

Appendix F Demonstration Exercise EXE-VLD-06-001 (Deploy Heathrow and Gatwick Arr-Dep Timeline in Swanwick Terminal Control) Report

F.1 Summary of the Demonstration Exercise EXE-VLD-06-001 Plan

This exercise concerns the integration of Gatwick and Heathrow Arrival and Departure information on single HMI to enable earlier runway gapping policy setting, therefore improving the delay profile and enabling Gatwick XMAN.

F.1.1 Exercise description and scope

The purpose of the Project 25 (PJ25) EXE-VLD-06-001 Operational Activities is to evaluate and to subsequently operationally trial a combined Arrival Manager (AMAN) and Departure Manager (DMAN) display in both Gatwick Tower and London Terminal Control (TC) Operations between December 2018 and March 2019. Without knowledge of the departing traffic, AMAN is at a disadvantage when trying to plan a continuously representative arrival delay prediction for single operation runway and the reverse is applicable for DMAN.

Therefore, to balance the delay experienced at both Gatwick Airport as ground delay and at NATS Swanwick as airborne delay, a single HMI display will be installed to provide AMAN and DMAN data at both the Gatwick Tower Supervisor and the TC Group Supervisor Airports (GSA) positions. This will aim to stabilise delay forecast to the point, it will be possible to introduce a 250kts descent speed trial in Swanwick AC and XMAN procedures with neighbouring ANSPs.

The associated procedures and training will be generated and delivered to support these activities.

The Operational Activities will follow a phased approach following on from Hardware/Software deployment in September 2018.

Integration of Gatwick Arrival and Departure Information on Single HMI in order to enable the airport ATC and the radar supervisors to agree a runway gapping policy at least one hour in advance. This will improve the delay predictions and provide a more stable delay profile, enabling XMAN deployment at Gatwick (single, mixed-mode runway)

The demonstration will consist of two phases, an initial Operational Evaluation followed by full Operational Trial.

F.1.2 Summary of Demonstration Exercise EXE-VLD-06-001 Demonstration Objectives and success criteria

The Objectives and success criteria for EXE-VLD-06-001 are provided in the xStream DEMOR main document, in chapter 3.4 "Summary of xStream Demonstration Plan".

They are further refined below for this exercise.

Operational Evaluation Success Criteria

During the PJ25 Evaluation the Group Supervisor Airports (GSA) and Watch Managers (WMs) will be asked to assess the AMAN/DMAN screen to provide feedback to enable the PJ25 project to move forward into the Trial phase. Data is to be collected from at least 50% of the GSA population and from all WM's across all watches, they will be asked to complete a questionnaire during the Evaluation. Data collected during the Evaluation phase will be analysed and reported to enable the PJ25 project to decide when to move into the Trial phase.

The acceptance criteria for the questions described in Table 1 below:

Measure	Acceptance Criteria
Q 1 Situation Awareness	70% ≥ improve your general situation awareness
Q2. Representative of operational traffic situation	70% ≥ Representative of operational traffic situation. (User acceptance)
Q3. Decision Making for setting Runway Spacing Policy	70% ≥ improves Decision Making for setting Runway Spacing Policy task
Q4 Additional Benefits	70% ≥ improves Decision Making for other AMAN tasks
Q5 Concerns or issues	No criteria. Just for information purposes for project

Table 1 – Evaluation Questionnaire Success Criteria

The acceptance criteria were set by the NATS Human Factors project representative and adopted by ANS, therefore will apply to both parties.

Trial Success Criteria

Statistical improvement identified based on operational feedback and statistical review during the Evaluation Phase of Arrival delay prediction over existing Arrival delay accuracy KPI figures (see Table 2 below) for 50 - 60 minutes range from airport which will enable the NATS PJ25 project to move to the Exercise 2 phase of an 250KT AC speed reduction and XMAN.

