FASTI Operational Focus Group

FASTI Operational Concept

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1. INTRODUCTION

The need for system support tools for air traffic controllers has never been greater. Concepts devised more than ten years ago under the European Air Traffic Control Harmonisation and Integration Programme (EATCHIP) have still not reached implementation. The development and validation of controller tools across Europe has been fragmented and uncoordinated leading to a diversity in system development and operational philosophies at both ANSP and industry level.

The forecast growth in air traffic, the drive for safety improvements and cost efficiencies, means that the time is now right for a greater focus on the implementation of controller system support to meet the needs of the airspace user. Classical methods of providing operational improvements all have their finite limit.
The First ATC Support Tools Implementation (FASTI) Programme aims at highlighting the need for the co-ordinated implementation and rapid deployment of an initial set of controller support tools. The programme will address short and medium term requirements but will also enable the introduction of further automation in ATC in the longer term. FASTI enables a move towards the EUROCONTROL objectives of ensuring a high quality, safe and cost effective service while matching capacity to airspace user demand.

FASTI objective is to:

Co-ordinate the implementation and deployment of controller system support tools, as required, across ECAC by 2012 in a harmonised way.

To achieve the above objective FASTI aims to:

- Contribute to capacity enhancement, cost efficiency and improved safety;
- Provide implementation support to ANSPs, Regulators and Industry in order to harmonise and expedite the deployment;
- Establish appropriate controller system support and performance levels across the ATM network;
- Act as an enabler for implementation of future automated support to ATC which is currently under development

Traditional ATC working methods, practices and procedures ***may*** need change in order to become compatible with this new system support resulting in requirements for coherent deployment with a change management process to ensure smooth and safe transition to the next generation ATC systems.

This concept outlines the scope of FASTI application, assumptions, dependencies and operational environments as well as descriptions of controller roles and working methods, required for the successful operational implementation of conflict prediction tools (e.g. MTCD) and enablers (e.g. MONA, TP, HMI and SYSCO).

The target audience of this document is operational personnel, airspace and ATM system planners, Human Factors and Safety practitioners and operational focus groups.

2. CONCEPT SCOPE AND OBJECTIVES

The scope of FASTI Programme encompasses the implementation of Medium Term Conflict Detection (MTCD) and enablers Monitoring Aids (MONA) and System Supported Co-ordination (SYSCO). Trajectory Prediction (TP) and Human Machine Interface (HMI) are critical to the performance and use of FASTI tools.

This operational concept scope covers the implementation of FASTI capability at Air Traffic Service Units (ATSU's) comprising upper, lower en-route and extended TMA operations. This includes ATC sectors where the operational environment may range from low to high traffic density and complexity.

Benefits will vary according to the target environment.

This operational concept will form the basis and permit the elaboration of safety, performance, human factors and operational requirements required for implementation.

2.1 FASTI Tools

The FASTI tools are as follows

Medium Term Conflict Detection (MTCD)

Assists the controller in conflict identification and planning tasks by:

- Providing early detection of conflicts;
- Facilitating flexible routing/ conflict free trajectories;
- Identifying aircraft constraining the resolution of a conflict or occupying a flight level requested by another aircraft

Monitoring Aids (MONA)

Helps controllers reduce the workload associated with traffic monitoring tasks by:

- Providing warnings if aircraft deviate from a clearance or plan and reminders of instructions to be issued
- Provides conformance monitoring triggering trajectory re-calculation essential for the MTCD

System Supported Co-ordination (SYSCO)

Permits controllers to conduct screen to screen co-ordination between adjacent ATSU's /sectors reducing workload associated with co-ordination task

Facilitates early resolution of conflicts through inter ATSU/sector co-ordination

Enables controllers to conduct tactical co-ordination during the co-ordination and transfer of flights between ATSU's

3. OPERATING PRINCIPLES

The following principles are applicable to the use of FASTI tools.

Principle 1

Implementation of FASTI capability shall be preceded by the development and documentation of future controller roles, responsibilities, and working methods relating to the use of tools and system support.

