, SAWS Aviation Weather Centre



DAY 2: ON-SITE VISITS

SAWS HQ, Bolepi House, Pretoria - KMD Delegation

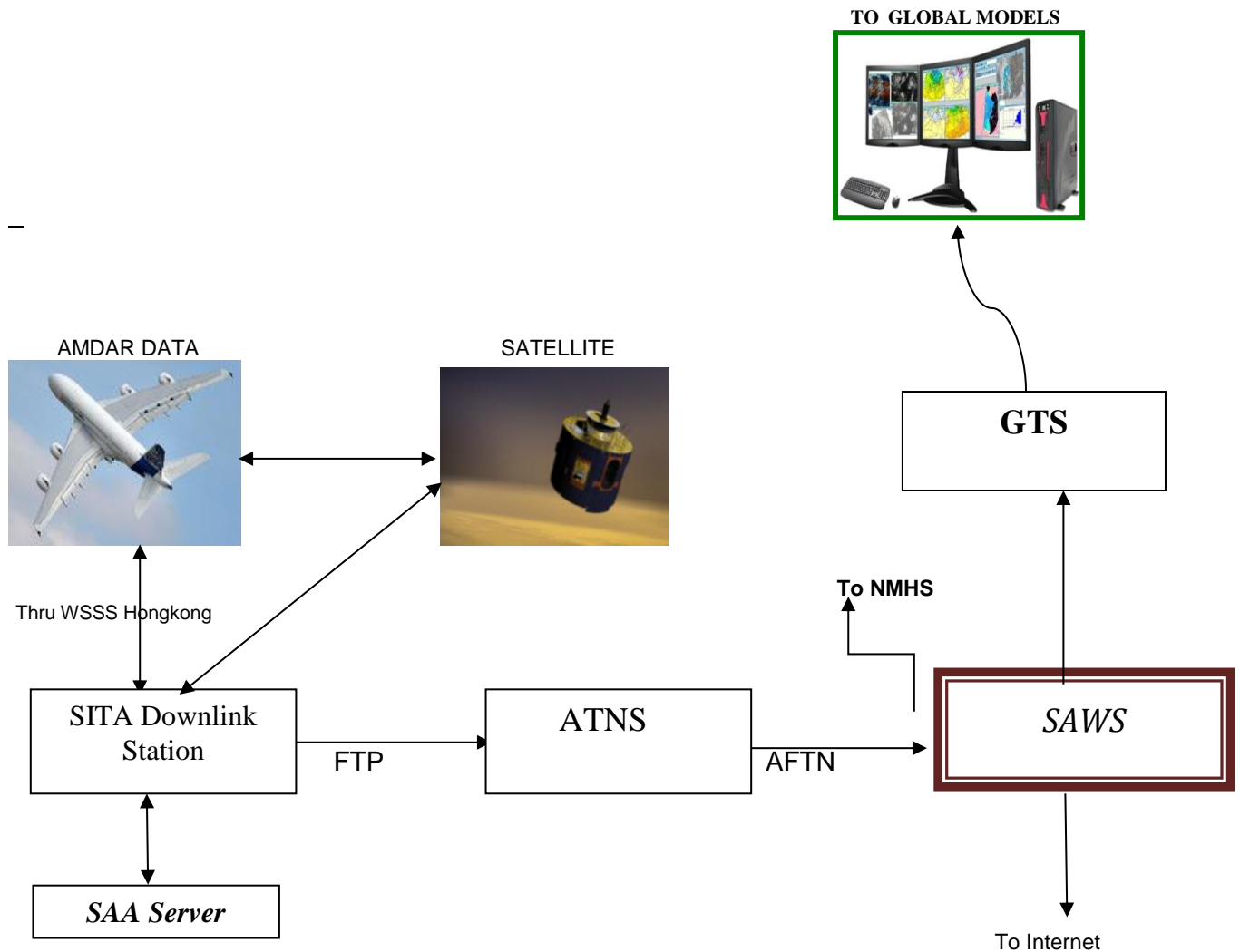
Training Section

Mr. Jannie Stander, Head of the RTC and also In-Chargen charge of Aviation Forecasting

Provided the list of courses offered at SAWS RTC include;

- Satellite Training, (Centre of Excellence), Forecasting, Marine, Aviation and Public Weather.
- Of interest was the Met. Technical Course (equivalent of Met. Technologist at KMD) which incorporate AWS maintenance which includes the removal and replacement of meteorological sensors.

FLOW OF AMDAR DATA FROM AIRRAFTS AND SATELLITES TO SAWS



Research and Development

Dr Joel Botai - Senior Scientist Applications

Overview of the Section as having 42 members, 1 Professor, 8 PHDs and 20 MSc in various.

- Provides Public Good and Commercial Services.
- SAWS is registered as an accredited National Research Institution.
- SAWS recognizes research as professional cadre within its operations.
- Active research activities in AgroMet, HydroMet, Health, Energy, Now-casting, Weather and Climate Changes are undertaken at SAWS.
- A proposal to incorporate social scientists in the SAWS cadre was being drawn up.