	2017			2018		
	Jul-17	Oct-17	Total	Jul-18	Oct-18	Total
Candidate Flights Per Day	46%	27%	40%	43%	35%	39%
AMAN Mean Average Predicted Delay for Candidate Flights	11.99 Minutes	10.53 Minutes	11.68 Minutes	11.15 Minutes	11.70 Minutes	11.37 Minutes
AMAN Average Accuracy for Candidate Flights vs Actual Stack Delay	7.44 Minutes Overestimate	7.00 Minutes Overestimate	7.42 Minutes	6.99 Minutes Overestimate	7.41 Minutes Overestimate	7.16 Minutes
Standard Deviation of AMAN Accuracy for Candidate Flights vs Actual Stack Delay	6.55 Minutes	6.00 Minutes	6.36 Minutes	6.43 Minutes	6.65 Minutes	6.52 Minutes

Table 2 – TC AMAN Delay Prediction Accuracy Baselines

F.1.3 Summary of Demonstration Exercise EXE-VLD-06-001 Demonstration scenarios

The Evaluation Phase will use AMAN data and DMAN data to provide an overview of the combined sequence information onto a single timeline and to allow the evaluation of data quality and any improvement of the predicted delay vs actual delay information calculated.

It will also provide TC GSA and Tower Supervisor exposure to the new presentation of AMAN & DMAN information to gain familiarisation and support the evaluation of the accuracy and benefit of the data provided and the suitability of the HMI.

Throughout the Evaluation Phase, TC Operational decisions will be based primarily on information provided by CHMI, TLPD & AMAN, whereas Gatwick Tower Operational decisions will be based primarily on previously existing information as provided by CHMI, EFPS, the ATM etc. The new AMAN/DMAN screen will be considered as secondary information for Evaluation purposes only.

An ATC Project expert will be available for agreed periods to assist with the evaluation whilst not impacting the Operation.

The purpose of this activity is to evaluate the performance of the new AMAN/DMAN display along with any changes in Group Supervisor Airports (TC) and Watch Managers (KK TWR) situational awareness.

Feedback from TC GSAs and EGKK WMs will be collected to determine whether use of the AMAN/DMAN tool will help to improve decision making and situational awareness when performing existing tasks. Main output from the evaluation phase, in addition to the user questionnaires, will be a continuous analysis of the accuracy of the delay prediction for both Arrivals and Departures over time.

To allow a data quality evaluation of the predicted delay information, DMAN parameters are continuously maintained in Gatwick Tower.

The Initial Evaluation will start once the AMAN/DMAN data sharing via NATS SWIM-WS has commenced and the GSAs and WMs have been briefed on the new display. Once this has been performed the Evaluation will be performed continuously during airport operating hours.

The Evaluation in TC and Tower commenced on the 18th December 2018 with the first briefing to the TC GSA and Tower Supervisor and completed on the 28th March 2019.

F.1.4 Summary of Demonstration Exercise EXE-VLD-06-001 Demonstration Assumptions

The assumptions concerning EXE-VLD-06-001 are provided in the xStream DEMOR main document, in chapter 3.4 "Summary of the xStream Demonstration Plan".

F.2 Deviation from the planned activities

The Heathrow AMAN/DMAN trial was unable to commence during the PJ25 timeframe due to Heathrow Tower being unable to procure and install a Web Server to provide the Departure information via PENS to the installed AMAN/DMAN client in the TC Operation.

The following objectives were not assessed during the Operational Evaluation of the combined AMAN/DMAN Gatwick HMI;

OBJ-VLD-05-001 is TMA Capacity,

OBJ-VLD-05-002 is Enroute Capacity.

The result of the EGKK AMAN/DMAN Operational Evaluation described in the section below resulted in the agreed success criteria to enter Operational Trial not being met.

Therefore, an analytical investigation into operational parameter improvements of the EGKK AMAN system was undertaken to identify whether the required improvement in delay accuracy to enter EXE-VLD-06-002 EGKK XMAN Trial could be met. This provided a statistically significant improvement in the AMAN delay prediction accuracy which allow the entry into the EGKK XMAN trial EXE-VLD-06-002.

F.3 Demonstration Exercise EXE-VLD-06-001 Results

F.3.1 Summary of Demonstration Exercise EXE-VLD-06-001 Demonstration Results

See also main document chapter 4.

The operational evaluation has not met the success criteria, this is due to the traffic situation not being deemed as sufficiently representative of the current situation at Gatwick. There were, however, several positive points gained during this evaluation:

- The feedback supports the notion that the concept is strong and would be welcomed into the ops room.
- The respondents overwhelmingly felt that the combined timeline of AMAN/DMAN would enhance their situation awareness and provide a clear graphical representation of information that they need to complete their tasks.
- In terms of decision making, the respondents largely felt that this solution would improve it and give them the information needed to plan effectively.
- A high number of participants cited that the solution would improve efficiency.

