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Guidelines for ATCO Manpower Planning Processes

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Abstract

This document focuses on providing guidelines on Air Traffic Controller (ATCO) Manpower Planning processes, which consolidates and builds on previous research and publications relating to ATCO Manpower Planning. One of the main benefits of this guidelines document on ATCO Manpower Planning is to help foster improved understanding of the Manpower Planning processes and components which leads to enhanced quality in the prediction, assignment and use of staff. In addition, by addressing a wide range of readers (including manpower planners, supervisors, ATCOs, senior management and staff members at all levels), the document provides transparency on the elements of Manpower Planning which should enable manpower planners to benchmark their current practices and identify areas for improvement.

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EXECUTIVE SUMMARY

This document is part of the work of the Manpower Sub-Programme (MSP), Work Package (WP) 003 within the European Air Traffic Management (ATM) Programme (EATMP). This is the first deliverable in this WP and concerns Air Traffic Controllers (ATCOs) Manpower Planning (MP) in the current ATM system. The MSP concentrates on the development of professional Human Resources Management (HRM) methodology conforming to best practices and includes concepts, methods and tools for MP and staffing of ATM organisations (ATMOs) in current and future ATM.

Previous deliverables on MP in the EATCHIP framework dealt with an in-depth shortage analysis which offered insights to the general MP and manning processes (EATCHIP 1998b), a systems view of ATMO MP (EATCHIP 1998c) and the tactical approaches of the manpower staffing methodology in the day-to-day practice of MP work in ATMOs (EATCHIP 1998d).

The underlying theme of this document is that MP is a complex and dynamic process.

Chapter 1, "Introduction" describes the background, purpose and scope of the document.

Chapter 2, "A Strategic and Systems Perspective" clarifies the benefits of taking a systems and strategic approach to ATCO MP as ATMOs of the future are likely to be in a state of continuous change and uncertainty.

Chapter 3, "ATCO Manpower Planning Methodology" describes the key inputs, processes and outputs to determine the number of ATCOs required and available. In addition, guiding principles, guidelines and policy recommendations are provided.

Chapter 4, "ATCO Manpower Planning Management" describes key guidelines for managing the MP process efficiently and effectively.

Chapter 5, "Summary of Guiding Principles" describes the main principles outlined in the document.

Chapter 6, "Summary of Guidelines" describes the main guidelines outlined in the document.

Annex A, "ATCO Manpower Planning Time Horizons Triggers" provides examples of short, medium and long-term triggers, their implications together with possible actions that could be taken.

Annex B, "ATCO Manpower Planning Monitoring Factors" provides an overview of the various factors that need to be monitored for effective MP.

A list of reference, glossary of terms used in the document, abbreviations and acronyms are provided.

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1. INTRODUCTION

This document is part of the work in the Specialist Task (ST) 03 within the EATCHIP framework concerned with guidelines for work organisation staffing and MP. This work continues now in the framework of EATMP. The MSP concentrates on the development of professional Human Resources Management (HRM) methodology conforming to best practise guidelines (including concepts and tools) for MP and staffing of ATM organisations (ATMOs).

Application of Guidelines for Work Organisation and Manpower Planning Objective number 6.4.1 of the Convergence and Implementation Programme (CIP) Edition 3.2.01 of the EATCHIP Work Programme Document (EWPD Version 3.2) of the European Organisation for the Safety of Air Navigation (EUROCONTROL) calls for an "Application of guidelines for Work Organisation, Staffing and MP".

The current document was put forward for consideration to the Manpower Sub Group (MSG) in November 1999 and the Human Resources Team (HRT) in April 2000 and reflects the comments and amendments made by both groups.

1.1 Purpose

The main purpose of this document is to act as a guide to facilitate Air Traffic Controller (ATCO) staffing and MP in ATMOs. This document will also help to foster improved common understanding of the components of the MP process taking into account broader planning considerations.

By describing in detail the requisites for MP this document provides more transparency and awareness of the complex task of MP.

The main user of this document should be the manpower planner responsible for MP of ATCOs.

Other users will include managers involved in both strategic and operational planning issues.

This document should also be used as a source of information between the different categories of people involved in planning activities (manpower and human resources managers, operational heads, and training managers).

The document concentrates on guidelines related to the MP process, which focus on a generic approach to MP. Consequently, it was not feasible to cover all details and possibilities.

1.2 Scope

The MSG recognised that efficient and effective MP is of great importance to many Service Providers at present and will be of even greater importance in the future due to the challenges in ATM system changes. This document is based on the insights and practical experiences of MPs involved in ATCO MP in several ECAC states with differing needs and organisational structures. For the purpose of this document, the term ATCO should be interpreted as any controller function in the operations environment (e.g. radar, planner, tower, approach etc.).

1.3 Benefits

The main benefits of this guideline document on ATCO MP are that it:

- improves understanding of the MP processes and components which leads to enhanced quality in the prediction, assignment and use of staff;
- provides transparency on the elements of MP, which should enable MPs to benchmark their current practices and identify areas for improvement;
- provides a standardised format for understanding and communicating the MP process between MP participants both within and between ATMOs;
- provides a valuable training tool which can be used by training institutes in teaching the principles of MP.