Principle 2

FASTI promotes a strategic planning approach to air traffic control augmented by controllers task-sharing to provide more conflict-free trajectories for longer time periods.

Principle 3

The ultimate responsibility for conflict detection and resolution will remain with the controller(s).

Principle 4

FASTI Area of Interest is not constrained by adjacent sector boundaries or ACC area boundaries. Co-operation across boundaries is facilitated by FASTI.

Principle 5

MTCD and enablers such as MONA and SYSCO may co-exist with other Decision Support Tools (e.g. AMAN, DMAN) and work concurrently with them.

Principle 6

Where the crossing of civil sectors by OAT under the control of a military ATSU has been coordinated between the civil and military units/sectors, the OAT traffic shall be subject to MTCD.

4. OPERATIONAL ENVIRONMENT

4.1 Airspace, Sectors and MTCD Horizons

This operational concept scope covers the implementation of FASTI capability at ATSU's comprising upper, lower en-route and extended TMA sectors. This includes sectors where the operational environment may range from low to high traffic density and complexity. Benefits will vary according to the target environment.

Sector length and geometry (including collapsed sector configurations) vary and consideration should be given to the type of support that MTCD would provide within and beyond sector boundaries. ***MTCD is deemed to be primarily a planning tool*** however sector length (e.g. Sector transit time greater than 20 minutes or very short sectors) could implicitly highlight a need for new operational procedures and requirements to be defined and addressed.

4.2 Area of Interest between ATSU's

The use of MTCD and MONA is expected within the Area of Interest (AoI) defined between two ATSU's. Each ATSU will need to define its requirements for conflict detection, co-ordination and conformance monitoring.

4.3 Civil/Military Environments

FASTI tools support airspace or segregated area conflict detection as well as civil/military co-ordination. Where dual ATC service provision is provided between civil and military ATSU's in the same airspace each ATSU would be expected to have equivalent capabilities to ensure the safe and expeditious handling of traffic. Where ATC services are integrated then OAT transits and GAT trajectories will be expected to be integrated in one ATC system.

4.4 Conflict Types

The types of conflicts encompassed by MTCD can be considered as tactical in nature. Spatial conflicts are generally defined whereby the distance and/or altitude between aircraft are less than the required minima. This includes multiple aircraft conflicts in any configuration and also airspace conflicts (Intrusion of prohibited/military/segregated airspace). Conflict types include:

- Crossing conflicts
- Converging conflicts
- Opposite direction conflicts
- In trail or catch-up conflicts
- Vertical – climb/descent conflicts
- Airspace conflicts
- Combinations of any of the above conflict types

5. ASSUMPTIONS AND DEPENDENCIES

Tools and system support features supported by intuitive and usable HMI. The availability of the following is thus, assumed;

- An operational MTCD[1];
- Monitoring Aids or similar functions;
- Trajectory Prediction (TP);
- Inter-sector/centre Electronic Co-ordination capability including tactical messaging;
- Intuitive and user-friendly HMI including Trajectory Edition Functionality

Additional assumptions [Ref 1] address the users' entry into the human-automation relationship with expectations that:

- The system is appropriate for the tasks for which it was designed and that it will remain so;
- The system exhibits technical competence;
- The system is responsible

The above descriptions are intentionally generic, which facilitates inclusion of different systems and proposed support tools and additional functions. The provision of reliable and accurate trajectory prediction is critical to the MTCD process. MONA ensures conformance monitoring and serves to alert the controller to deviations and also to provide reminders of planned actions or tasks. SYSCO assumes the implementation of ABI, ACT, REV, MAC and for civil/mil BFD and CFD as its baseline.