The feedback was collected from all of the watches to ensure a representative sample of the respondents. Results are shown in Figure 1.

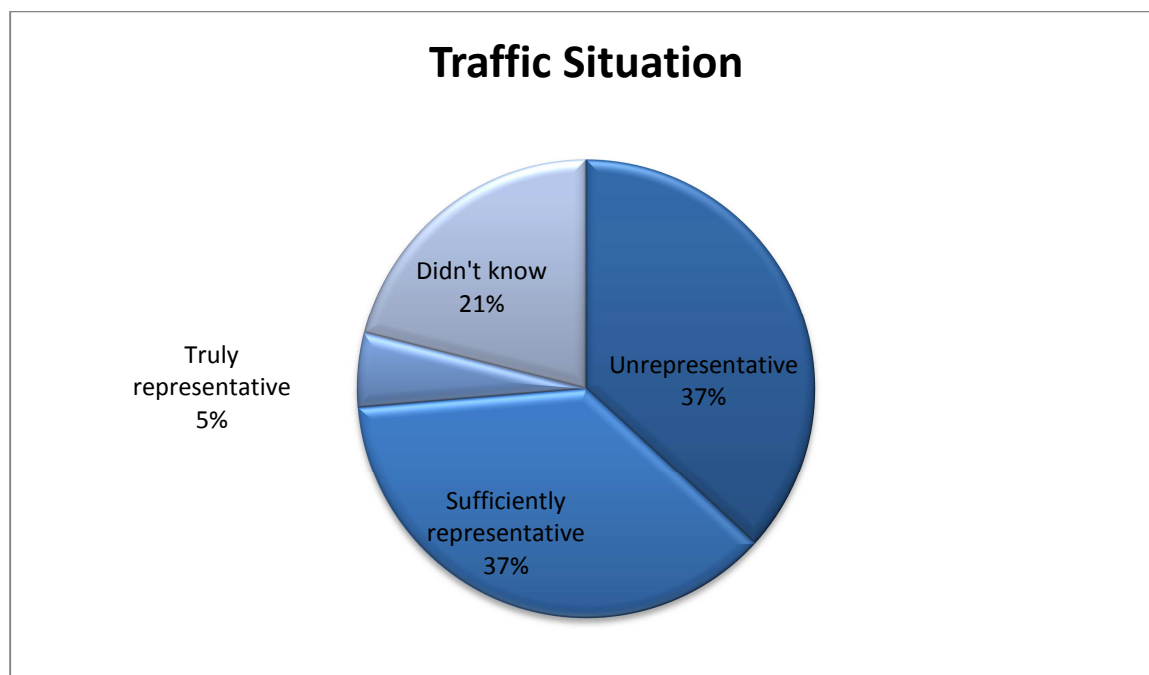


Figure 1: Questionnaire results "Is the Gatwick Departures Information on the AMAN/DMAN screen representative of the operational traffic situation at Gatwick"

Tower

Only 50% of the Tower Supervisors surveyed on the accuracy of the arrival information provided on the combined AMAN/DMAN screen deemed it to be sufficiently operationally representative. This is below the 70% success criteria for this KPA, therefore the Tower Operation concluded the AMAN/DMAN HMI could not progress into the Operational Trial Phase.

TC

The chart demonstrates that the participants were not in agreement over whether the traffic sample was representative of the situation at Gatwick. The 5% 'Truly Representative' answer represents only one respondent. However, there were seven participants who cited sufficiently representative and seven who stated unrepresentative. There were also four participants who stated that they could not provide an answer to this question. The success criteria determined for this question was that 70% or more of participants selected either sufficiently or truly representative. As the total for these two options only totals 42%, this again failed to meet the success criteria to allow the AMAN/DMAN HMI to progress to the Operational Trial Phase

There were no clear differences in responses based on watches but given the smaller than desirable sample size, this is to be expected.

The negative feedback was driven, for the most part, by concerns over the accuracy of the information provided. This concern was raised multiple times by multiple participants. As is the nature with questionnaires it is possible that this one negative aspect had an impact on other areas and resulted in more negative responses throughout all of the questions.

