



A Human Performance Assessment of the Multi-Sector Planner Concept – iFACTS Quick Win in Step 1

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Abstract

The purpose of this work was to optimise further the deployment of ATC staff in relation to the traffic conditions they are required to manage. The proposal is to achieve this by a combination of introducing enhanced planner support tools and more flexible sector manning configurations. This document describes a high-level review of the issues and benefits of the enhanced planner tools and the flexible controller working configurations (i.e. current working configurations, interim multi-sector planner (iMSP) and single person operations (SPO)) and transitions into and out of these configurations. A set of recommendations was developed from a human performance perspective for the tools and staffing configurations. This first phase of work has been fulfilled using input from a relatively small but representative sample of en route controllers, some of whom already had experience of the proposed tools, obtained during developmental simulations. Controller opinion and feedback was gathered and assessed by Human Factors Specialists to derive a set of issues and benefits associated with flexible working configurations and the enhanced planner tools, together with a series of recommendations that should be addressed in the next stage of this work.

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Table of Contents

EXECUTIVE SUMMARY	5
1 INTRODUCTION	7
1.1 PURPOSE OF THE DOCUMENT	7
1.2 INTENDED READERSHIP	7
1.3 SCOPE OF THE DOCUMENT	7
1.4 HUMAN PERFORMANCE WORK SCHEDULE WITHIN THE PROJECT	7
1.5 STRUCTURE OF THE DOCUMENT	7
1.6 ACRONYMS AND TERMINOLOGY	7
2 HUMAN PERFORMANCE ASSESSMENT	10
2.1 DESCRIPTION OF BASELINE AND ASSUMPTIONS – HUMAN PERFORMANCE SPECIFICS.....	10
2.1.1 <i>Description of the baseline/reference scenario</i>	10
2.1.2 <i>Description of the solution scenario</i>	10
2.1.3 <i>Consolidated list of assumptions</i>	10
2.1.4 <i>Related WP 4-15 projects to be considered in the HP assessment</i>	10
2.2 SCREENING AND SCOPING THE IMPACT OF THE CHANGE	11
2.3 SUMMARY OF MAIN HP IMPACTS - HP ASSESSMENT OBJECTIVES - HP ACTIVITIES AND OUTCOMES.....	12
2.3.1 <i>Issues and impacts, HP assessment objectives</i>	12
2.4 HP ASSESSMENT FINDINGS AND CONCLUSIONS.....	23
2.4.1 <i>Main findings per HP assessment objective</i>	23
2.4.2 <i>HP maturity of the concept addressed by the project</i>	23
2.4.3 <i>Conclusions</i>	23
3 REFERENCES	25
ANNEX A - HUMAN PERFORMANCE ISSUE REGISTER	26
ANNEX B - HUMAN PERFORMANCE RECOMMENDATIONS REGISTER	35

List of tables

Table 1: Description of the change	11
Table 2: Enhanced Planner Tools and Flexible Controller Working Configuration Review	14

Executive summary

The purpose of this work was to optimise further the deployment of ATC staff in relation to the traffic conditions they are required to manage. The proposal is to achieve this by a combination of introducing enhanced planner support tools and more flexible sector manning configurations. This study reports upon work to conduct a high-level review, from a human performance perspective, of the issues and benefits associated with the enhanced planner tools (see technical specification for full details [1] – [8]) and the flexible controller working configurations (i.e. current working configurations, interim multi-sector planner (iMSP) and single person operations (SPO)) and transitions into and out of these configurations.

Controller opinion and feedback was gathered and assessed by Human Factors Specialists from a human performance perspective, in the context of London Area Control operations in NATS. Most of the controllers who participated had experienced the use of the proposed tools during developmental simulations.

The predicted consequences of changing the staffing configuration (1P to 2T or SPO), based on input from controllers, may be summarised as follows:

- Some reduction in the tactical controller's ability to manage tasks in a timely fashion, particularly when dealing with unusual events or emergencies, which could also have effects on other sectors.
- Some reduction of situation awareness for the planner, in 1P-2T configuration, e.g. may be less aware of both tacticals' traffic due to divided attention.
- A possible change in the number of handovers which is yet to be determined – this may be an increase to maximise the flexibility of the staffing configurations (i.e. frequently swapping between 1P-1T and 2x1P-1T) or fewer tactical handovers (as the sectors might stay in the 1P2T configuration rather than swapping between 1P-1T and 2x1P-1T).

Based on the information obtained in this study, the extent of these effects is likely to be sector dependent, particularly with regard to the nature of the sectors involved and the traffic flows therein.

Predicted consequences of some features of the enhanced planner toolset include:

- Controller confusion as a result of the way in which strip recovery is handled by the system, and the lack of strip prioritisation.
- The missing of a flight strip due to use of the 'Tidy' function (strip dropped when should be retained).

These issues should be amenable to remedy through design modifications to the system and HMI.

Controller opinion was positive towards the enhanced planner tools. A number of potential issues were identified and it was possible to produce recommendations tailored to address these in future work. Key benefits of the enhanced tools identified by this study include the following:

- Consolidation of legacy NERC tools (Look See/What If, Planner EFS) with an operating environment being significantly dependent on trajectory prediction.
- More staffing configurations to choose from, to suit traffic, time of year, sector differences etc.
- Development of current system core capabilities (interim Future Area Control Tools Support (iFACTS) in NATS' case) (trajectory prediction, medium term conflict detection, flight path monitoring) to support planner decision making as follows:
 - Reduce the workload associated with agreeing entry and exit coordinations.

- Provide a better picture of future interactions in the planning time horizon.
- Reduce the workload associated with the planner's tasks by providing tools that support decision making.
- Facilitate improved communication of boundary agreements through coordination conditions.
- Identification to the Planner of potential workload for the Tactical(s) when considering co-ordination decisions.

Of the three controllers who took part in the workshops, opinion was very positive towards the potential benefits of the enhanced planner tools and flexible working configurations. A number of potential issues were highlighted for which mitigation appears to be available and recommendations have been made to reflect this.

On the basis of this initial work the tools and working configurations are considered to be worthy of further investigation, as the work has shown there to be potentially many benefits to implementing this toolset and working configurations into the operational context.

1 Introduction

1.1 Purpose of the document

The purpose of this document is to describe the result of the high-level human factors review conducted to date of the issues, benefits and top level recommendations associated with proposed enhanced tools [1] – [8] and flexible controller working configurations in en route operations with reference to the Human Performance (HP) assessment process. Further to this, a number of recommendations are described based on a human factors analysis of the findings.

1.2 Intended readership

This document is intended primarily for the SESAR audience with an interest in human performance and safety. It is also of interest to research and development staff working on proposed enhanced planner tools.

1.3 Scope of the document

This document represents a human factors technical note reporting on the activities carried out in two workshops with controllers and the findings of this exercise.

1.4 Human performance work schedule within the project

The Human Performance assessment activities for this aspect of 478 started in May 2012 and finished in August 2012.

1.5 Structure of the document

This document conforms to the appropriate SESAR template for HP Assessment activities. The main sections of this report are an introduction describing the purpose of the work, followed in section 2 by a description of the baseline scenarios relating to this human performance assessment. This section also captures the issues and impacts highlighted, together with the benefits identified. The main activities and outputs of this study are presented in a table (Table 2) of this document as per the template. Issues are itemised in Annex A, and recommendations in Annex B.