In the context of the FASTI tool implementation the following SYSCO messages are relevant [Reference OLDI standard 3.0]:

- RAP – Referred Active Proposal;
- ROF – Request On Frequency;
- CDN – Co-ordination Message
- HOP – Hand-Over Proposal;
- SDM – Supplementary Data Message (From transferring unit to accepting unit);
- RLS – Release Message;
- RRV – Referred Revision Proposal Message (Non-standard transfer conditions or referral to standard revision);
- INF – Information Message
- RTI – Request Tactical Instructions Message
- TIP – Tactical Instructions Proposal Message

[1] The MTCD 'look-ahead' horizon will be up to 20 minutes but this may vary depending on system capability, sector configuration, traffic characteristics, etc

6. NEW ATC PROCEDURES

6.1 New Procedures

The implementation of FASTI will enable the development of improved ATC procedures between ATSUs some examples of which are detailed below:

- Reduction in the use of Flight Level Allocation Systems – use of semi-circular allocation and progression to the tactical use of “all levels”;
- Reduce constraints – changes to standing agreements, based on procedural separations, by lifting the need for ATC constraints related to airspace and sector organization;
- Reduce level capping – more tactical allocation of cruising levels due to enhance planning, conflict detection and co-ordination;
- Civil/mil coordination procedures;
- Procedures to avoid a controller offering an aircraft to the next sector on a clearance that would cause a conflict in the next sector’s airspace in the vicinity of the sector boundary;
- Changes to co-ordination LOAs – further reductions in longitudinal separation planning minima between ATSUs. Changes to radar handover procedures in order to improve flexibility;
- Migration from the use of heading to track when radar vectoring and hence avoiding the current inconsistency between ground and airborne systems

7. CONTROLLER ROLES AND WORKING METHODS

7.1 Controller Teams

Today's distribution of operational human resources results in sector management by:

- Single person operations
- Planner and Tactical[2] Controller (PC and TC);
- PC and TC and supporting personnel (ATC assistant and/or Co-ordinator)

FASTI provides new opportunities for the utilisation of operational staff as follows:

- Single person operations with enhanced support
- For 2 adjacent sectors two Tactical and One Planner Controller
- Tactical and Planner Controller

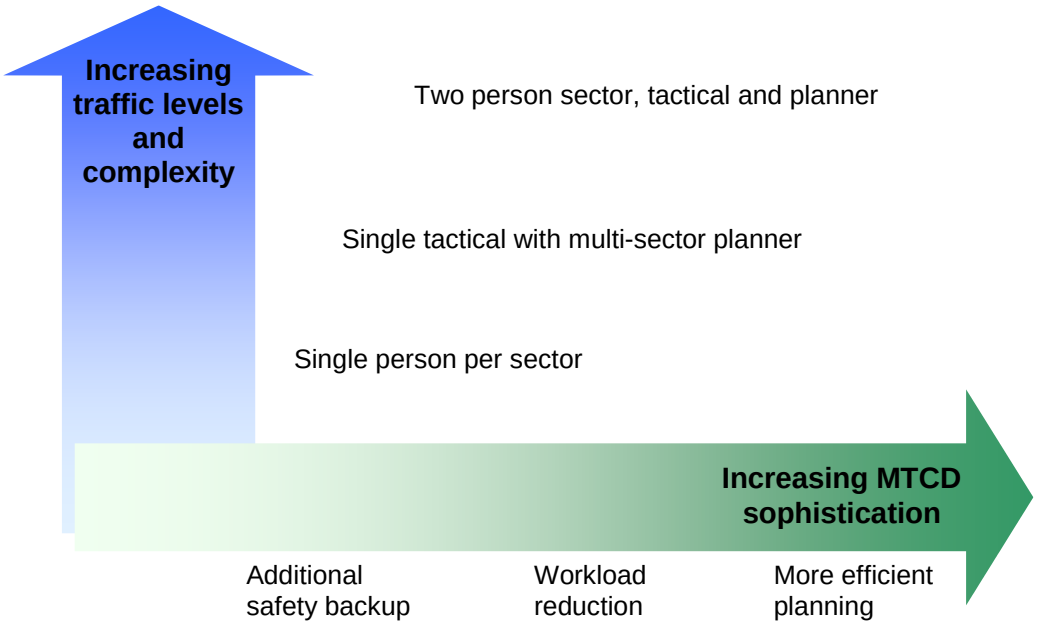

Figure 1 FASTI and Controller Teams/Roles

7.2 Working Methods

The working methods that are prescribed for the use of FASTI tools take account of ***task-sharing*** and/or a ***task*** distribution. A technology enabled concept for FASTI promotes a 'paradigm shift' to a 'trajectory-oriented' operational paradigm. Trajectory orientation is a procedural concept that enables en-route controllers to plan and co-ordinate trajectories across

[2] The term Tactical Controller (TC) will be used in this document to identify the role sometimes described as the Executive Controller.

sector boundaries while efficiently maintaining separation and conforming to flow-rate constraints [Ref 3].