1. Results per KPA

a. KPA Safety

i. Quantitative Assessment

The question below was asked of the Gatwick TC GSA:

Are there any additional benefits to the display of departure information on the AMAN/DMAN screen for other AMAN related or GSA tasks?

Safety Yes/No

Efficiency Yes/No

Other Yes/No

Results are presented in Figure 2.

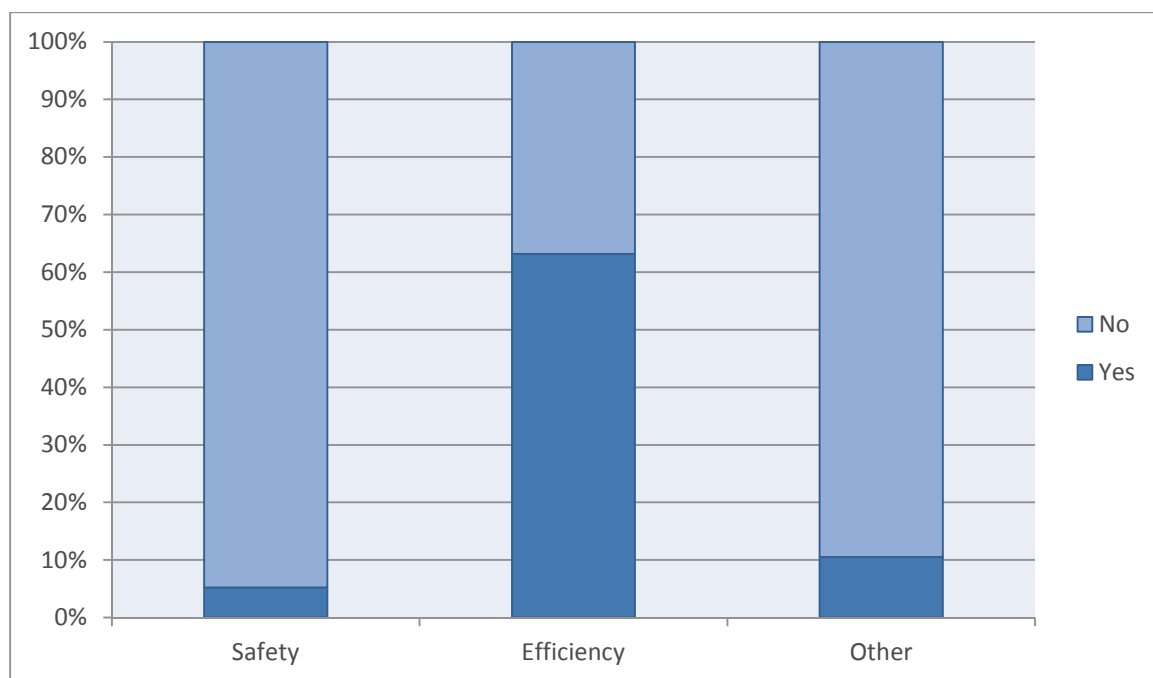


Figure 2: Questionnaire results (19 respondents from TC)

ii. Qualitative Assessment

Questionnaire results related to Safety

All but one respondent did not feel that there would be any improvement to safety as a result of the operational introduction of DMAN information combined with AMAN information in the

Founding Members



TC Operation. However, not a single respondent commented that it would have any form of negative impact on safety.

b. KPA Predictability and Punctuality

i. Quantitative Assessment

Predicted Arrival Delay

NATS Analytics was asked to compare the accuracy of AMAN predicted delay for recorded live traffic samples whilst modifying the average final approach speed which is a single value for all arriving aircraft as it had been deemed this value to be too low. The result of a low value is the overestimate of arrival delay because the AMAN system is calculating the aircraft to be flying the final approach sector of the flight too slowly. The result of this investigation concluded the configured speed of 140KT was too low and recommended an increase to 154KTS. This was deployed as an operational configuration change on the 25th July 2019 and a subsequent analytical analysis identified the improvements in Table 3 below to the predicted arrival delay.