1.4 Background

These guidelines consolidate and build on previous research and publications relating to ATCO MP and, in particular, the following:

EATCHIP (1996) addressed strategic and tactical planning issues as well as associated planning problems concerning quantitative Air Traffic Services (ATS) manpower requirements. This document contains descriptive resolutions to MP.

EATCHIP (1998a) continued the work started by the Select Group for Assessing Manpower Issues (SGAMI) in December 1992 and provided information on ATCO requirements and expectations for the period 1998 to 2002 and an update and evaluation of ATCO requirements and expectations for the period 1993 to 1997.

EATCHIP (1998b) drew attention to some critical issues in MP based on available data. Eleven different hypotheses concerning shortage and surplus management of ATCOs are formulated and their consequences discussed.

EATCHIP (1998c) described how a systems view can explain and help to better understand problems with HRM e.g. MP.

EATCHIP (1998d) detailed the tactical perspective of the manpower staffing methodology in ATMOs by focusing on the day-to-day way of determining the number of controllers needed to perform the core task of an ATMO. The document also fosters the common understanding of broader and long-term MP considerations in the manning process.

EATMP (1999a) described and applied dynamic systems modelling to the issue of ATCO MP.

EATMP (1999b) discussed current issues in relation to strategic, tactical and management of MP in ATMOs in Europe and provides conceptual strategic and practical insights into current planning problems and solutions as were put forward at the first EUROCONTROL workshop on ATCO Manpower Planning.

In particular, the Workshop not only revealed an urgent need for ATCO resources in a number of Air Traffic Control (ATC) units but also for more communal approaches in providing the necessary capacity in the European airspace. It was also stressed that a systemic view should be adopted to find balanced solutions that serve the overall objectives and deal with the dynamics of the distributed ATM system.

This document aims at integrating these and other findings into a consistent, balanced and comprehensive methodology, guidelines and recommendations.

1.5 Document Overview

In order to incorporate the many facets to the dynamic and complex issue of ATCO MP, this document is divided into three parts (illustrated in [Figure 1](#) below) as follows:

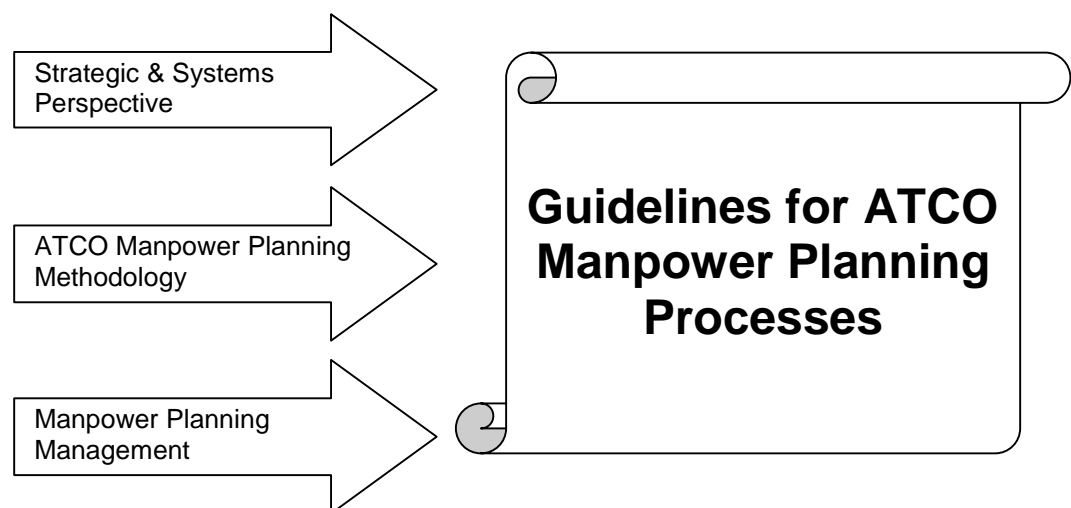


Figure 1: Document Overview

A Strategic and Systems Perspective

This part outlines the rationale for a strategic and systems approach to ATCO MP and explains why this approach is necessary and how the rationale can be applied.

ATCO MP Methodology

This chapter details the ATCO MP Methodology (the steps required in matching ATCO manning requirements with ATCOs available). The key inputs, processes, outputs, guiding principles, policy recommendations and guidelines are provided.

MP Management

This part of the document covers issues to help improve the management of the MP process which include managing surplus / shortages, data management, computer modelling and simulation, managing the time horizons, communication and co-operation etc.