In general, traditional ATC at sector level is both tactical and reactive with a sector focus. The way forward with FASTI inspires a more proactive approach with a strategic planning philosophy coupled with task distribution and planned/organised task management within the sector and beyond. In contrast with current practices trajectory oriented ATC emphasises on controller actions that work cooperatively across sectors and depend on each other for well planned, nominally conflict-free flow of traffic.

The controller skills and expertise remain as valuable and important as they have been in traditional ATC with requirements for learning, development and training of new skills and expertise.

7.3 Controller Roles

Traditional ATC methods consisted of ***responsibility*** allocation within the controller teams, in conjunction with local procedures and practices. The support that MTCD provides requires a more formal definition of the team controller roles and also promotion of the concept that the system is now a team component with a role.

Traditional allocation of responsibilities implicitly ensured the PC role was that of support to the TC with limited or no authority in the decision making process for air traffic control. However FASTI as an enabler provides opportunity to allocate specific tasks and/or functions to team members. The team in this context includes the system since the interdependencies between human and machine are important factors. The controller depends on the system for information while the system depends on the controller for updating of flight data, intent information where applicable, trajectory conformance assurance etc. The quality and accuracy of the system output can only be useful if the controller(s) support the system and vice versa.

Various trials and pioneering implementations have shown that MTCD can be deployed in diverse operational environments taking into consideration the diversity in the operational procedures, local constraints and requirements, airspace characteristics as well as traffic density and complexity.

7.3.1 Sector Team with a Planning controller and a Tactical controller

Consider the traditional controller team, Planning Controller (PC) and Tactical Controller (TC), with the addition of FASTI.