	2017	2018	2019	
	July 2017	July 2018	Pre-config change (1-24 Jul 19)	Post-config change (27 Jul - 3 Aug 19)
Number of flts where predicted delay >= 7 mins so eligible for slow down by XMAN procedures (candidate flts) per day	46%	43%	45%	21%
AMAN avg predicted delay – all flts	6.64 mins	5.95 mins	6.47 mins	3.57 mins
AMAN avg predicted delay – candidate flts	11.99 mins	11.15 mins	11.67 mins	9.96 mins
AMAN avg accuracy – all flts vs actual airborne holding	2.91 mins overestimate	2.79 mins overestimate	2.94 mins overestimate	0.59 mins overestimate
AMAN avg accuracy – candidate flts vs actual airborne holding	6.89 mins Overestimate	6.47 mins Overestimate	6.45 mins overestimate	3.74 mins Overestimate

Table 3 – TC AMAN Delay Prediction Accuracy

ii. Qualitative Assessment

None.

c. KPA Capacity

As described in section F2, no qualitative or quantitative assessment on enroute capacity was achieved during the Operational Evaluation of the combined AMAN/DMAN HMI.

i. Quantitative Assessment

None

ii. Qualitative Assessment

Questionnaire results related to ATCO workload

No direct questions were asked on ATCO workload during the Operational Evaluation, however, subjective feedback was provided via the opportunity to expand on their answers to the first 4 questions and question 5 which asked them to raise any 'concerns or issues'.

Other subjective feedback related to ATCO workload

One comment received from the TC GSA when the participants were asked whether the Gatwick Departures Information on the AMAN/DMAN screen is representative of the operational traffic situation at Gatwick was 'GSAs do not have time to fully integrate the AMAN/DMAN'. This is arguably symptomatic of controllers perceiving any change as negative and having concerns about workload. Although this is a reasonable point for a controller to make, and is something that should be carefully monitored, it does call into question the reliability of the answers provided as it is possible that one negative concern is skewing the responses provided.

The following comments were received from the TC GSA when the participants were asked whether the addition of departures onto a combined timeline will improve decision making for the specific task of co-ordinating the 'Runway Spacing policy' with Gatwick.

- DMAN will be a distraction at best
- The screen will be very busy in summer
- I can gain much more from a 30 second conversation with the tower sup than I can from spending 10 mins looking at DMAN

These are interesting points and seem to show concern over general increased workload and a change to the nature of the way in which they perform their role. This seems to highlight more general concerns rather than specific concerns over decision making.

The following comments were received from the TC GSA when the participants were asked to write down any additional comments that they had or to raise any concerns that had not been covered by the other areas.

- Even more to look at for an already busy GSA
- Concerned that we will not have the spare capacity
- Added complexity on display
- GSA have enough information to look at without another screen

These responses cited that increased complexity could ultimately increase GSA workload.

No feedback was attained from the Tower Supervisors in relation to workload.

Questionnaire results related to ATCO situation awareness

TC

This question asked the respondents to assess whether they anticipated that the addition of departures information as a combined timeline on the AMAN/DMAN display will improve their general situation awareness for Gatwick Traffic. For this question, there was a simple yes or no response required. This question received a positive response, with 16 respondents stating yes, 2 opting for no and one person who commented 'possibly'. The success criteria for this question was the same as above, with 70% or more of respondents stating that it would improve their situation awareness. At just over 84% providing a yes answer, this meets the success criteria.