2. A STRATEGIC AND SYSTEMS PERSPECTIVE

2.1 Introduction

ATMOs of the future are likely to be in a state of continuous change and uncertainty as indicated in ATM Strategy 2000+ (e.g. privatisation and corporatisation of ATMOs, new technology). Consequently, the following are some of the challenges facing MPs today:

- perceived European shortage of ATCOs;
- decrease in the supply of suitable people to train and recruit as ATCOs;
- cost and time taken to recruit and train ATCOs;
- increasing number of qualified ATCOs who leave to take up other duties outside the Operations Room (OPSroom);
- increased level of stress due to the increase traffic levels that ATCOs have to deal with which may lead to unexpected departures of ATCOs;
- uncertainty about future changes in the tasks and roles of ATCOs due to changes in operational and technological environments.

Most of these issues are dealt with by MPs on a national basis. However, there is an ever-increasing need to move beyond competition and national perspectives to a regionalised co-operation and thus benefiting from economies of scale in managing resources.

Therefore, MP is likely to be seen not only as the thread that ties together all HRM activities but also as the instrument for establishing and signalling when and how activities should change. HR managers and in particular MPs will need to take the role of enablers and even a driving force for organisational and operational change. To be effective in this role they will need to adopt a strategic and systems perspective for understanding how the behaviour of individuals influence and are influenced by the larger organisational, environmental and operational context over time. This chapter outlines a strategic and systems perspective to ATCO MP to provide an overall context for ATCO MP. The following topics are addressed:

- Objective of MP;
- A Strategic Perspective;
- A Systems Perspective.

2.2 Objective of ATCO MP

The overall objective of ATCO MP is to provide a sufficient number of qualified personnel, on a timely basis, to ensure the provision of ATS.

In addition, HRM programmes (e.g. recruitment, selection, training, licensing and staff development) will help to ensure that a sufficient number of people with the required abilities, knowledge and skills are available to:

- provide safe, efficient and cost effective ATC services;
- adapt and cope successfully with future changes;
- make full use of the potential of ATCOs in the OPSroom and associated duties;
- gain competitive advantages and returns on investment.

2.3 A Strategic Perspective

2.3.1 Definition

Strategic MP is the key link between an ATMOs strategic plan and its overall HRM function (as illustrated in [Figure 2](#) below). The strategic ATCO manpower plan is a projection of how an ATMO plans to acquire and utilise its ATCOs. It affects and is affected by the ATMOs overall strategic plan, and it serves as a basis for overall HRM (e.g. recruitment, selection, training, licensing and staff development).

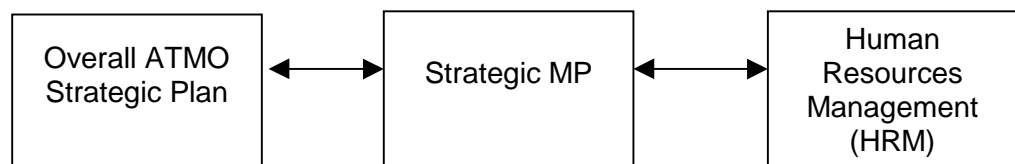


Figure 2: Integrated Strategic MP

2.3.2 Characteristics of Strategic MP

The following are the key characteristics of taking a strategic MP approach:

A Long Range Focus

A strategic MP sets the long-term direction of an ATMOs HRM policies and programmes. The time horizon is five years or more.

Integrated with Strategic Plan and HRM

A strategic perspective to MP requires approaches where the business strategic planning of business areas are integrated with MP. The focus is on a synthesis of business strategic planning and MP, which highlights HRM programmes that are a priority to accomplishing the business results. Ideally, the two strategies should operate hand in hand so that any modifications to one strategy are reflected in the other and should support each other.

Strategic MP also requires that all HRM programmes are planned for. Planning for only one or two activities such as recruitment and selection is ineffective.

Line Managers and MPs to Work in Partnership

An integrated linkage between business and manpower plans requires MPs and line managers to work jointly to develop business plans and determine manpower needs (qualitative and quantitative).

Recognises the Impact of the External Environment

Strategic MP needs to explicitly recognise the threats and opportunities posed by the external environment in the form of laws, economic conditions, social and demographic changes, domestic and international political forces, technology etc.

Recognises the Impact of Competition and Dynamics of the Labour Market

The factors of competition in attracting, rewarding and using ATCOs has a major effect on an ATMOs manpower strategy. Forces are evident in local, regional, national and European markets. Labour market dynamics of wage rates, unemployment rates, working conditions, benefit level and competitor reputation all have an impact on and affect strategic manpower decisions.

Formalised

The strategic manpower plan should be formalised which clearly indicates both quantitative and qualitative HRM programmes that are required to meet the ATMOs strategic plans. The necessary documentation and data should also support the plan.

Budgets and Cost Focus

Today ATMOs are requiring much more transparency on how HRM affects budgets. Increasingly, MPs need to justify decisions and activities on a cost benefit basis. They are being held accountable in a financial sense for HRM programmes e.g.

- Are the programmes and policies worth it?
- Do they produce the desired results?

Competition and business restructuring will increase the demand for accountability. Therefore, MPs should be aware of the cost implications of proposed HRM in their strategic plans and endeavour to seek value for money whilst at the same time ensuring that quality is not hampered.