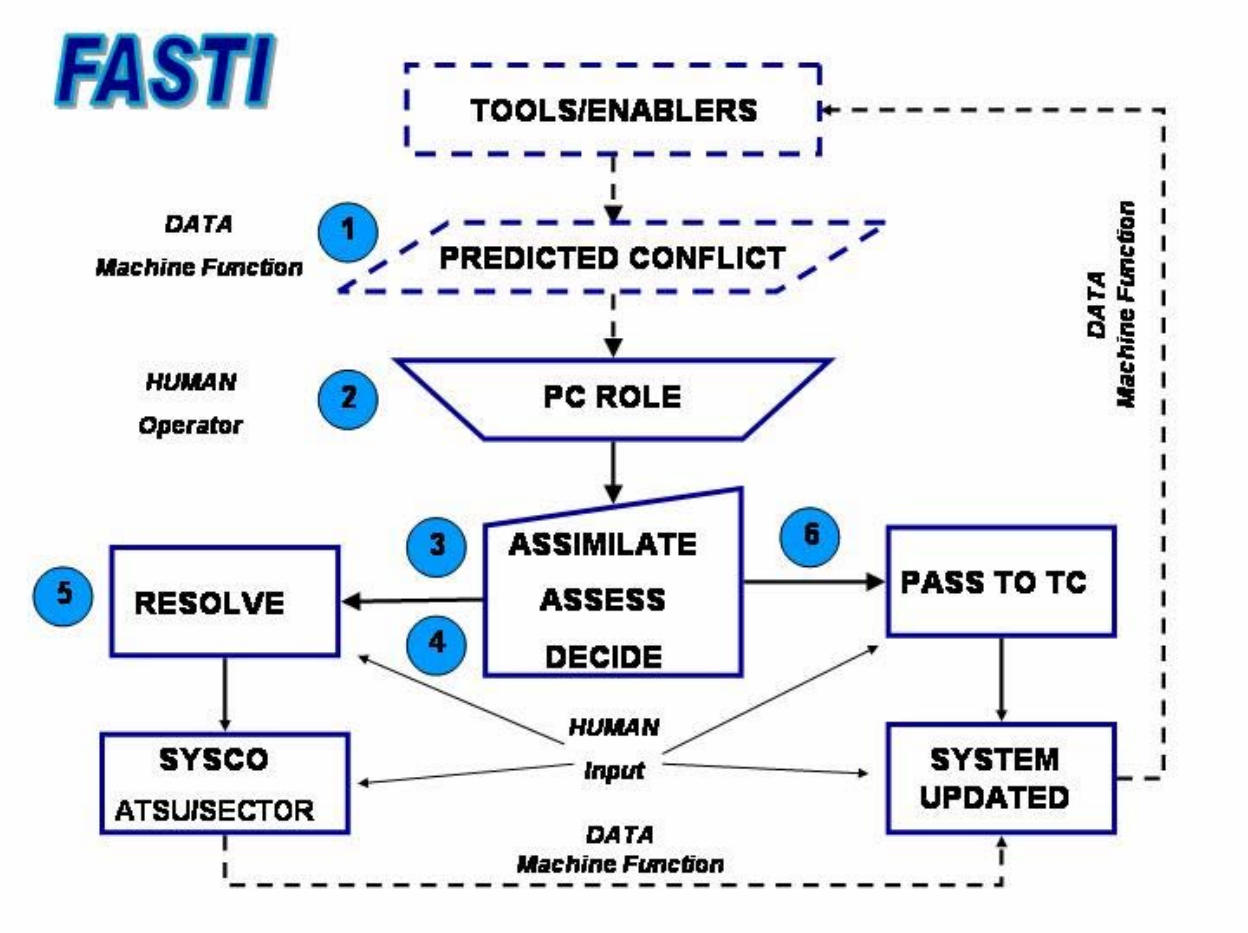

Figure 2 Human/Machine Roles – Planning Controller

1. The system detects potential conflicts within a 20 minute look-ahead time period, based on current trajectory information and the PC is notified.

2. The PC monitoring/scanning process results in detection of the data provided by the system

3. Mental operations implicitly lead to a decision by the PC to act on the information and its content. The PC uses probing tools or some system measurement tools in the process of assessing the nature and impact of a detected conflict prior to making a decision. This should result in the PC providing a *resolution* either by:

   4. Ignoring the conflict (i.e. due to foreseen circumstances the conflict will time expire or not occur);

   5. Resolving it by modifying an entry or exit condition {e.g. request change, with SYSCO, of the Planned Entry level (PEL) or Exit Flight Level (XFL)} The PC coordination takes account of LoA conditions or indeed make proposals outside LoA conditions if circumstances provide this alternative (FASTI flexibility).

   6. Deciding that the conflict is purely tactical and manageable by the TC and therefore transfers it to the TC (Note: this inter-team co-ordination may be explicit or implicit)