1.6 Acronyms and Terminology

Term	Definition
Human Factors (HF)	HF is used to denote aspects that influence a human's capability to accomplish tasks and meet job requirements. These can be external to the human (e.g. light & noise conditions at the work place) or internal (e.g. fatigue). In this way, "Human Factors" can be considered as <i>focussing on the variables that determine Human Performance</i> .
Human Performance (HP)	HP is used to denote the human capability to successfully accomplish tasks and meet job requirements. In this way, "Human Performance" can be considered as <i>focussing on the observable result of human activity in a work context</i> . Human Performance is a function of Human Factors (see above). It also depends on aspects related to Recruitment, Training, Competence, and Staffing (RTCS) as well as Social Factors and Change Management.
HP activities	HP activities are evidence-gathering activities that are carried out as part of Step 4 (Arguments & Evidence) of the HP assessment process. They can

Term	Definition
	comprise, among others, activities such as task analyses, cognitive walkthroughs, and experimental studies.
HP assessment	An HP assessment is the documented result of applying the HP assessment process to the SESAR project-level (i.e. WP4-15 projects). HP assessments provide the input for the HP case.
HP assessment process	The HP assessment process is the process by which HP aspects related to the proposed changes in SESAR are identified and addressed. It covers the conduct of HP assessments on the project-level as well as the HP case building over larger clusters of projects. Further development of this process constitutes the scope of Project 16.04.01.
HP benefit	An HP benefit relates to those aspects of the proposed ATM concept that are likely to have a positive impact on human performance.
HP Case	An HP case is the documented result of combining HP assessments from projects into larger clusters (e.g. Operational Focus Areas, deployment packages) in SESAR.
HP issue	An HP issue relates to those aspects in the ATM concept that need to be resolved before the proposed change can deliver the intended positive effects on Human Performance.
HP impact	An HP impact relates to the effect of the proposed solution on the human operator. Impacts can be positive (i.e. leading to an increase in Human Performance) or negative (leading to a decrease in Human Performance).
HP recommendations	HP recommendations propose means for mitigating HP issues related to a specific operational or technical change. HP recommendations are proposals that require additional analysis (i.e. refinement and validation). Once this additional analysis is performed, HP recommendations may be transformed into HF requirements.
HP requirements	HP requirements are statements that specify required characteristics of a solution from an HF point of view. HP requirements should be integrated into the DOD, OSED, SPR, or specifications. HF requirements can be seen as the stable result of the HF contribution to the project, leading to a redefinition of the operational concept or the specification of the technical solution.
iFACTS	Interim Future Area Control Toolset. This was implemented on NATS' en route ATC system in 2011 and provides a suite of tools built around medium term conflict detection, which supports the tactical controller.
iMSP	Interim Multi-Sector Planner: variable staffing configuration whereby one planner covers more than one tactical controller.
LAS	Local Area Supervisor: staff member responsible for the supervision of the sectors in a Local Area Group.
LAG	Local Area Group – a defined set of sectors in geographic proximity
MTCD	Medium Term Conflict Detection – trajectory prediction determines the likely future positions of aircraft (in 4D) which are then processed by MTCD to predict how close aircraft, based on the proximity of the associated areas of

Term	Definition
	uncertainty, will come to one another.
SPO	Single Person Operations: where one operator covers the role of Tactical and Planner combined.

2 Human Performance Assessment

2.1 Description of Baseline and Assumptions – Human performance specifics

2.1.1 Current en route operation, with tactical and planner supported by existing iFACTS. Description of the baseline/reference scenario

N/A - Not applicable to activity described in this study.

2.1.2 Description of the solution scenario

As discussed in this document.

2.1.3 Consolidated list of assumptions

N/A - Not applicable to activity described in this study.

2.1.4 Related WP 4-15 projects to be considered in the Human performance assessment

N/A - Not applicable to activity described in this study.

2.2 Screening and Scoping the Impact of the Change

This section describes the main HP-related impacts of the changes resulting from the proposed concept in terms of who will be impacted and how, and identifies the impacted HP work areas, the focus of the HP assessments.

Table 1: Description of the change

HP WORK AREA/SUB-AREA	CHANGE & AFFECTED ACTORS
PROCEDURES , ROLES & RESPONSIBILITIES	
ROLES & RESPONSIBILITIES	<p>CHANGING FROM A TEAM OF ONE PLANNER AND ONE TACTICAL CONTROLLER (1P-1T), TO ONE PLANNER AND TWO TACTICAL CONTROLLERS (1P-2T), AND ALSO CHANGING TO SINGLE PERSON OPERATIONS (SPO), I.E. ONE PERSON OPERATING AS BOTH TACTICAL AND PLANNER CONTROLLER (IF TRAFFIC LEVELS AND COMPLEXITY ALLOW).</p> <p>LOCAL AREA SUPERVISOR (LAS) WILL HAVE ULTIMATE RESPONSIBILITY FOR CHANGING BETWEEN CONFIGURATIONS BUT THE PLANNER (OR PLANNERS) WILL BE BEST PLACED TO INITIATE CHANGING BETWEEN CONFIGURATIONS. THIS WILL BECOME AN ADDITIONAL ELEMENT OF THESE ROLES.</p>
PROCEDURES	<p>NOT AN EXPLICIT PART OF THIS PHASE OF THE WORK. THE IMPACT ON PROCEDURES WAS DISCUSSED BUT POTENTIAL CHANGES TO THEM COULD NOT BE ASSESSED, AS THEY HAD NOT BEEN DEVELOPED TO SUFFICIENT DETAIL AT THE TIME OF THIS STUDY. TO BE EXPLORED AT A LATER PHASE OF THE WORK WHEN PROCEDURES HAVE BEEN DEVELOPED.</p>
TASKS	<p>ADDITIONAL TASKS AND REVISED TASKS ASSOCIATED WITH WAYS OF WORKING WITH THE ENHANCED PLANNER TOOLSET AND REVISED STAFFING CONFIGURATIONS.</p>
HUMAN & SYSTEM	
ALLOCATION OF TASKS	<p>INCREASED FLEXIBILITY IN THE ALLOCATION OF TASKS BETWEEN TACTICAL AND PLANNER. GREATER ABILITY TO SHARE SOME TACTICAL CONTROLLER TASKS.</p>
PERFORMANCE OF TECHNICAL SYSTEM	<p>SET OF ENHANCED PLANNER TOOLS PROVIDED TO ASSIST THE PLANNER ROLE</p>
HUMAN – MACHINE INTERFACE	<p>INTEGRATION OF ENHANCED PLANNER TOOLS INTO THE EXISTING NATS SYSTEM (IFACTS). THE TOOLS ARE THE SAME FOR ALL STAFFING CONFIGURATIONS, WITH THE EXCEPTION OF INTEGRATED COORDINATION, WHICH IS AVAILABLE FOR SPO ONLY.</p> <p>ADDITION OF WIRELESS HEADSET FOR PLANNER IN INTERIM MULTI SECTOR PLANNER (iMSP) CONFIGURATION.</p>
TEAMS & COMMUNICATION	
TEAM COMPOSITION	<p>TEAM STRUCTURE CHANGES FROM FOUR ACTORS (I.E. CURRENTLY 2 DISTINCT TEAMS) TO THREE (I.E. TWO TACTICALS EACH WORKING WITH A PLANNER TO ONE PLANNER WORKING WITH TWO TACTICAL CONTROLLERS). IN</p>

	SINGLE PERSON OPERATIONS ONE ACTOR IS CONTROLLING TRAFFIC.
ALLOCATION OF TASKS	ALLOCATION OF TASKS FOR THE TEAM IS VERY LIKELY TO CHANGE BUT AS TO HOW IS YET TO BE DETERMINED.
COMMUNICATION	COMMUNICATIONS MAY BE IMPACTED WHERE ONE PLANNER HAS TO DIVIDE ATTENTION BETWEEN TWO TACTICALS. THIS SHALL BE EXPLORED IN LATER STUDIES.
WORKING ENVIRONMENT	
WORKPLACE LAYOUT	CONFIGURATION OF WORKSTATIONS MAY BE CHANGED WITH ONE PLANNER SEATED BETWEEN TWO TACTICAL CONTROLLERS OR BESIDE ONE OR OTHER OF THE TWO TACTICALS. THIS SHALL BE EXPLORED IN LATER STUDIES.
PHYSICAL ENVIRONMENT	UNAFFECTED OVERALL
ORGANISATION & STAFFING	
COMPETENCE REQUIREMENTS	UNDERSTANDING OF MULTI-SECTOR PLANNER (iMSP) ROLE; FAMILIARITY WITH ENHANCED PLANNER TOOLS
STAFFING REQUIREMENTS & STAFFING LEVELS	INCREASES POSSIBILITY OF STAFFING FLEXIBILITY WITHIN THE OPERATION
REGULATORY REQUIREMENTS	UNCHANGED
TRAINING & DEVELOPMENT	
TRAINING REQUIREMENTS	FAMILIARITY WITH ROLE CHANGES UNDER MULTI-SECTOR PLANNING; TRAINING ON ENHANCED PLANNER TOOLS., TRAINING FOR LACK OF REDUNDANCY AND FALLBACKS.
TRAINING DESIGN	SUPPLEMENT EXISTING KNOWLEDGE / SKILLS

2.3 Summary of main Human Performance Impacts – Human Performance Assessment Objectives - HP Activities and Outcomes

This section presents:

- The main changes identified through the analysis and discussion, which may result from the introduction of enhanced planner tools and flexible controller working configuration.

2.3.1 Issues and impacts, Human Performance assessment objectives

The aim of this study was to conduct a preliminary high-level review of the enhanced planner tools and flexible controller working configurations (e.g. interim multi-sector planner (iMSP) and single person operations (SPO)). This study was to be performed in this instance from a human factors viewpoint. The outcome priorities were consideration of:

- the issues;
- the benefits;
- the high-level recommendations related to the enhanced planner tools and staffing configurations.