Supported by Adequate HR Information System

An effective HR Information System as a decision support system provides valuable information to decision-makers and alerts them to potential future problems or opportunities. Information should be available on, for instance:

- staff turnover;
- absences;
- quality and performance rating;
- salary levels;
- rewards.

2.3.3 Benefits

The main benefits of taking a strategic perspective to ATCO MP are:

- smooth adaptation of ATMO structure and staffing over time in response to environmental changes;
- increased quality and efficiency of HRM programmes which are in line with the strategic direction of ATMOs;
- lower costs as a result of improved use of ATCOs available.

2.3.4 Constructing a Strategic ATCO Manpower Plan

The construction of a strategic ATCO manpower plan maps out how to translate the organisation's strategic plans and objectives into future quantitative and qualitative HRM requirements for ATCOs, together with plans to fulfil those requirements over both the shorter and longer term through various HRM programmes. The key steps (as outlined in [Figure 3](#)) involved are:

Step 1: Analyse ATMOs Strategic Objectives

To align the strategic manpower plan with the ATMOs strategy an analysis is required of objectives and business influences to ensure that the correct premises or factors are incorporated in the strategic manpower plan. For example, a growth-orientated business strategy needs to be supported by a manpower strategy of aggressive marketing, recruiting, selection and training of staff.

Step 2: Analyse Environmental and Organisational Influences

National and European employment and economic policy influence MP. An assessment of the HR educational / skill level of the labour market from which ATMO draws is critical. This assessment enables the prediction of future changes, assess their effects and thus plan recruiting and training systems that take maximum advantage of the forecasted educational / skill mix.

Step 3: Examine the Job Structure and Design

Examining ATCOs jobs in light of new technological change will likely result in job changes. This will impact selection, staffing, training, hiring and other aspects of the manpower plan. Another factor that needs to be examined in this step involves the aspirations and skill level of ATCOs. This issue deals with motivation, work ethic, expectations and job skills ATCOs bring to the job. Changes in ATCOs aspirations, expectations and skills may require the redefinition and restructuring of jobs to some extent to reflect these changes.

Step 4: Examine ATCO Job Skills

Once the new job structure and design is determined, the next step is to examine the skills required in each job category. Forecasting future skills needs and preparing to fill those needs today is a critical feature of the strategic approach to MP. Estimations of how the skills will change need to be

built into the manpower plan. Explanatory job descriptions that specify the duties, skills and qualifications required for each job should be available, preferable computerised and easily assessed for personal and career development and training purposes.

Step 5: Match and Estimate ATCO Shortage or Surplus

From the comparison between the number of ATCOs required and ATCOs available a shortage or surplus will be detected. Decisions are required as to how to deal with surpluses and shortages in view of the ATMOs objectives. If a surplus is predicted the manpower plan needs to consider whether individuals should be transferred, retired etc. If a shortage is predicted, the ATMO must be aware that the time horizon, in many instances, is up to five years to recruit, select, train and license *ab initio*.

Step 6: Gap Analysis

A gap analysis is used to reconcile the forecasts of ATCOs demand and supply. The process involves MPs developing several scenarios of various environmental forecasts with alternative supply and demand forecasts. Gap analysis is also used to match potential problems / opportunities and solutions in order to evaluate how an ATMO might respond to the future. The gap analysis decision making process involves a search for alternative solutions, evaluation of alternatives, and the choice of appropriate solutions.

Step 7: Determine HRM Strategic Objectives

The HRM strategic objectives need to be specified in line with strategic objectives with regard to ATCO utilisation. In developing these objectives specific policies need to be formulated to address e.g.

- How to fill positions - from within the organisation or hiring individuals from the labour market?
- How to link training and development objectives with MP objectives?
- How to ensure that the organisation has a continuously adaptive and flexible ATCO population?

Step 8: Establish Specific Plans for HRM

Specific objectives should be established for every HRM component from recruiting to termination of staff. The overall manpower plan should drive the specific objectives established for each HRM component (e.g. recruitment, training, licensing, reward, performance etc.) and these then determine the development of specific policies and programmes.

Step 9: Monitor and Evaluate HRM Plans

Plans must be monitored and evaluated on an ongoing basis to ensure that they are meeting objectives. Plans must be redesigned as input data or forecasts change. (See also Chapters 4.3, 4.4 & 4.7).