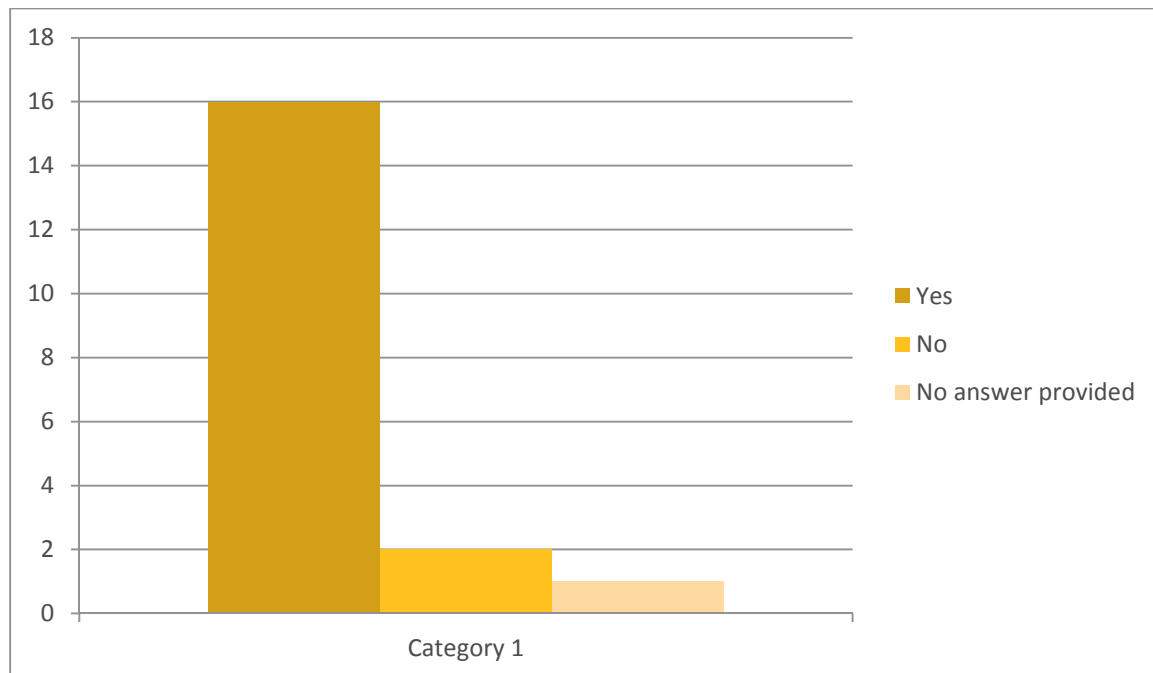


Figure 3: Responses to whether the departure information improves Situation Awareness

The feedback on this section was overwhelmingly positive and most respondents commented that this would give them a greater clarity of outbound delay, a clear visual representation of the situation and would enhance their overall picture. The two respondents



who did not say that they thought this would improve their situation awareness gave two different reasons as to why. One person commented that it would need to be integrated with their current AMAN in order to be relevant and the other person linked it to the traffic situation and commented that as this was unrepresentative then their situation awareness would not improve. Despite these two comments, it is clear from the questionnaire data that the consensus is that this will improve Situation Awareness and the feedback highlighted that this would be welcomed by the controllers.

Tower

1. Do you anticipate that the addition of arrivals information as a combined timeline on the AMAN/DMAN display will improve your general situation awareness for Gatwick traffic? Yes/No

ATCOs	1	2	3	4	5	6	7	8	9	10	11	12
Response	Yes	Yes	Yes	No	Yes	No	N/C	Yes	Yes	Yes	Yes	N/C

80% of Tower Supervisors agreed that the provision of Arrival information on a combined AMAN/DMAN HMI would improve their general situational awareness, resulting in a pass for this acceptance criteria.

Other subjective feedback related to ATCO situation awareness

TC

The third question asked related to decision making, specifically whether the addition of departures onto a combined timeline will improve decision making for the specific task of co-ordinating the 'Runway Spacing policy' with Gatwick.

Respondents were given a yes or no option for this question. The responses consisted of 14 people who felt that it would improve decision making and 5 respondents who said that it would not improve this area. Based on the success criteria of 70% or more respondents agreeing that it would improve their decision making, this question meets the success criteria at 74%. The positive comments received on this question included:

- You are more informed with this information
- GSA can agree spacing periods for efficiency and delay management

Tower

3. Do you anticipate that the addition of arrivals information as a combined timeline on the AMAN/DMAN display will improve decision making for the specific task of co-ordinating the 'Runway Spacing policy' with TC? Yes/No

ATCOs	1	2	3	4	5	6	7	8	9	10	11	12
Response	Yes	Yes	Yes	Yes	No	No	N/C	Yes	Yes	No	Yes	N/C

70% of Tower Supervisors agreed that the provision of Arrival information on a combined AMAN/DMAN HMI would improve their decision making for the specific task of co-ordinating the 'Runway Spacing Policy' with TC, resulting in a pass for this acceptance criteria.



2. Results impacting regulation and standardisation initiatives

Not applicable.

F.3.2 Analysis of Exercises Results per Demonstration objective

1. EXE-VLD-06-001 OBJ-VLD-01-001 Results

This objective was to show that xStream operational improvements are respecting the current level of safety in air traffic management.