Table 2: (page 11) provides an overview of the content of each of the HP activities and of the main findings.

Table 2: Enhanced Planner Tools and Flexible Controller Working Configuration Review

	Enhanced Planner Tools and Flexible Controller Working Configuration Review
DESCRIPTION / OBJECTIVE	Examine the potential for enhanced planner tools to increase en route capacity, whilst maintaining safety, with greater flexibility of staffing. Conduct a high-level review of the issues, benefits and recommendations from a human performance perspective for flexible controller working configurations (iMSP and SPO) that would be supported by a set of enhanced planner tools.
ADDRESSED HP ASSESSMENT OBJECTIVES	<p>Identification of potential human performance outcomes associated with the use of:</p> <ul style="list-style-type: none"> • Flexible tactical/planner role configuration • Enhanced (multi-sector) planner tools*. <p>*It should be noted that although there are tools specifically to support the proposed 1P-2T configurations, the majority of the enhanced Planner tools are just as applicable to (and should provide benefit for) a standard 1P-1T team.</p>
ISSUES ADDRESSED / INVESTIGATED (FROM ISSUE ANALYSIS)	<p>Although the original concept at the outset initially included tools tailored to support planning tasks, the eventual implementation of iFACTS was reduced in scope to include tools for the Tactical role only hence there is a gap in the capability of the iFACTS system (although Planners have access to, and have successfully made use of, the tactical tools to aid some of their decisions and awareness of the tactical situation). Whilst tactical controllers are supported by an extensive set of tactical tools which assist their situation awareness, decision making, etc., in current operations planners have few (if any) dedicated tools above those basic co-ordination functions that have been available from LACC’s move to the NERC system (electronic co-ordination, LookSee and WhatIf, etc.). iFACTS has helped to increase the capacity of tacticals but now planners are becoming the ‘capacity limit’ in the system in some sectors due largely to this lack of planner specific tools. There is now a desire to extend the capabilities of iFACTS by adding tools specifically addressing core aspects and responsibilities of the planner role.</p> <p>The provision of a set of tools specifically to support the planner may also permit a greater degree of flexibility at each sector position. Currently, each control team must be made up of one tactical and one planner. Enhanced tools may permit different staffing configurations to be deployed in individual sectors at the discretion of supervisory staff offering the potential to “open” more sectors more often, thus increasing the capacity and efficiency of the Centre.</p>
TOOL/METHOD USED	This high-level Human Factors review was carried out by examining the current en route tactical and planner roles and responsibilities and identifying elements that would be impacted by proposed flexible working configurations and enhanced planner tools. A task analysis was used as a starting point to identify the tasks likely to be affected.

	<p>The main review was based upon workshops with operational controllers from the London Area Control (LAC) function at the Swanwick Centre. A proportion of participants were invited that had had recent experience of proposed planner tools during development simulations conducted in February and March 2012. Other participants had no prior knowledge of the tools proposed to support flexible configurations. This provided a mix of knowledge and experience. The impact of the change on the Local Area Supervisor role, within the LAC context, was also considered.</p> <p>The first workshop (with three en route controllers) was carried out on 14th June 2012 and aimed to introduce participants to the concept of proposed flexible controller working configurations such as multi-sector planner (i.e. 1 planner and 2 tacticals) and SPO. The workshop aim was to work from first principles to highlight:</p> <ul style="list-style-type: none"> • Benefits and issues to the operation that might arise as a result of a flexible approach to manning the operational sectors. • Recommendations to facilitate flexible working configurations, paying particular attention to the planner role. <p>Whilst a quantitative measure of the issues was outside the scope of this study, an assessment of the general impact on the operation was conducted.</p> <p>The main flexible working configurations discussed were:</p> <ul style="list-style-type: none"> • 1 Planner and 1 Tactical (i.e. current situation). • 1 Planner for 2 Tacticals (referred to as Interim Multi-sector Planner – iMSP). • Single person operations (i.e. one controller fulfilling the combined roles of Tactical and Planner on a sector or banded sectors). <p>The second workshop (with two controllers and two system subject matter experts) focused more closely on the nature of the tools required to support flexible working configurations. A number of tools already under development were demonstrated to the participants (some of whom had had the opportunity to use them in simulations). This workshop aimed to further refine the set of issues and benefits.</p> <p>The subset of controllers used in both workshops are regarded as representative of the group of controllers that had simulation experience of the tools and staffing configurations and represented most of the sector groups from the en route operation.</p> <p>General feedback from participants suggested that the approach was rigorous. It is also considered that because the controllers that participated constituted a small but representative sample of the general population, it is legitimate to extrapolate the findings from these individuals to the entire planner controller population, although there may be some particular issues specific to each sector or sector combination.</p>
<p>ACTIVITY INFORMATION</p>	<p>See previous section.</p>
<p>SUMMARY OF MAIN FINDINGS</p>	<p>The predicted consequences of introducing the enhanced planner tools and changing the staffing configuration (1P and 1T, 1P and 2T or</p>

	<p>SPO) may be summarised as follows:</p> <ul style="list-style-type: none"> • Increased flexibility of operational sectors and sector groups. • Increased planner capability and potentially capacity. • Changes in the dynamics of the way that staff interact with each other. <p>Related to these findings is a requirement for stringent role definition (for each staffing configuration) and appropriate training for the enhanced tools and transitions into and out of the staffing configurations. While the Local Area Supervisor (LAS) role does not inherently change, they will need further training to manage this.</p> <p>There is considered to be a high probability that the extent of these effects may be sector dependent, particularly with regard to the nature of the sectors involved (i.e. location, possible splits, etc.), whether vertically or horizontally arranged, such that the physical location of the single planner in the 1P-2T configuration could be critical.</p> <p>Considerable benefits accruing from introduction of the enhanced planner toolset were identified (see ‘Benefits’ section of this table); the consensus among controllers was that there was a distinct and urgent need for these refinements to iFACTS and that their implementation should be facilitated as quickly as possible.</p> <p>The Human Factors view is that:</p> <ul style="list-style-type: none"> • Controllers appear to be highly motivated to embrace the concepts of flexible working configurations as long as they are supported by appropriate tools. • On the basis of the work undertaken, it is apparent that some sectors would be likely to obtain greater benefit from flexible working configurations and enhanced planner tools more than others (see ‘1. Future Considerations’ below). • The residual issues appear to be around workload concerns associated with divided attention and role confusion. The loss of the planner as a second pair of eyes is not thought to be a significant drawback as long as support tools take on much of this function.
<p>NEWLY IDENTIFIED ISSUES</p>	<p>At a high level, the planner’s role is to coordinate traffic in and out of the sector and to ensure that a safe balance is drawn between moving the traffic in an expeditious way and ensuring the Tactical does not become overloaded through “goals” (e.g. co-ordinations) that are unachievable given the traffic level and sector constraints – i.e. excessive complexity at high traffic levels. Further to this the planner also acts as another pair of eyes and ears on the sector, monitoring the iFACTS Separation Monitor (SM) for the tactical and alerting them to any unusual situations, issues etc.</p> <p>A number of issues were identified with regards to the concept of having a shared planner or operating as a single person, covering both tactical and planner tasks.</p> <p>This section captures the issues identified and references the associated recommendations, which are summarised in Annex A and B respectively.</p> <p>1. Future Considerations</p>

ID 1.1: Some sectors may be better suited to iMSP than others:

- Based on experience in simulations, one controller felt sectors that were adjacent but quite separate were easier to work than those that had interactions (i.e. those with intermediate boundaries that had very few flights passing from one tactical sector to the other within the team). Vertically divided airspace was more difficult to manage for the planner (in the 1P-2T configuration), and it was more difficult to judge the workload of the tactical controllers for each sector/group of sectors. It should be noted that this view may have been significantly influenced by the particular traffic flows in particular sectors in the simulations the controller participated in.
- It is anticipated that all Sectors and Local Area Groups (LAGs) should be able to use iMSP tools in the 1P-2T configuration, at certain times during a 24 hour period depending on traffic while only some sectors would be able to use SPO, depending on the traffic levels and complexity.
- One of the most limiting variables is the nature of current airspace sectorisation. The enhanced iMSP tools may not be fully optimised due to airspace sectorisation. Of course, this is just as true of present day iFACTS.
- Currently planners are sector valid and this must be managed for iMSP configurations to ensure the planner is valid for the sectors they are working, in 1P-2T. There may be scope for low-traffic level Planner validations only (e.g. night-time etc.) and a review of “validation criteria” with these new possible team arrangements might be beneficial.