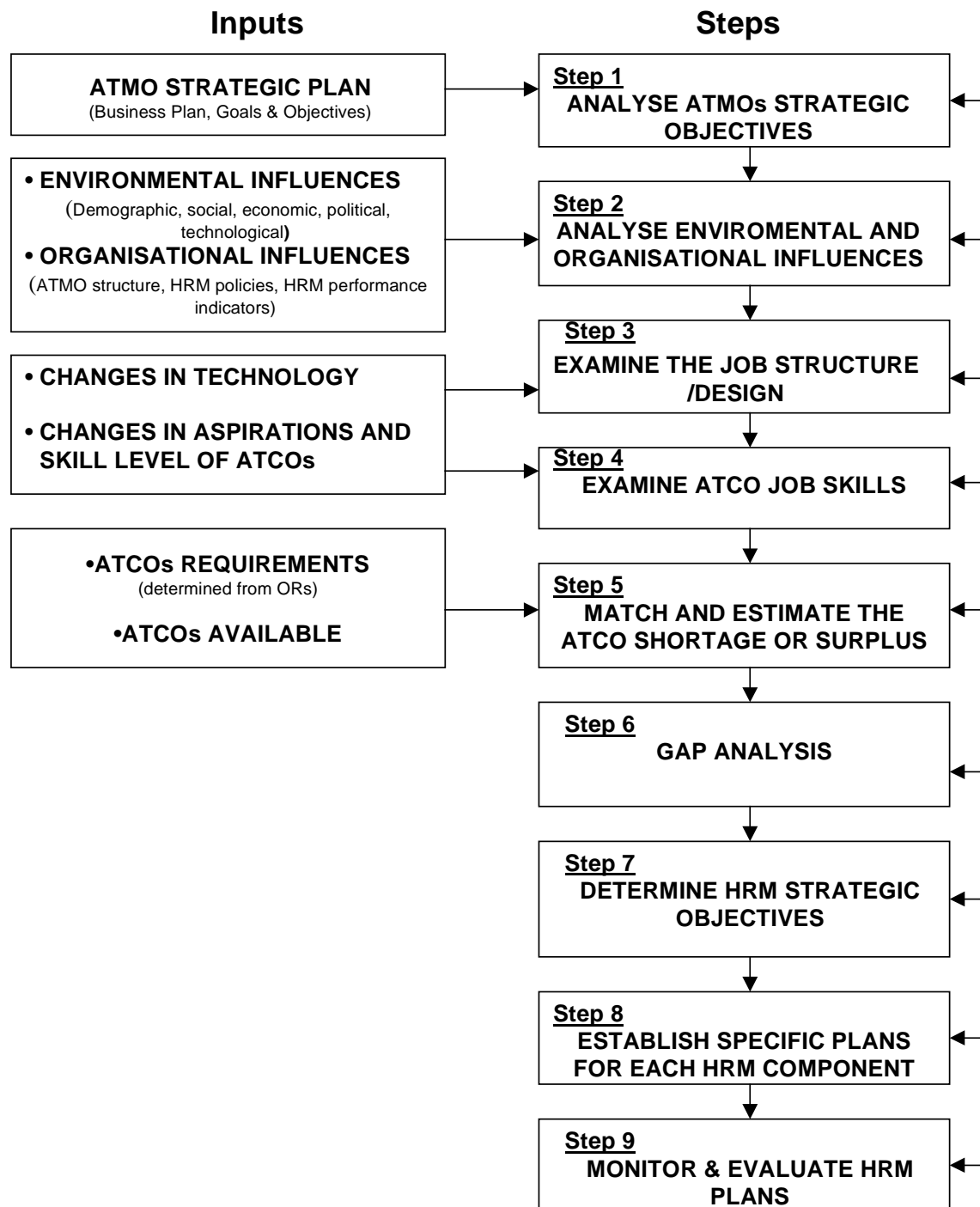


Figure 3: Steps involved in the Strategic MP Process

2.3.5 Guiding Principles

- MPs should carefully anticipate changes in Operational Requirements (ORs) and their consequences to ATCO requirements and systematically plan for meeting these requirements far in advance.
- Strategic MP requires that a broad focus is taken which ensures that all HRM components are planned for (e.g. recruitment, selection, licensing, training, and development).
- The strategic manpower plan should be formalised and indicate both the quantitative and qualitative HRM programmes that are required to meet the strategic plans. The necessary documentation and data should also support the plan.
- MPs should be aware of the cost implications of proposed HRM programmes in their strategic plans and endeavour to seek value for money whilst at the same time ensuring that quality is not hampered.
- Information should be available to facilitate the strategy formulation decision making process. An effective HR information system provides valuable information to decision-makers and alerts them to potential future problems or opportunities.
- Line managers and MPs should work in partnership to develop business plans and determine a manpower plan.

2.3.6 Policy Recommendations

- Policies should formulate and describe both the quantitative and qualitative aspects related to MP and should explain how these should be tackled in MP.
- The implications of changes to HR policies, business strategies linked to MP etc. should be fully indicated and understood before implementation occurs.