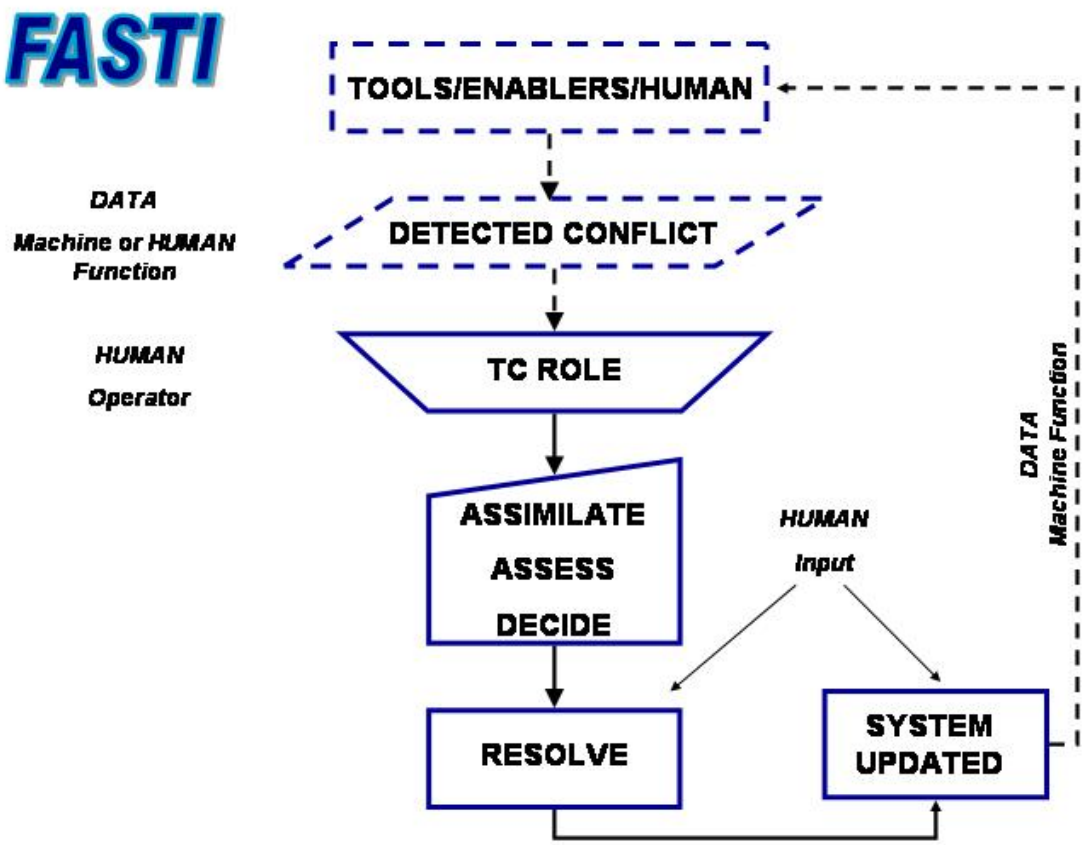

Figure 3 Human/Machine Roles – Tactical Controller

The result of the transfer of the conflict to the TC indicates that the PC considered it likely that some tactical action should be taken by the TC to resolve/monitor a detected conflict. In the process of making this decision the PC will be aware of current and future workload of the TC.

The TC (refer Figure 3) is supported by the system and the PC. The empowerment of the PC results in the TC having more organised workload and earlier notification of conflicts due to the system support and that of the PC. In the processes of information assimilation, assessment and decision making the TC is similarly supported by the system tools and functions.

Notification of the conflict to the TC may be discretionary (e.g. set system reminder or time to act), or set dynamically as a parameter by the TC (e.g. Flag the conflict with *x* minutes to start of conflict or potential loss of separation) and whichever the case the HMI should support and enable the action.

7.3.2 Single Person Operation (Planning and Tactical Roles Combined)

The possibility of a combined roles operation will be facilitated by FASTI. In this configuration a single person operation is envisaged.

In this scenario the tools are configured as required and the controller is responsible for strategic planning as well as tactical traffic management. On detection of a planning conflict the controller could decide to resolve it by co-ordinating with adjacent ATSU/sectors using SYSCO to modify an entry and/or exit condition or consider the conflict as tactical to be resolved later. The controller is aware of current and future workload and therefore can plan the “the best time

to act" and use the system support as necessary (e.g. Reminder, modify the system trajectory etc).