Climate Services

Mrs. Charlotte McBride - Ag. Senior Manager Climate Services

Provided an overview of data management which uses METCAP database and the archival and storage facilities which have data going back to the 1800s, some of which are still on paper.

- SAWS have 3 data entry clerks, 3 scientists and a stores manager.
- At the current rate/resources of data-entry, SAWS will need 26 year to clear the backlog!
- Some of the data is on microfilm.
- SAWS outsources services for paper and microfilms storage facility from a professional document handling firm.
- SAWS operates an observation network of 212 AWS, 25 Weather Offices, 25 Lightning Detection System, 163 Automatic Rainfall Stations, 8 Climate Stations 1128 manual rainfall stations, 10 Upper Air stations (1 GAW and 1 Ozone), 23 SST (Marine Stations) and 14 radars.
- SAWS outsources services for storage facility from a professional document handling firm.

KMD Delegation at NMHS Bolepi House Pretoria



Visit to SAA Technical, OR Tambo International - KMD Delegation



CONCLUSION

The Workshops were viewed as a major success from all participants, and in addition to the KMD and KQ delegates learning of the benefits and impact of AMDAR Programme, it was recommended that the communication channels remain open with their South African counterparts and that once the Programme is underway in Kenya then a visit from SAWS and SAA to Kenya be organised in early 2018 to continue with the training and learning process. Furthermore, it was recommended that KMD and KQ strengthen their working relationship and agree on a Memorandum of Understanding (MoU) which covers all pertinent elements of their partnership within the AMDAR Programme and note the mutually beneficial nature of the engagement when developing arrangements related to the sustainability of the Project. Other general benefits from both Workshops included the following:

- An improved understanding of each partner's requirements i.e. National Meteorological Service and the Airline;
- An appreciation of the required cooperation and continued interaction between the NMS and the airline;
- An improved understanding of the ICT processes, data exchange and display of information between the NMS and the airline;
- The research benefits for both parties that can be derived from the AMDAR data;
- Modalities of compensation and sharing of costs between the airline and the NMS;

SPECIFIC RECOMMENDATIONS

- i) KMD should budget for the AMDAR Projects sustainability at the end of the 2 years especially on items like Data Communication transmission costs which are quite expensive;
- ii) Maintenance costs which are approximately 10% of the establishment cost for infrastructure and assets should be considered;
- iii) The SAWS have not yet implemented AMDAR data assimilation in their models but instead have entered into a partnership with the UK Met Office who do the assimilation into the UK-Unified model. KMD may have to consider following this route as a fast step towards achieving this goal and train its staff in this area;
- iv) KMD should introduce an interactive weather briefing among the different Counties, airports and the NMC in real-time for uniform and quick dissemination of the daily forecasts;
- v) KMD to apply through WMO for access to the web-based global AMDAR data access portal located at the National Oceanic and Atmospheric Administration (NOAA) in the USA;
- vi) KMD should request SAWS for the in-house web-based tool to decode the AMDAR data into TAC ASCII format;
- vii) KMD team identified general areas of mutual collaboration between SAWS and KMD, these include research in meteorological application areas such as biometeorology (Malaria), Agro-Met and Hydromet (drought and flood monitoring).
- viii) The collaboration between KQ and KMD should be much stronger for the success of the Kenya AMDAR project. This was evident in the collaboration seen between SAWS and SAA. The collaboration can be strengthened by having frequent meetings which will help resolve any issues arising.
- ix) KQ will need to familiarize and prepare to consume the weather products that will be provisioned through the Kenya AMDAR project to derive the full benefits such as fuel savings and improved route plans.
- x) The frequency of observations helps in real time data to aviation for respective airports hence enabling airlines to make timely decision averting extra fuel burn due to holding or diversions. KQ will need to provide the weather data coming from the aircrafts at the recommended frequencies.

ANNEX 1 : Knowledge Sharing Workshop Programme

KNOWLEDGE SHARING WORKSHOPS FOR THE DEVELOPING OF FORECASTING APPLICATIONS AND PRODUCTS PRODUCTS BASED ON AMDAR DATA AVAILABILITY

KENYA METEOROLOGICAL DEPARTMENT (KMD)

KENYA AIRWAYS (KQ)

SOUTH AFRICAN AIRWAYS (SAA)

SOUTH AFRICAN WEATHER SERVICE (SAWS)

23-24 OCTOBER 2017 – KQ DELEGATION

2 -3 NOVEMBER 2017 – KMD DELEGATION

OR TAMBO INTERNATIONAL, JOHANNESBURG, SOUTH AFRICA

CONCEPT NOTE

Context

WMO-AMCOMET has commenced a project under the UK Department for International Development (DFID)/WISER programme - Weather and Climate Information Services for Africa - for the development and implementation of the Aircraft Meteorological DATA Relay (AMDAR) Programme in Kenya.