Guideline 1: Strategic ATCO MP

- The manpower plan should be fully integrated and be consistent with the overall strategic plan. ATMO strategy should be determined first, and then manpower strategy should be developed.
- Outside influences of economic conditions, technology, the labour market and so on should be explicitly considered when developing the manpower plan.
- Changes in job design should be explicitly recognised in the plan, the plan should not assume that the structure of jobs in the future will be the same as they are today.
- Estimating future shortages or surpluses or skill category should use computer techniques and quantitative models as appropriate in order to manage the process more effectively.
- HR information systems should be used as a decision support system and should alert managers to problems and / or opportunities.
- MPs and line managers should work in partnership in formulating all points in the MP process.
- The manpower plan should be kept flexible and adaptable so that it can be changed as conditions change. In particular, the strategy formulation process should remain flexible and readily adaptable to change. Flexible planning, which is continuously smoothed and adjusted to the supply and demand of staff is a key to MP success.
- It is necessary to monitor and control feedback on qualitative information and trends, which may impact different levels of planning, and time horizons.

2.4 A Systems Perspective

2.4.1 Introduction

The formulation of a strategic manpower plan requires choices and decision making. However, strategy formulation deals with the future, which is difficult to predict with certainty. MPs are required to make predictions on the demand and supply of ATCOs under conditions of uncertainty.

Ongoing changes in today's ATMOs environment means that the future cannot be easily anticipated by simply projecting past trends in a linear way. Therefore, strategic MP aims to deduce the consequences of the policies underlying a proposed strategy. A systems perspective based on models can

facilitate this challenge by acting out the consequences of strategy proposals in an overall organisational setting.

2.4.2 A "System" Description

A system is a perceived whole whose elements 'hang together' because they continually affect each other over time and operate towards a common purpose. If this would not be the case, the system would fail and its energies would be blocked or would offset each other.

System dynamics is a term that describes the way in which the elements interact within a current system. Each of the actions, a manpower planner, for example, takes will produce some desired results but almost certainly some unintended consequences elsewhere. MPs have to learn and to recognise the ramifications and trade off of actions taken. Good results of MP in a complex system depend on bringing together all relevant perspectives and describing all interdependencies. This requires co-operation between all partners in the process.

2.4.3 Application to ATCO MP

ATCO MP is complex system because:

- MP requires balancing the actual number of ATCOs required with the size of the pool of ATCOs available. A multiple of variables, which are interconnected and interdependent, affect both of these factors. For example, the size of the pool of ATCOs available is affected by retirements, ATCOs transferring to non-operational jobs etc. [Figure 4](#) illustrates some of the many variables, which contribute to MP.
- As time horizons widen what will be needed and what will be available is less easily answered. For example, producing a qualified ATCO can take up to five years from the beginning of the recruitment campaign to a fully qualified and licensed ATCO. This requires MPs to decide on the number of ATCOs required five years from now rather than the number needed now. This figure will be influenced by a number of factors which are difficult to determine e.g. the number of *ab initio*s who will be selected, start training and who will successfully complete the training stage, the growth in traffic volume, impact of new technology etc.
- Decisions are influenced by other participants in the system and their current understanding of the causes and effects of their actions that reflect this understanding.
- The many interconnected variables and influences means that it is not possible to just do one thing due to the many variables that matter. It is also not straightforward to decide on the actual numbers required due to other participants in the process, for example operations manages, ATCOs, HR managers etc.

- It is dynamic in that the cause and effect are distant in time and changes occur at many timescales. In addition, the consequences over time are subtle and not obvious to the many participants in the system.
- Many obvious solutions to problems fail or actually worsen the situation. For example, a stop and go approach to training *ab initio* to deal with shortage / surplus may result in the longer term in reducing the quality of the training cycle and consequently lead to an increase in training failure rates.

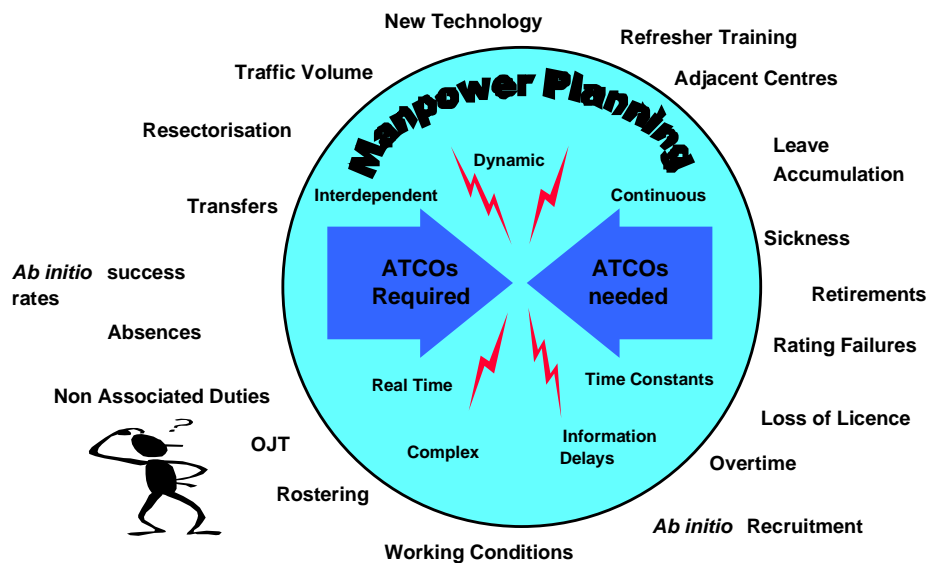


Figure 4: Examples of variables in ATCO MP

2.4.4

Benefits

The main benefits of a systems perspective are that it:

- enables the shift from seeing MP issues / problems as separate from the rest of the organisation and the wider context to being inextricably connected.
- recognises the interrelationships and patterns resulting in underlying issues being identified that influence behaviour over time.
- provides an opportunity to develop and test out possible scenarios over time. Thus, revealing flaws and inconsistencies in proposals that might not otherwise come to light until implemented.