ID 1.2: As with bandboxing and splitting, until patterns of usage are established, it is unlikely the various staffing configurations could be planned in advance and rostered accordingly, due to variables such as weather, wind and traffic complexity, etc. However over time as patterns of usage are identified, it may well be possible to take advantage of iMSP in the watch roster manning levels (thus providing an efficiency benefit).

ID 1.3: ‘Sector efficiency’ as opposed to planning volume efficiency (where ‘efficiency’ relates to throughput, quality of service, etc.) will be key regarding decisions about staffing configurations (for example 1P-2T may result in better overall sector efficiency, but may reduce planner efficiency).

ID 1.4: Inappropriate configuration selection could lead to inappropriate staffing levels for the traffic at any given time, possibly leading to workload peaks or overload..

ID 1.5: iMSP (i.e. 1P-2T) may result in a possible change in the number of handovers which is yet to be determined – this may be an increase to maximise the flexibility of the staffing configurations (i.e. frequently swapping between 1P-1T and 2x1P-1T) or fewer tactical handovers (as the sectors might stay in the 1P2T configuration rather than swapping between 1P1T and 2x1P1T).

ID 1.6: SPO may be more suited to sectors that are more ‘tactical’ in nature, reducing the anticipated benefits of SPO and planner tools on

those sectors.

ID 1.7: SPO may reduce the ability to offer a better, more tailored service to flights.

ID 1.8: Under SPO it would be very important for offering sectors to present traffic well, so as to help the SPO to fulfil their role and if done badly, this may result in issues being passed from sector to sector.

2. Job & Task

ID 2.1: Due to the introduction of at least two new staffing configurations there may be (at least initially) resultant role confusion within the team and potentially on the neighbouring sectors.

ID 2.2: Under SPO, it is likely that the controller could drop planner tasks (secondary tasks) in favour of tactical tasks (primary tasks), under certain circumstances, e.g. emergencies.

3. Situation Awareness

ID 3.1: One planner cannot listen in to two tacticals (and their RT) at the same time, thus situation awareness (SA) is likely to be impacted.

ID 3.2: Removal of the planner controller from the loop is also a possibility, as a result of reliance on tools, which could mean that SA is degraded/reduced. However the tools should help focus the planner on the real problems, so it may actually allow for greater opportunity to keep on top of the traffic (i.e. improved SA). This needs further consideration.

ID 3.3: A planner in 1P-2T configuration can toggle between the two tacticals' views, but if the planner becomes distracted they may forget which view they are looking at and thus their SA may be degraded.

4. System Safety

ID 4.1: Due to future predicted increases in traffic capacity, the margin for error and spare capacity of the controller is likely to reduce; hence capacity to deal with abnormal/emergency situations is lessened with only one planner working with two tactical controllers. This could lead to a situation described as 'switching suddenly into an overload', rather than 'drifting into an overload', particularly for SPO. This could be mitigated by stipulating that in these cases, the LAS would provide immediate support (and get more help if necessary).

ID 4.2: When the enhanced planner tools are added to the existing iFACTS (and NERC) system there may be system defects/bugs in existence which may impact the effectiveness of the enhanced planner tools. Good system verification would help to mitigate this risk.

ID 4.3: In the absence of a planner, a single person is less likely to spot their own mistakes (in part due to the effects of confirmation bias), therefore introducing potential of single point of failure.

ID 4.4: Some (Planner) electronic flight strips may be missed ('tidied') and leading to issues if involving aircraft too close to the boundary, thus giving very little time to react. This could be exacerbated if the SM is closed (accidentally) or the criteria were changed for the SM (i.e. not 15 miles).

5. Task Performance

ID 5.1: The tactical controller's ability to manage tasks in a timely

manner is likely to be negatively affected by not having a dedicated planner to carry out co-ordination support - in the current 1P-1T configuration, the planner can devote all their attention on making inputs that, if done well, help to reduce the tactical's task load.

ID 5.2: Based on experience in simulations, it is likely that the tactical controllers would take on more planner tasks (largely internal coordinations and other tasks, varying between individuals and sectors) and this was contrary to the expectation that the tactical role would not change as part of iMSP.

ID 5.3: The reduced capacity under SPO may impact other adjacent sectors, causing delays in conducting tasks (e.g. transferring traffic at an optimum point) and thus have a knock on effect for adjacent/abutting sectors.

6. Teamwork & Communications

ID 6.1: Team dynamics as a whole are likely to change in unpredictable ways as a result of the iMSP tools and staffing configurations. It is not yet clear whether these changes may be negative or positive.

ID 6.2: Controllers suggested that in emergency situations, one of the tacticals could be neglected by the planner (i.e. that tactical that is not dealing with the emergency). This would be due largely to difficulties associated with monitoring 2 tacticals (e.g. having to split limited cognitive resources between 2 tacticals, being able to accurately listen to one RT frequency at a time, etc.). This may be exacerbated by use of the tools themselves leading to delay in planner reaction. Obvious mitigation here is to always request immediate extra support in emergencies.

7. Training

ID 7.1: The full benefits of the enhanced planner tools will not be realised if training in their use is inadequate.

ID 7.2: The LAS may not always determine the optimum use of staffing configurations (e.g. timing of change, best configuration, etc.), thus reducing their effectiveness.

8. User Confidence

ID 8.1: Complacency due to over reliance on tools was considered to be a possibility.

ID 8.2: The tools are designed around exactly how the planners currently do their job which may lead to a less proactive planner (e.g. just doing basic planning), resulting in situations being ignored and thereby an over reliance on the tools. Of course, just as at present, there will always be a range of planner ability and proactivity and it may be that tools may actually further enhance the skills of some.

9. User Interface

ID 9.1: Confusion may develop because the iMSP system does not prioritise strips when they are recovered. This could lead to non-detection of important information (linked to being out of the loop due to automation of tasks):

- Further to this, the recovered strip always appears at the bottom of the list, and if the accepted bay is filling up the Recovered

	<p>designator may be ‘hidden’ because of the scrolling facility.</p> <p>ID 9.2: Flights that ‘SLUT in’ (Sector Look Up Table) and out automatically will come in under Auto Accept and a double click of Tidy will drop the strip, which may mean a flight that has a conflicting entry flight level (displayed in purple by iFACTS) may get dropped and missed.</p> <p>ID 9.3: Potential for variation between displayed information on two Separation Monitors within the same sector (at the Planner positions compared to either of the tactical positions), when in 1P-2T configuration. This could pose particular problems for an OJTI.</p> <p>ID 9.4: The enhanced tools may introduce more information in the planner’s SM when in 1P-2T configuration, increasing workload as the planner has to interpret the information being presented (e.g. potential planner confusion when drawing information from an adjacent tactical separation monitor which may be set up differently).</p> <p>ID 9.5: Prototype HMI and increased complexity of the instruction palette in the version simulated to date (being used for purposes other than as designed) could lead to:</p> <ul style="list-style-type: none"> • Incorrect selection, accidental coordination etc. • Increased workload, in order to correct what was done incorrectly. <p>10. Workload</p> <p>ID 10.1: A controller working in a single manned configuration may have a poorer understanding of forward loading (forthcoming traffic density) as attention is diluted between two roles in SPO – the planner protects the tactical and to some extent the sector in this regard at present. Potential mitigation here is for the LAS to take some responsibility.</p> <p>ID 10.2: During bandboxing or splitting in 1P-2T configuration, there may be potentially more steps involved for the planner, thus increasing their workload and the duration of the task. This should be managed in conjunction with the Local Area Supervisor (LAS). With experience though, it is likely that bandboxing and splitting will become more efficient.</p> <p>ID 10.3: SPO configuration may reduce the capacity of the controller to deal with non-standard flights and increase the amount of time it takes to deal with the extra tasks.</p> <p>ID 10.4: Anything unusual/emergent could cause workload issues for the SPO controller, possibly leading to a greater risk of sudden workload peaks and potentially overloads.</p> <p>11. Workstation & Equipment</p> <p>ID 11.1: Consideration needs to be given to the location of the planner in 1P-2T configuration as no clear ‘ideal’ solution emerged during simulations. There is a need to take sector specifics into consideration, as some sectors benefit from the tactical controllers being closely located.</p>
<p>BENEFITS</p>	<p>General benefits</p> <p>As well as potential issues with iMSP enhanced tools, the study identified the following potential benefits:</p>