The corresponding success criterion is fulfilled when the safe management of traffic by ATC is not compromised and new procedures do not cause critical incidents.

As identified in F3.1, no safety degradation or improvement was identified by the introduction of a combined AMAN/DMAN HMI in the Gatwick TC or Tower Operations.

The objective can be considered fulfilled.

2. EXE-VLD-06-001 OBJ-VLD-02-001 Results

This objective was to show that xStream operational improvements provide a better predictability and punctuality of air traffic in TMA / terminal sectors.

The corresponding success criterion is fulfilled when differences between planned / predicted and actual traffic flow at prominent points or at the runway are reduced.

Predicted Arrival delay was reduced.

50% of Gatwick Tower Supervisors and 42% of TC GSA concluded that the predicted arrival and departure delay information provided was sufficiently accurate at the time of the Operational Evaluation.

Subsequent improvements to the TC AMAN delay accuracy was achieved by the modification of the approach speed configuration.

The Gatwick Tower DMAN delay information is anticipated to improve with a plan set out by the airport to re-enter Eurocontrol Network Management Airport Collaborative Decision Making (A-CDM) operations and a future accuracy assessment by both Tower and TC is scheduled.

The objective can be considered fulfilled.

3. EXE-VLD-06-001 OBJ-VLD-05-001 Results

This objective was to show that ATC capacity usage in TMA is optimized by xStream operational improvements.

The corresponding success criterion is fulfilled when Traffic load, ATC workload or complexity in terminal sectors is reduced.

ATCO Situation Awareness as one enabler of ATC capacity was increased. However, the impact on ATCO workload was not explicitly rated negative but nevertheless seen sceptical. Further, some acceptance issues were raised.

4. EXE-VLD-06-001 OBJ-VLD-05-002 Results

This objective was to show that available enroute sector capacity allows the application of xStream operational improvements.

The corresponding success criterion is fulfilled when Traffic load, ATC workload or complexity in enroute sectors do not exceed available capacity.

As described in section F2, no qualitative or quantitative assessment on enroute capacity was achieved during the Operational Evaluation of the combined AMAN/DMAN HMI.

F.3.3 Unexpected Behaviours/Results

None identified.

F.3.4 Confidence in the Demonstration Results

1. Level of significance/limitations of Demonstration Exercise Results

The NATS PJ25 Human Factor & Safety & Gatwick Tower project focal points agreed that Data was to be collected from at least 50% of the GSA population and from all WM's across all watches via the questionnaire that needed to be completed during the Operational Evaluation to align with accepted HF principles.

The accuracy of the DMAN information provided by Gatwick tower was always anticipated to be not fully operationally representative. This is due to the requirement for the DMAN parameters to be maintained as a 'best endeavour' by the Tower Supervisor as the DMAN system is considered non-operational until the airport re-enters A-CDM operations.

2. Quality of Demonstration Exercise Results

NATS has no concerns with the quality of the results summarised in this report related to the Operational Evaluation of the combined AMAN/DMAN HMI.

3. Significance of Demonstration Exercises Results

Not applicable.

F.4 Conclusions

The results show that by meeting the required acceptance criteria for ATCO Situational Awareness and associated Decision Making there is a clear benefit to combining AMAN & DMAN data into a single HMI and providing this information to an airports Approach and Tower operation. However, this benefit can only be realised if the data being presented is fully operational and of significant accuracy when compared to the live operational traffic situation

F.5 Recommendations

F.5.1 Recommendations for industrialization and deployment

This section contains recommendations for industrialization and deployment phases:



- A full set of Operational ATCO user requirements is required to design a suitable HMI to be used in an operational environment
- The HMI provided to meet the requirements should be subject to standard verification and validation methodology
- Operational accuracy of Arrival (AMAN) and Departure (DMAN) should be determined and acceptable levels agreed
- Acceptable levels of training on new combined AMAN/DMAN HMI should be established
- Appropriate Method of Operations/Procedures should be provided to ATCO users to ensure correct interpretation and application of the data provided
- The HMI shall be subject to standard Human Factors and Safety Assessment process

F.5.2 Recommendations on regulation and standardisation initiatives

It is recommended to:

Standardize the XML format for the exchange of requests between an approach and tower AMAN and DMAN data