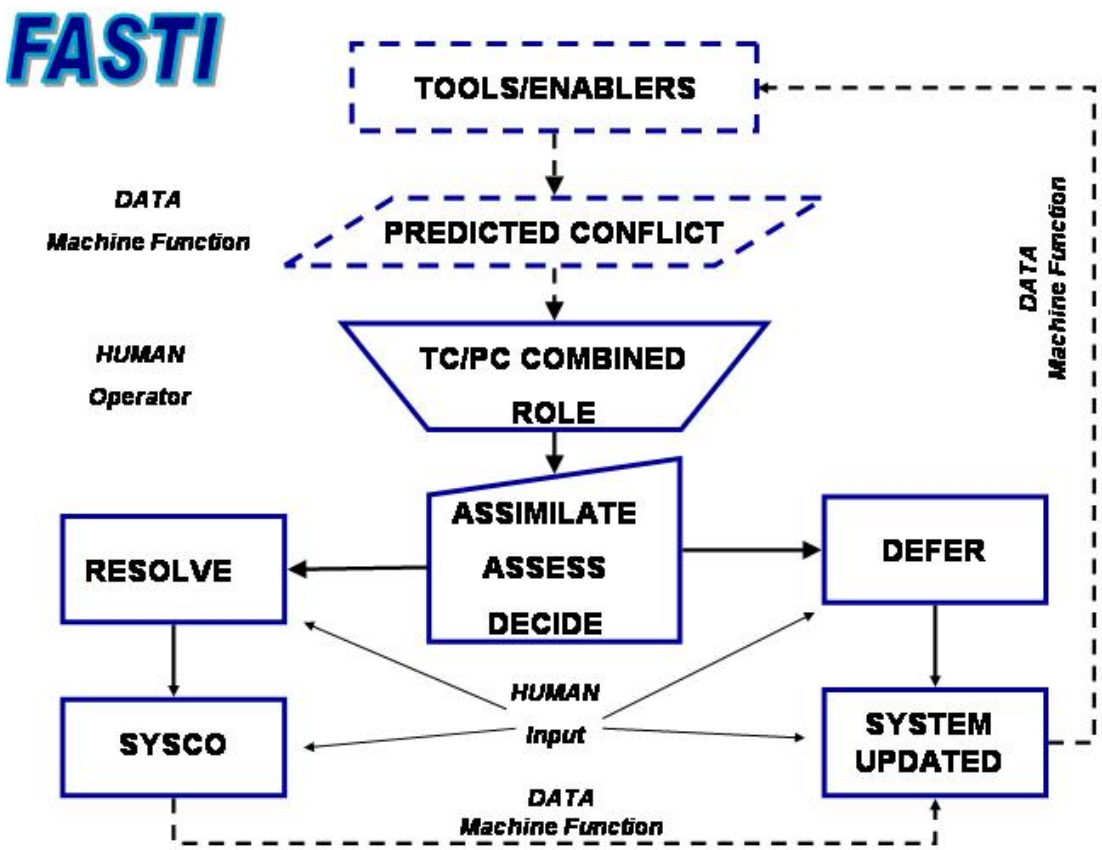

Figure 4 Human/Machine – Single person Operations (TC and PC combined)

The controller configuration of display and use of the system as well as a clearly prescribed working method should ensure effective and efficient management of traffic.

7.3.3 Multi-sector Planning Role

It is feasible to consider an arrangement whereby a PC could provide support to a number of TCs who operate in different sectors. This type of role could be considered as that of a Multi-Sector Planner (MSP). In this scenario the PC filters predicted conflicts with a focus on conflict-free trajectories to alleviate or smooth the tactical workload of the TCs. This is not to say that the PC would solve ***All*** conflicts for the TCs but more to ensure that potentially critical traffic situations and the associated workload are manageable for the TCs, *at the time of occurrence* (e.g. a multiple aircraft conflict reduced to a less complex conflict or even totally resolved).

In this MSP role the strategic planning focus is aimed at:

- Performing planning tasks related to conflict resolution;
- Performing tasks that will reduce the workload of the TC;
- Using the FASTI in an effective and efficient manner;
- Monitoring sector workload to ensure that potential workload peaks are smoothed or reduced to comfortable and manageable levels

Sector and ACC capacity management is a function of FMP or a similar role. In the MSP role the PC is subjectively aware of sector limits in terms of density and complexity. This should

ensure that actions taken by the PC are coherent with published procedures and preferences of the sector TC.