1. Consolidation of legacy NERC tools (Look See/What If, Planner EFS) with a trajectory based operating environment for planner purposes.
2. Improved handling of aircraft agreements over internal sector boundaries (for 1P-2T) compared to current iFACTS '5 minutes back on track' NFL trajectories.
3. More staffing configurations to choose from, to suit traffic, time of year, sectors differences etc.
4. The iMSP concept for implementation on iFACTS results in improvement of iFACTS core capabilities (trajectory prediction, medium term conflict detection, flight path monitoring) by delivering bespoke planner tools to support planner decision making as follows:
 - Reduce the workload associated with agreeing entry and exit coordinations by using extra information provide by planner tools.
 - Provide a better picture of future interactions in the planning time horizon through use of predictive tools.
 - Reduce the workload associated with housekeeping tasks by designing tools that manage or reduce these;
 - Facilitate improved communication of boundary agreements through coordination conditions.
5. Splitting: currently in iFACTS splitting tasks take over a minute. This may be less onerous if going from two to three controllers (rather than two to four) – assuming there is no requirement later to go to four members of staff.
 - Working with three people on and one on break is more efficient and 'comfortable' than two on two off. This may be more efficient and may remove/reduce 'spinning' between watches (i.e. movement of staff on the normal roster to support other watches).
6. Flight profiles: a planner with a 'bigger' picture should be able to deliver better flight profiles. Tacticals would then be less busy and therefore able to provide more efficient flight profiles and this may have a knock on beneficial effect on adjoining sectors through better presentation of traffic.

Benefits associated with SPO:

7. Traffic levels allowing the SPO configuration to be used should be such that workload is manageable and provides the single controller with sufficient stimulation, in order to maintain vigilance.
8. The SPO configuration could be used to release staff when a sector is a quiet. This could be beneficial for fatigue management, as it could provide further opportunities for breaks. Alternatively, controllers could be used for non-operational tasks (e.g. training development).
9. Sectors may need more people and the SPO configuration means that extra staff can be released and moved to where they are needed most.

Benefits associated with specific tools:

10. iFACTS MTCD enhanced looksee/what if:

- Targets attention to tracks that are of interest.
- Reduces workload involved in calculating the look see/what if. This is done through the tools by showing a graphical representation of the result.
- More accurate (enhances the primary conflict detection tools).
- High light, low light function which allows the planner to choose which tracks are of interest and 'low lights' all others.
- The enhanced tools 'What If' will recognise 'manually recognised flights', which is a function not currently available in iFACTS.

11. Coordination constraints:

- Gives a more representative and accurate picture of traffic to the planner, using trajectory prediction etc.
- Will increase the amount time available to make decisions.

2.4 Human Performance Assessment Findings and Conclusions

2.4.1 Main findings per Human Performance assessment objective

The high-level review conducted in this study examined the issues and benefits of the flexible controller working configurations (i.e. iMSP and SPO) and the enhanced planner tools from a human performance perspective. The aims of this study have been fulfilled using controller opinion and feedback, which was gathered and assessed by Human Factors Specialists to derive a set of issues and benefits, together with a series of recommendations that should be addressed in the next stage of this work.

In general, controller opinion was positive towards the enhanced planner tools. A number of potential issues were identified and it was possible to produce recommendations tailored to address these in future work. A selection of key benefits of the enhanced tools identified by this study include the following:

- Consolidation of legacy NERC tools (Look See/What If, Planner EFS) with a trajectory based operating environment for planner purposes.
- Development of current system core capabilities of iFACTS (in NATS' case) by delivering bespoke planner tools to support planner decision making as follows:
 - Reduce the workload associated with agreeing entry and exit coordinations by using extra information provide by planner tools.
 - Provide a better picture of future interactions in the planning time horizon through use of predictive tools.
 - Reduce the workload associated with housekeeping tasks by designing tools that manage or reduce these.
 - Facilitate improved communication of boundary agreements through coordination conditions.

Again, overall controller opinion was very positive towards the potential benefits of flexible working configurations; in particular, the benefit offered through more staffing configurations to choose from to suit traffic, time of year, sector differences etc. was identified. A number of potential issues were highlighted for which mitigation appears to be available and recommendations have been made to reflect this.

However further work will be required to consider the output of this study and specify the exact mitigation required to permit the benefits to be realised and to investigate human performance issues and potential human error.

2.4.2 Human Performance maturity of the concept addressed by the project

This study moves the HP maturity of the enhanced planner tools and flexible working configuration concepts forward. However, further work is required.

2.4.3 Conclusions

Although there is a degree of interaction between the two elements of iMSP – staffing configuration and the enhanced planner toolset – issues identified in this activity can be attributed to each element largely in isolation.

In general, the predicted consequences of changing the staffing configuration (1P to 2T or SPO) may be summarised as follows:

- Some reduction in the tactical controller's ability to manage tasks in a timely fashion, particularly when dealing with unusual events or emergencies, which could also have knock-on effects for other sectors.
- Some reduction of planner Situation Awareness for the planner, in 1P-2T configuration, e.g. may be less aware of both tacticals' traffic due to divided attention.
- A possible change in the number of handovers which is yet to be determined – this may be an increase to maximise the flexibility of the staffing configurations (i.e. frequently swapping between 1P-1T and 2x1P-1T) or fewer tactical handovers (as the sectors might stay in the 1P2T configuration rather than swapping between 1P-1T and 2x1P-1T).

Based on the information obtained in this study, the extent of these effects may be sector dependent, particularly with regard to the topological orientation of the sectors involved, whether vertically or horizontally aligned, such that the physical location of the single planner in the 1P-2T configuration could be critical.

Predicted consequences of some features of the enhanced planner toolset are:

- Confusion due to the way in which strip recovery is handled by the system, and the lack of strip prioritisation.
- The missing of a flight strip due to use of the Tidy function (strip dropped when should be retained).

These issues should be amenable to remediation through design modifications to the system and HMI.

Considerable benefits accruing from use of the enhanced planner toolset were identified (Table 2 'Benefits'); the consensus among controllers was that there was a distinct and urgent need for these refinements to iFACTS and that their implementation should be facilitated as quickly as possible.

However, controllers were of the opinion that a staggered approach to implementation is likely to be beneficial, with the tools to be introduced first to allow a period of familiarisation to occur prior to the introduction of new staffing configurations. It was believed that this approach would reduce the issues associated with the iMSP concept as a whole.

To conclude, the human factors view is that, on the basis of the workshops, the tools and staffing configurations will be of benefit to the planner and the sector team, so long as the issues highlighted are addressed satisfactorily. The 37 recommendations made should guide the work to mitigate these issues. Further work is required to develop these and specify the exact actions required.

3 References

- [1] TN-001v0f iMSP Planner Trajectories
- [2] TN-002v0f iMSP Integrated Coordination
- [3] TN-003v0d iMSP Planner MTCD
- [4] TN-004v0e iMSP MTCD Enhanced Look-SeeWhat-If
- [5] TN-007v0c iMSP Planner Workstation Display
- [6] TN-008v0d iMSP Multi-Sector Coordination
- [7] TN-009v0b iMSP Jurisdiction and Communication
- [8] TN-014v0b Planner Context Flight Display

Annex A - Human Performance Issue Register

Note 1: It was beyond the scope of this study to quantify the impact on Human and/or System Performance of the issues highlighted. This will be established in a formal hazard analysis which would be carried out in the development phase of iMSP development.

Note 2: The issues presented in this report are in an ‘open’ status pending further consideration by NATS and other SESAR partners.

Note 3: The ‘Priority’ assessment has been made based on the expert judgement of the HF authors of this report and should be seen as suggestive of the general priority that should be given to the issue. A more accurate assignment will be possible during future phases of work.

Issue ID	HP issue	Impact on Human and/or System performance	Source <i>Issue Analysis or HP activity N</i>	Priority (see note 3) <i>Low, Medium, High¹</i>	Status <i>Closed, Open, Not addressed</i>	Justification of Status <i>Findings (or absence of) justifying the status</i>
1. FUTURE CONSIDERATIONS						
ID 1.1	<p>Some sectors may be better suited to iMSP than others:</p> <ul style="list-style-type: none"> ○ One of the most limiting variables is the nature of airspace sectorisation. The team configurations may not be fully optimised due to airspace sectorisation. ○ Based on experience in simulations, one controller felt sectors that were adjacent but quite separate were easier to work than those that had interactions (i.e. those with intermediate boundaries that had very little crossers). Vertically divided airspace was more difficult to manage for the planner, and it was more difficult to judge the workload of the tactical controllers for each sector/group of sectors. It should be noted that this view may have been significantly influenced by the particular traffic flows in particular sectors in the simulations the 	<i>See note 1</i>	Workshop (issue analysis)	Medium	Open	<i>See note 2</i>

¹ **High:** Negative and significant Impact on safety, a safety concern, or a serious degradation of safety performance.