The Kenya (AMDAR) Programme is a partnership between WMO, Kenya Meteorological Department (KMD) and Kenya Airways (KQ) for the establishment and operation of a meteorological observing program facilitating the automated reporting of meteorological atmospheric information from a fleet of aircraft. The program uses the aircraft's existing sensors, avionics and telecommunications system to gather, process and disseminate data that is used directly to improve the accuracy of weather forecasting services and applications.

One of the major funded activities of the project is the Development of Forecasting Applications and Products for Aviation and other sectors - which will build on the new AMDAR Programme and resulting data availability to enhance KMD forecasting and services capabilities and also, as an additional outcome, leading to improved Kenya Airways operations and efficiencies.

As an initial element of this activity, the project wishes to collaborate with the South Africa AMDAR Programme (SAWS and SAA), by convening a workshop in Johannesburg, South Africa in October 2017, to seek the assistance and advice of SAWS and SAA on developing ideas, strategies and plans for undertaking and implementing this activity over the next 2 years of the project.

The expansion of the AMDAR program in Africa through the development of the Kenya AMDAR Program would have flow on benefits to wider Africa and to South Africa.

Objectives

1. SAWS experts to discuss with delegation on benefits of AMDAR to National Meteorological and Hydrological Services and Air Transport Industry (ATI).
2. Demonstration of products and service benefiting from AMDAR
3. SAA representatives to discuss with delegation on airline participation and benefits from changes to flight operations

4. Visit institutions
5. Brainstorm on the ideas and issues to implement the best practices

Expected outcomes

- Determine new KMD products and applications to developed based on AMDAR data availability
- Determine the KQ specific aviation services to be developed
- Determine new KQ procedures to be developed for flight operations

Proposed Time and Location

KMD Delegation - 23-24 October 2017, OR Tambo International, Johannesburg, South Africa

KQ Delegation - 2-3 November 2017, OR Tambo International, Johannesburg, South Africa

Participants

- SAA - Kobus Olivier
- SAWS - Francis Moseleho
- SAWS - Gaborekwe Khambule
- SAWS - Luthando Masimini
- SAWS - Morwakoma Matabane
- KMD – Elijah Bukachi
- KMD – Peter Mutai
- KMD – David Muchemi
- KMD – John Mungai
- KQ – Patrick. Muisyo
- KQ – Moses Oduma
- WMO – Mark Majodina
- WMO – Moyenda Chaponda

Programme

DAY 1 – 23 October 2017 / 2 November 2017

Morning Session (09:00-12:20) (tea/coffee break 10:30-11:00)

SAWS Perspective - Demonstration of products and services benefiting from SA AMDAR

- Brief Overview of South Africa AMDAR Programme (SAWS AMDAR Programme Manager)
- Presentations by SAWS experts on:
 - Management and admin of the AMDAR Program, requirements and benefits (SAWS AMDAR Programme Manager)
 - AMDAR Data Processing, Display & Utilisation (SAWS IT Manager)
How is AMDAR Data integrated into SAWS Systems and eventually the GTS through the LAN.
 - Use of AMDAR in Aviation Forecasting (SAWS Aviation Forecast Manager)
Weather products available for airline, ATC, Airport management and CAA
 - Use of AMDAR in Numerical Weather Prediction (SAWS NWP Expert)
How has the new unified model for short range forecasting utilized AMDAR products for its verification, improvement and development for users.
 - AMDAR in Public Weather and other Forecasting Applications (Forecast Services Manager)
What forecasting products are available for public weather, Severe weather demonstration Project products, early warning forecasts etc. Any new forecast products envisaged soon?

- Reflections and discussion with KMD and KQ representatives (SAWS Experts)

Lunch at 12:20-13:30

Afternoon Session (13:30–17:00) (tea/coffee break 15:00–15:30)

(SAA Perspective - Airline participation and benefits from changes to flight operations)

- Presentations on:
 - o Management and admin of the SA AMDAR Programme – requirements and benefits (SAA Engineer/Manager)
 - o Impact and Benefits to Flight Operations (SSA Flight Operations Manager)
 - Weather services and products used by SSA in flight operations
For airline and ATC/Airport
 - Fuel management
Savings with the use of AMDAR data)
- Reflections and discussions with KQ and KMD representatives(SAA Experts)

DAY2 – 24 October 2017/3 November

Morning Session (09:00-12:20) (tea/coffee break 10:30-11:00)

- Site visits to SAWS HQ, Bolepi House and SAA Technical (*AMDAR Ground Receiving Station/s, NMHS, NWP, Aviation Forecasting, SAA Flight Operations units*)
 - o Demonstration of AMDAR-related systems and products in SAWS (SAWS Experts)
 - o Demonstration of SAWS and SAA collaborations and interactions (SAWS and SAA Experts)

Lunch at 12:20-13:30

Afternoon Session (13:30–17:00) (tea/coffee break 15:00–15:30)

- Brainstorming Session and exchange of ideas
- Conclusions and reporting on outcomes of the workshops