MTCD provides information on detected conflicts to the PC/MSP for a number of sectors or for a particular area of interest (AoI). The PC/MSP can assess the nature, severity, location, time of occurrence and potential impact on a particular sector TC and the probable associated workload. Consideration of all the factors empowers the PC/MSP to decide on the best strategy to adopt in dealing with the conflict information. This may result in taking action to;

- resolve conflicts using SYSCO (inter-sector or inter-ACC) or;
- defer resolution by allocation to the subject sector TC or;
- doing nothing due to foreseen circumstances that may alleviate concern or need for action by the PC/MSP or the TC

These actions by the PC/MSP could be performed at a tactical level of intervention compliant with the scope and remit of the allocated tasks and responsibility encompassed in local or bilateral procedures (e.g. a tactical resolution proposal with SYSCO).

The role of the PC/MSP is in effect similar to that described earlier (Refer Figures 2 and 4) in the process of information assimilation and decision making. Another MSP role could provide planning for a number of sectors operated by both PC and TC.

7.4 Controller Working Methods

Methods of work for controllers vary due to a large number of factors in spite of the end goal being essentially the same for all. Local procedures and role definitions, task allocation etc necessarily require particular behaviour however; the skill, knowledge and expertise requirements are similar for the European controller population. Some factors contributing to particular local behaviour encompass segregated or prohibited airspace and their activation periods, sectorisation structure and sector geometry (e.g. vertical v horizontal), traffic profiles and complexity (e.g. predominance of en-route, vertical movement, complex crossing or converging traffic etc) and the ground system technology. Additional considerations relate to constraint management for Arrival/Departure flows, Oceanic entry/exit etc.

FASTI promotes the strategy of defined task distribution between controllers and between controllers and the system. Prescribed working methods facilitate this task distribution as well as the use of tools and interface functions[3] in the performance of these tasks. The core philosophy is to perform ATM/ATC with a strategic approach in the use of FASTI resulting in nominally conflict-free trajectories.

The implementation of FASTI requires an approach, which in essence should be task/tool focused. The addition of new tools encompasses supporting enablers and these must be integrated into the controller task performance and decision making processes.

7.4.1 Task Management

The management of controller and system tasks in the FASTI environment will require a concise identification and clarification process to be employed. This process should incorporate, or be in conjunction with, a change management process thus ensuring a clear understanding of what is to be changed and/or modified. In addition there are important training issues to be defined and addressed and in the overall context these issues are addressed in the FASTI Operations Manual and FASTI Human Factors guidance documentation. This will provide guidance on how change is managed and implemented.

[3] The details of task/tool relationships and the use of the system are beyond the scope of this concept. This level of detail will be addressed in the FASTI Operations Manual – FASTI Concept of Use and Human Factors Guidance Documentation.

7.4.2 Tasks and Tools

A task/tool focus is required for FASTI implementation. New working methods are required for FASTI tools whereby the addition of FASTI is achieved in a collaborative manner ensuring task-sharing and task distribution are successful in providing benefit to all stakeholders and actors.

FASTI introduces a new set of tools and enablers, which require prescribed methods of use to be defined for efficient use in achieving the FASTI objectives.

Traditional working methods do not match requirements of FASTI and therefore must be changed while at the same time safety must not be degraded and as a minimum criterion for deployment, current safety levels shall be ensured.

8. IMPLEMENTATION ISSUES

The evolution of ATC systems in recent decades has by and large been relatively easy since the “automation” has targeted enhanced HMI display issues. This is not to take a simple view of the technology involved but from the user viewpoint additional functionality has been useful but with minor impact at the front end of ATC. The progression to more complex and supportive automation proposes a challenge in the change management process. Technology has a new role due to the nature and type of support it provides and there are many factors to be considered in the context of implicit and explicit change requirements. Commercial concerns are a reality for all aviation stakeholders and in addition for ATC there are a number of areas of concern to be addressed such as Safety and Human Factors, Cost and Benefit to the controller, Training and Education for the controller and also the business context for ANSPs.

A starting point for FASTI should ensure an understanding of what it is FASTI will change and what changes should be implemented. There are a number of tools, disciplines and processes that can be employed to facilitate change management for FASTI. The areas that are critical to FASTI encompass:

- Safety considerations;
- Human Factors and training issues;
- System safety and reliability;
- Cost/benefit;
- Implementation convergence and harmonization

Many Human Factors considerations as well as Safety management issues have to be addressed when the decision to implement FASTI is taken.

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