Medium: Negative and significant impact on KPA other than safety, for instance, a degradation in efficiency or capacity, a negative impact on environment.

Low: No significant impact on HP and/or KPAs.

D10 – 04.07.08 04.07.08 Validation Report - Appendix Human Performance Assessment Report

Issue ID	HP issue	Impact on Human and/or System performance	Source <i>Issue Analysis or HP activity N</i>	Priority (see note 3) <i>Low, Medium, High¹</i>	Status <i>Closed, Open, Not addressed</i>	Justification of Status <i>Findings (or absence of) justifying the status</i>
	<p>controller participated in.</p> <ul style="list-style-type: none"> ○ It is anticipated that all Sectors and LAGs should be able to use iMSP tools in the 1P-2T configuration, at certain times during a 24 hour period depending on traffic while only some sectors would be able to use SPO, depending on the traffic levels and complexity. ○ Currently planners are sector valid and this must be managed for iMSP configurations to ensure the planner is valid for the sectors they are working, in 1P-2T. 					
ID 1.2	As with bandboxing and splitting, until patterns of usage are established, it is unlikely the various staffing configurations could be planned in advance and rostered accordingly, due to variables such as weather, wind and traffic complexity, etc. However over time as patterns of usage are identified, it may well be possible to take advantage of iMSP in the watch roster manning levels (thus providing an efficiency benefit).	<i>See note 1</i>	Workshop (issue analysis)	Low	Open	<i>See note 2</i>
ID 1.3	'Sector efficiency' as opposed to planning volume efficiency (where 'efficiency' relates to throughput, quality of service, etc.) will be key regarding decisions about staffing configurations (for example 1P-2T may result in better overall sector efficiency, but may reduce planner efficiency).	<i>See note 1</i>	Workshop (issue analysis)	Medium	Open	<i>See note 2</i>
ID 1.4	Inappropriate configuration selection could lead to inappropriate staffing levels for the traffic at any given time, possibly leading to workload peaks or overload.	<i>See note 1</i>	Workshop (issue analysis)	High	Open	<i>See note 2</i>

D10 – 04.07.08 04.07.08 Validation Report - Appendix Human Performance Assessment Report

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ID 1.5	iMSP (i.e. 1P-2T) may result in a possible change in the number of handovers which is yet to be determined – this may be an increase to maximise the flexibility of the staffing configurations (i.e. frequently swapping between 1P-1T and 2x1P-1T) or fewer tactical handovers (as the sectors might stay in the 1P2T configuration rather than swapping between 1P1T and 2x1P1T).	<i>See note 1</i>	Workshop (issue analysis)	High	Open	<i>See note 2</i>
ID 1.6	SPO may be more suited to sectors that are more 'tactical' in nature, reducing the anticipated benefits of SPO on some sectors	<i>See note 1</i>	Workshop (issue analysis)	Low	Open	<i>See note 2</i>
ID 1.7	SPO may reduce the ability to offer a better, more tailored service to flights.	<i>See note 1</i>	Workshop (issue analysis)	Medium	Open	<i>See note 2</i>
ID 1.8	Under SPO it would be very important for offering sectors to present traffic well, so as to help the SPO to fulfil their role and if done badly, this may result in issues being passed from sector to sector.	<i>See note 1</i>	Workshop (issue analysis)	Medium	Open	<i>See note 2</i>
2. JOB & TASK						
ID 2.1	Due to the introduction of at least two new staffing configurations there may be (at least initially) resultant role confusion within the team and potentially on the neighbouring sectors.	<i>See note 1</i>	Workshop (issue analysis)	High	Open	<i>See note 2</i>
ID 2.2	Under SPO, it is likely that the controller could drop planner tasks (secondary tasks) in favour of tactical tasks (primary tasks).	<i>See note 1</i>	Workshop (issue analysis)	Medium	Open	<i>See note 2</i>
3. SITUATION AWARENESS						
ID 3.1	One planner cannot listen in to two tacticals (and their RT) at the same time, thus situation	<i>See note 1</i>	Workshop (issue	High	Open	<i>See note 2</i>

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	awareness is likely to be impacted;		analysis)			
ID 3.2	Removal of the planner controller from the loop is also a possibility, as a result of reliance on tools, which could mean that SA is degraded/reduced. However the tools should help focus the planner on the real problems, so it may actually allow for greater opportunity to keep on top of the traffic (i.e. improved SA). This needs further consideration.	<i>See note 1</i>	Workshop (issue analysis)	High	Open	<i>See note 2</i>
ID 3.3	A planner in 1P-2T configuration can toggle between the two Tacticals' views, but if the planner becomes distracted they may forget which view they are looking at and thus their SA may be degraded.	<i>See note 1</i>	Workshop (issue analysis)	High	Open	<i>See note 2</i>
4. SYSTEM SAFETY						
ID 4.1	Due to future predicted increases in traffic capacity, the margin for error and spare capacity of the controller is likely to reduce; hence capacity to deal with abnormal/emergency situations is lessened with only one planner working with two tactical controllers. This could lead to a situation described as 'switching suddenly into an overload', rather than 'drifting into an overload', particularly for SPO. This could be mitigated by stipulating that the in these cases, the LAS would provide immediate support (and get more help if necessary).	<i>See note 1</i>	Workshop (issue analysis)	High	Open	<i>See note 2</i>
ID 4.2	When the enhanced planner tools are added to the existing iFACTS (and NERC) system there may be system defects/bugs in existence which may impact the effectiveness of the enhanced planner tools. Good system verification would help to mitigate this risk.	<i>See note 1</i>	Workshop (issue analysis)	Medium	Open	<i>See note 2</i>

Issue ID	HP issue	Impact on Human and/or System performance	Source <i>Issue Analysis or HP activity N</i>	Priority (see note 3) <i>Low, Medium, High¹</i>	Status <i>Closed, Open, Not addressed</i>	Justification of Status <i>Findings (or absence of) justifying the status</i>
ID 4.3	In the absence of a planner, a single person is less likely to spot their own mistakes (in part due to the effects of confirmation bias), therefore introducing potential of single point of failure.	<i>See note 1</i>	Workshop (issue analysis)	High	Open	<i>See note 2</i>
ID 4.4	Some (Planner) electronic flight strips may be missed ('tidied') and leading to issues if involving aircraft too close to the boundary, thus giving very little time to react. This could be exacerbated if the Separation Monitor (SM) is closed (accidentally) or the criteria were changed for the SM (i.e. not 15 miles).	<i>See note 1</i>	Workshop (issue analysis)	High	Open	<i>See note 2</i>
5. TASK PERFORMANCE						
ID 5.1	The tactical controller's ability to manage tasks in a timely manner is likely to be negatively affected by not having a dedicated planner to carry out co-ordination support – in the current 1P1T configuration, the planner can devote all their attention on making inputs that, if done well, help to help to reduce the tactical's task load	<i>See note 1</i>	Workshop (issue analysis)	Medium	Open	<i>See note 2</i>
ID 5.2	Based on experience in simulations, it is likely that the tactical controllers would take on more planner tasks (largely internal coordinations and other tasks, varying between individuals and sectors) and this was contrary to the expectation that the tactical role would not change as part of iMSP.	<i>See note 1</i>	Workshop (issue analysis)	Medium	Open	<i>See note 2</i>
ID 5.3	The reduced capacity under SPO may impact other adjacent sectors, causing delays in conducting tasks (e.g. transferring traffic at an optimum point) and thus have a knock on	<i>See note 1</i>	Workshop (issue analysis)	Medium	Open	<i>See note 2</i>

Issue ID	HP issue	Impact on Human and/or System performance	Source <i>Issue Analysis or HP activity N</i>	Priority (see note 3) <i>Low, Medium, High¹</i>	Status <i>Closed, Open, Not addressed</i>	Justification of Status <i>Findings (or absence of) justifying the status</i>
	effect for adjacent/abutting sectors.					
6. TEAMWORK & COMMUNICATIONS						
ID 6.1	Team dynamics as a whole are likely to change in unpredictable ways as a result of the iMSP tools and staffing configurations. It is not yet clear whether these changes may be negative or positive.	<i>See note 1</i>	Workshop (issue analysis)	Low	Open	<i>See note 2</i>
ID 6.2	In emergency situations, one of the tacticals could be neglected by the planner (i.e. that tactical that is not dealing with the emergency). This would be due largely to difficulties associated with monitoring 2 tacticals (e.g. having to split limited cognitive resources between 2 tacticals, being able to accurately listen to one RT frequency at a time, etc.). This may be exacerbated by use of the tools themselves leading to delay in planner reaction. Obvious mitigation here is to always request immediate extra support in emergencies.	<i>See note 1</i>	Workshop (issue analysis)	High	Open	<i>See note 2</i>
7. TRAINING						
ID 7.1	The full benefits of the enhanced planner tools will not be realised if training in their use is inadequate.	<i>See note 1</i>	Workshop (issue analysis)	High	Open	<i>See note 2</i>
ID 7.2	ID 7.2: The LAS may not always determine the optimum use of staffing configurations (e.g. timing of change, best configuration, etc.), thus reducing their effectiveness.	<i>See note 1</i>	Workshop (issue analysis)	High	Open	<i>See note 2</i>
8. USER CONFIDENCE						
ID 8.1	Complacency due to over reliance on tools was considered to be a possibility.	<i>See note 1</i>	Workshop (issue analysis)	Medium	Open	<i>See note 2</i>

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			analysis)			
ID 8.2	The tools are designed around exactly how the planners currently do their job which may lead to a less proactive planner (e.g. just doing basic planning), resulting in situations being ignored and thereby an over reliance on the tools. Of course, just as at present, there will always be a range of planner ability and proactivity and it may be that tools may actually further enhance the skills of some.	<i>See note 1</i>	Workshop (issue analysis)	Medium	Open	<i>See note 2</i>
9. USER INTERFACE						
ID 9.1	<p>Confusion may develop because the iMSP system does not prioritise strips when they are recovered. This could lead to non-detection of important information (linked to being out of the loop due to automation of tasks)</p> <ul style="list-style-type: none"> ○ Further to this, the recovered strip always appears at the bottom of the list, and if the accepted bay is filling up the Recovered designator may be ‘hidden’ because of the scrolling facility. 	<i>See note 1</i>	Workshop (issue analysis)	High	Open	<i>See note 2</i>
ID 9.2	Flights that ‘SLUT in’ (Sector Look Up Table) and out automatically will come in under Auto Accept and a double click of Tidy will drop the strip, which may mean a flight that has a conflicting entry flight level (displayed in purple by iFACTS) may get dropped and missed.	<i>See note 1</i>	Workshop (issue analysis)	High	Open	<i>See note 2</i>
ID 9.3	Potential for variation between displayed information on two Separation Monitors within the same sector (at the Planner positions	<i>See note 1</i>	Workshop (issue analysis)	High	Open	<i>See note 2</i>

D10 – 04.07.08 04.07.08 Validation Report - Appendix Human Performance Assessment Report

Issue ID	HP issue	Impact on Human and/or System performance	Source <i>Issue Analysis or HP activity N</i>	Priority (see note 3) <i>Low, Medium, High¹</i>	Status <i>Closed, Open, Not addressed</i>	Justification of Status <i>Findings (or absence of) justifying the status</i>
	compared to either of the tactical positions), when in 1P-2T configuration. This could pose particular problems for an OJTI.					
ID 9.4	The enhanced tools may introduce more information in the planner's SM when in 1P-2T configuration, increasing workload as the planner has to interpret the information being presented (e.g. potential planner confusion when drawing information from an adjacent tactical separation monitor which may be set up differently).	<i>See note 1</i>	Workshop (issue analysis)	Medium	Open	<i>See note 2</i>
ID 9.5	<p>Prototype HMI and increased complexity of the instruction palette in the version simulated to date (being used for purposes other than as designed) could lead to:</p> <ul style="list-style-type: none"> ○ Incorrect selection, accidental coordination etc. ○ Increased workload, in order to correct what was done incorrectly. 	<i>See note 1</i>	Workshop (issue analysis)	High	Open	<i>See note 2</i>
10. WORKLOAD						
ID 10.1	A controller working in a single manned configuration may have a poorer understanding of forward loading (forthcoming traffic density) as attention is diluted between two roles in SPO – the planner protects the tactical and to some extent the sector in this regard at present. Potential mitigation here is for the LAS to take some responsibility.	<i>See note 1</i>	Workshop (issue analysis)	Medium	Open	<i>See note 2</i>
ID 10.2	During bandboxing or splitting in 1P-2T configuration, there may be potentially more steps involved for the planner, thus increasing	<i>See note 1</i>	Workshop (issue analysis)	Medium	Open	<i>See note 2</i>

D10 – 04.07.08 04.07.08 Validation Report - Appendix Human Performance Assessment Report

Issue ID	HP issue	Impact on Human and/or System performance	Source <i>Issue Analysis or HP activity N</i>	Priority (see note 3) <i>Low, Medium, High¹</i>	Status <i>Closed, Open, Not addressed</i>	Justification of Status <i>Findings (or absence of) justifying the status</i>
	their workload and the duration of the task. This should be managed in conjunction with the Local Area Supervisor (LAS). With experience though, it is likely that bandboxing and splitting will become more efficient.					
ID 10.3	SPO may reduce the capacity of the controller to deal with non-standard flights and increase the amount of time it takes to deal with the extra tasks.	<i>See note 1</i>	Workshop (issue analysis)	Medium	Open	<i>See note 2</i>
ID 10.4	Anything unusual/emergent could cause workload issues for the SPO controller, possibly leading to a greater risk of sudden workload peaks and potentially overloads.	<i>See note 1</i>	Workshop (issue analysis)	High	Open	<i>See note 2</i>
11. WORKSTATION & EQUIPMENT						
ID 11.1	Consideration needs to be given to the location of the planner in 1P-2T configuration as no clear 'ideal' solution emerged during simulations. There is a need to take sector specifics into consideration, as some sectors benefit from the tactical controllers being closely located.	<i>See note 1</i>	Workshop (issue analysis)	High	Open	<i>See note 2</i>

Annex B - Human Performance Recommendations Register

Note 1: It was beyond the scope of this study to indicate who should carry out each of the recommendations specified. The most appropriate actor for each is likely to become clear as this study is developed further.

Note 2: Those recommendations linked to issues assigned a high priority are highlighted with * in column 1.

Rec ID	Related Issue ID	Recommendation	Source <i>Issue Analysis or HP activity N</i>	Type <i>Design, Procedure, Training, Test...</i>	Status <i>Closed, Open, Not addressed</i>	Justification of Status <i>If a recommendation is closed because it was transformed into a requirement, reference the document in which the requirement has been integrated</i>
RECOMMENDATIONS ADDRESSING HP ISSUES						
1. FUTURE CONSIDERATIONS						
Rec 1.1	ID 1.1	Evaluate the sector differences with regards to the staffing configurations. This evaluation should, examine factors such as vertical versus horizontal airspace division; time of day issues; staffing validations on sectors, in order to optimise the use of the enhanced tools and staffing configurations across operations.	Issue Analysis	To be assigned during future phase of work.	Open	New recommendation
Rec 1.2*	ID 1.2	Ensure a minimum staffing level is identified and maintained, given the inherent unpredictability of factors such as weather and traffic etc. This will ensure sufficient staff is available to maintain service levels and safety in all situations.	Issue Analysis	To be assigned during future phase of work.	Open	New recommendation
Rec 1.3	ID 1.3	Investigate a measure of sector efficiency to aid decisions about when to transition between staffing configurations.	Issue Analysis	To be assigned during future phase of work.	Open	New recommendation
N/A	ID 1.4	See recommendation Rec 1.2	Issue Analysis	To be assigned	Open	New recommendation

D10 – 04.07.08 04.07.08 Validation Report - Appendix Human Performance Assessment Report

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				during future phase of work.		
Rec 1.4*	ID 1.5	Ensure that any increase in number of handovers does not introduce increased risk to operations due to increased flexibility in staffing configurations.	Issue Analysis	To be assigned during future phase of work.	Open	New recommendation
N/A	ID 1.6	See recommendation Rec 1.1	Issue Analysis	To be assigned during future phase of work.	Open	New recommendation
Rec 1.5	ID 1.7	Compare service levels achievable by baseline staffing (i.e. 1P-1T) and SPO.	Issue Analysis	To be assigned during future phase of work.	Open	New recommendation
Rec 1.6	ID 1.8	Consider using SPO only where traffic is likely to be presented well by offering sectors. Also, investigate techniques of enhancing traffic presentation in order to optimise SPO operations.	Issue Analysis	To be assigned during future phase of work.	Open	New recommendation
2. JOB & TASK						
Rec 2.1*	ID 2.1	Assess the extent to which role confusion is likely to result from new staffing configurations.	Issue Analysis	To be assigned during future phase of work.	Open	New recommendation
Rec 2.2	ID 2.2	Assess the extent to which any controller tasks are not completed, in the various staffing configurations. Further to this assess whether some tasks are more critical than others	Issue Analysis	To be assigned during future	Open	New recommendation

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		and the implications of not completing these.		phase of work.		
3. SITUATION AWARENESS						
Rec 3.1*	ID 3.1	The potential for reduction in SA as a result of less RT monitoring should be assessed, alongside other mitigations such as Mode S (comparison with CFL, for example).	Issue Analysis	To be assigned during future phase of work.	Open	New recommendation
Rec 3.2*	ID 3.2	The enhanced planner tools should be designed so that they compensate (as far as possible) for the absence of a planner (i.e. second pair of eyes) when in SPO configuration. Further to this the potential for reduction in SA as a result of planner being out of the loop should be assessed.	Issue Analysis	To be assigned during future phase of work.	Open	New recommendation
Rec 3.3*	ID 3.3	The potential for reduction in planner SA (in 1P-2T) relating to having two tactical views to monitor should be assessed.	Issue Analysis	To be assigned during future phase of work.	Open	New recommendation
4. SYSTEM SAFETY						
Rec 4.1*	ID 4.1	Handling abnormal situations or emergencies should be assessed for the various staffing configurations.	Issue Analysis	To be assigned during future phase of work.	Open	New recommendation
Rec 4.2	ID 4.2	Confirm the assumption that the existing system is defect/bug-free.	Issue Analysis	To be assigned during future phase of work.	Open	New recommendation

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Rec 4.3*	ID 4.3	The enhanced planner tools should be designed so that they compensate (as far as possible) for the absence of a planner (i.e. second pair of eyes) when in SPO configuration.	Issue Analysis	To be assigned during future phase of work.	Open	New recommendation
Rec 4.4*	ID 4.4	The HMI aspects of the 'Tidy' function should be designed to be resilient to human error.	Issue Analysis	To be assigned during future phase of work.	Open	New recommendation
Rec 4.5*	ID 4.4	Investigate the benefit of preventing SM closure.	Issue Analysis	To be assigned during future phase of work.	Open	New recommendation
5. TASK PERFORMANCE						
Rec 5.1	ID 5.1	The tactical's ability to manage tasks needs to be tested under a variety of operational conditions and compared to a baseline from current operations.	Issue Analysis	To be assigned during future phase of work.	Open	New recommendation
Rec 5.2	ID 5.2	The allocation of tasks between tactical and planner should be established and tested under a variety of operational conditions/scenarios.	Issue Analysis	To be assigned during future phase of work.	Open	New recommendation
Rec 5.3	ID 5.3	The SPO's capacity needs to be measured under a variety of operational conditions and compared to a baseline from current operations to assess if there is an effect on adjacent sectors.	Issue Analysis	To be assigned during future phase of work.	Open	New recommendation

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6. TEAMWORK & COMMUNICATIONS						
Rec 6.1	ID 6.1	The impact of the change (staffing configurations and enhanced tools) should be assessed in relation to teamwork and communications, throughout the operation.	Issue Analysis	To be assigned during future phase of work.	Open	New recommendation
Rec 6.2*	ID 6.2	The impact of emergencies and unusual situations on the planners' ability to assist two tactical should be assessed in 1P-2T configuration.	Issue Analysis	To be assigned during future phase of work.	Open	New recommendation
7. TRAINING						
Rec 7.1*	ID 7.1	It is recommended that following stringent role definition training needs are defined and appropriate training is delivered. Training should ensure that the controllers use the tools exactly as they were designed to be used. (Although we know the use will evolve over time and indeed this is where some of the benefit will be obtained from. It is therefore important to monitor that evolution for potentially risky methods of operation and ensure those are curtailed.)	Issue Analysis	To be assigned during future phase of work.	Open	New recommendation
Rec 7.2*	ID 7.2	It is recommended that specific training is developed for the LAS to help them to determine the optimum use of staffing configurations (e.g. timing of change, best configuration, etc._				
8. USER CONFIDENCE						
Rec 8.1	ID 8.1	The potential for planners to over rely on tools should be assessed under a variety of operational conditions/scenarios.	Issue Analysis	To be assigned during future	Open	New recommendation

Rec ID	Related Issue ID	Recommendation	Source <i>Issue Analysis or HP activity N</i>	Type <i>Design, Procedure, Training, Test...</i>	Status <i>Closed, Open, Not addressed</i>	Justification of Status <i>If a recommendation is closed because it was transformed into a requirement, reference the document in which the requirement has been integrated</i>
				phase of work.		
Rec 8.2	ID 8.2	Ensure that the design of the tools support current planner skills minimising the risk of over reliance.	Issue Analysis	To be assigned during future phase of work.	Open	New recommendation
9. USER INTERFACE						
Rec 9.1*	ID 9.1	The tools should be designed to minimise the risk of confusion, non-detection or removal of important information.	Issue Analysis	To be assigned during future phase of work.	Open	New recommendation
N/A	ID 9.2	See recommendation Rec 9.1	Issue Analysis	To be assigned during future phase of work.	Open	New recommendation
Rec 9.2*	ID 9.3	Investigate the implications of disparate information being displayed on planner and tactical displays, in 1P-2T configuration.	Issue Analysis	To be assigned during future phase of work.	Open	New recommendation
Rec 9.3	ID 9.4	Optimise the displayed information in the planner's SM.	Issue Analysis	To be assigned during future phase of work.	Open	New recommendation
Rec 9.4*	ID 9.5	Optimise the design of the Instruction Palette in order to minimise the effects of incorrect selection etc.	Issue Analysis	To be assigned during future phase of	Open	New recommendation

Rec ID	Related Issue ID	Recommendation	Source <i>Issue Analysis or HP activity N</i>	Type <i>Design, Procedure, Training, Test...</i>	Status <i>Closed, Open, Not addressed</i>	Justification of Status <i>If a recommendation is closed because it was transformed into a requirement, reference the document in which the requirement has been integrated</i>
				work.		
10. WORKLOAD						
Rec 10.1*	ID 10.1	The capacity of the SPO to determine future forward loading should be established and validated.	Issue Analysis	To be assigned during future phase of work.	Open	New recommendation
Rec 10.2	ID 10.2	The rate at which the various staffing configurations can transition in/out should be assessed against current and expected future traffic patterns.	Issue Analysis	To be assigned during future phase of work.	Open	New recommendation
N/A	ID 10.3	See recommendation Rec 4.1	Issue Analysis	To be assigned during future phase of work.	Open	New recommendation
N/A	ID 10.4	See recommendation Rec 4.1 and Rec 10.1	Issue Analysis	To be assigned during future phase of work.	Open	New recommendation
11. WORKSTATION & EQUIPMENT						
Rec 11.1*	ID 11.1	Physical constraints and requirements should be established with regards to the location of the planner in the 1P-2T configuration. This work should consider sector differences.	Issue Analysis	To be assigned during future phase of work.	Open	New recommendation
GENERAL RECOMMENDATIONS						
Rec 12.1	N/A	It is recommended that it may be beneficial to carry out a staggered implementation of the iMSP concept, rolling out the	Issue Analysis	To be assigned during future	Open	New recommendation

D10 – 04.07.08 04.07.08 Validation Report - Appendix Human Performance Assessment Report

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		enhanced tools before bringing in the different staffing configurations so as to allow a 'bedding in' time for tools usage before implementing staffing changes.		phase of work.		
Rec 12.2	N/A	MATS Part 2 should be updated to detail fully the use of the enhanced planner tools and flexible configurations.	Issue Analysis	To be assigned during future phase of work.	Open	New recommendation
Rec 12.3	N/A	Controllers would like the ability to point out traffic more than 18 minutes ahead, or to be offered traffic with more time to deliberate than is currently the case. It is therefore recommended that this functionality is reviewed in the light of the enhanced tools to determine whether this would help to mitigate some of the issues identified with respect to staffing configurations and the toolset.	Issue Analysis	To be assigned during future phase of work.	Open	New recommendation
Rec 12.4	N/A	It is recommended that the transition from one staffing configuration to another should be optimised to minimise the disruption caused by position handovers. For example, when moving from 1P-1T, to 1P-2T the additional controller could take on the tactical role, because the in-situ planner will have "the picture" so the handover would be tactical to tactical (similar to splitting currently).	Issue Analysis	To be assigned during future phase of work.	Open	New recommendation
Rec 12.5	N/A	Transition between staffing configurations needs to be smooth in order to make it work safely. Therefore it is recommended that a tool set for the LAS is developed to enhance their decision making in terms of when and how to change staffing configurations.	Issue Analysis	To be assigned during future phase of work.	Open	New recommendation

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