- provides an opportunity for participants involved in decision making to make their assumptions explicit about the range of interlinked principles and policies that make up the organisation. Thus, sharing their assumptions of specific manpower situations and developing clear strategy scenarios which aid the decision making process.

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3. ATCO MANPOWER PLANNING METHODOLOGY

3.1 Introduction

This chapter focuses on the MP methodology used to plan ATCO requirements. Reference is made in particular to EATCHIP (1998d), which details the tactical perspective of the manpower staffing methodology in ATMOs.

3.2 Background

The purpose of any staffing methodology in ATMOs is to determine the number of ATCOs needed to perform the core task (i.e. the deliverance of ATC service and the provision of a safe air traffic control environment) and possible additional tasks / duties in the ATMO (e.g. associated duties, participation in projects).

The airspace managed by an ATS provider is usually divided into control sectors containing consoles for en route: executive; planning and assistant (if necessary) control positions.

This combination of positions can vary depending on sector size. From these positions ATCOs organise a safe, orderly and expeditious flow of traffic. Consequently, the air traffic demand drives the number of hours control positions must be open on the one hand. On the other hand the maximum number of aircraft that an ATCO can handle drives the number of sectors in operation given the air traffic demand. Based on the actual opening and closing times of sectors various ORs profiles can be derived. Once the Operational Requirement (OR) has been established, it forms the basis for the calculation of the number of ATCOs needed. This is the cornerstone of determining manpower needs and it needs to be established in an appropriate manner.

The dynamic change in traffic demand over time and its consequent effect on the number of ATCOs required must be mapped onto the number of ATCOs available. The inflow, throughflow and outflow of staff resources determine this availability. The MP model outlined in [Figure 5](#) below illustrates the key variables necessary to derive a picture of the ATC manpower requirement at any particular point in time.

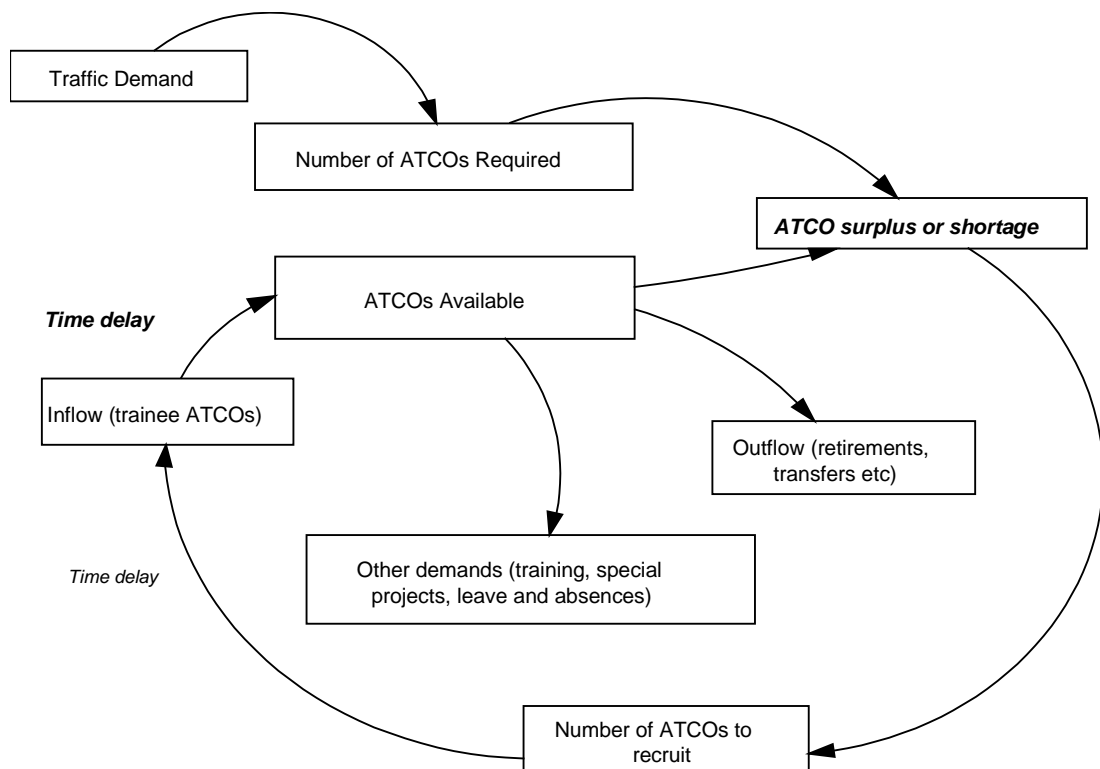


Figure 5: MP Model

3.3 Chapter Overview

This chapter has been structured according to the core of ATCO staffing i.e. balancing operational manning requirements with the number of ATCOs available for the planning period (as illustrated in [Figure 6](#)) in question which requires the following key activities:

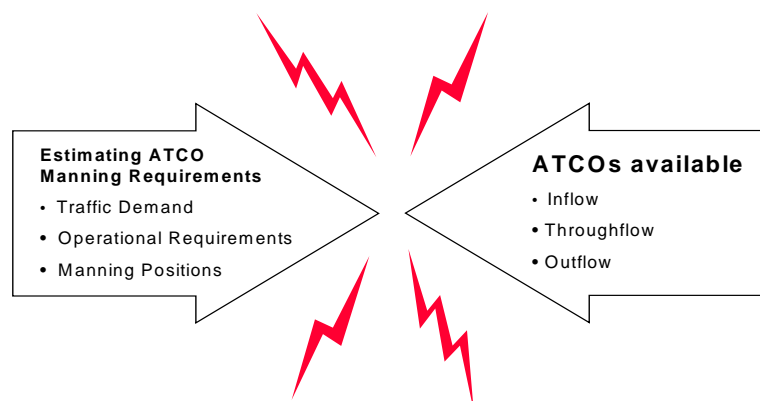


Figure 6: Components of ATCO MP Methodology

1. Estimating the ATCO Manning Requires analysing air traffic demand to determine ORs and estimating the number of ATCOs required.
2. Estimating the number of ATCOs available by estimating changes in in-flow, through-flow and out-flow.

The following paragraphs describe each of these factors and sub factors detailing the key input data, process, outputs, guiding principles, policy recommendations and guidelines.

3.4 Estimating ATCO Manning Requirements

3.4.1 Introduction

The following paragraphs describe the two key steps in estimating ATCO manning requirements, i.e.

- analysing Air Traffic Demand to determine ORs;
- estimating ATCOs required.

3.4.2 Analysing Air Traffic Demand to Determine ORs

Definition

Air traffic demand is the number of aircraft requiring ATS at a given time. The maximum number of aircraft that an ATCO can cope with from his / her working position is defined as the sector capacity and is a function of ATCO workload in that position. In principle, the bottleneck is the sector with the lowest traffic handling capacity or the highest separation standards on a certain route.

Objective

To analyse the traffic demand for the relevant airspace and the forecasted average flow of traffic to determine the opening and closing times for positions available in a sector.

Required Input Data

- Statistics on airspace capacity (e.g. the maximum number of aircraft to be controlled by an ATCO per hour for that sector). This includes information on:
 - Control position characteristics which reflect local requirements e.g. number and size of control positions, number of days per year a position is in operation, number of days of operation of the facility (per year);
 - what positions need to be manned by an executive ATCO supported by a planner and / or an Assistant Controller (AC);
 - the hours a position is manned accordingly;

- historic data on opening and closing times of sectors/positions for previous time periods;
- statistics on air traffic demand;
- statistics on daily and seasonal variations;
- traffic growth/decrease projections for the planning period;
- strategy reports on new developments/concepts in airspace management;
- letters of agreement with adjacent centres;
- manpower policies of adjacent centres.

Process

Based on the analysis of traffic demand (volume, growth and available sector capacity) the opening and closing times of sectors can be determined. The opening hours for positions can vary from day to day, from weekday to weekend and from season to season. There are occasional irregular peaks in demand, which occur at the start of the holiday season etc. Normally the OR is calculated from the average opening and closing times rather than peak requirements (to prevent overhead of staff in OPSroom) derived from historical data for the planning timeframe. Where traffic demand leads to sector limitations earlier opening and later closing times will need to be considered in determining the OR.

Consideration needs to be given to the following factors in determining the ORs for opening and closing times of sectors:

- ORs are the foundation for determining ATCO manpower requirements. Subjective data which does not reflect the real requirements from OPS leads to an incorrect calculation of manpower requirements, resulting in too many or too few controllers in the OPSroom at any one time. It can also result in positions remaining closed despite demand. Therefore, clear justifications and solid arguments from OPS are paramount for effective MP.
- ORs from adjacent centres impact the ORs of an ATC centre. Constructive discussions should take place between adjacent ATC Units and MPs about letters of agreement to ensure that the ORs reflect reality and optimise handover positions.
- ORs form the basis for the figure entered in the year's budget for manpower required. It is important to know that enough staff have been budgeted not more not less. Therefore, transparency is required on how the OR figure is calculated to ensure that it is based on real ORs.
- In addition, overestimating ORs has a knock on effect of overestimating the overhead costs of the ATS provided (i.e. the provision for training and other demands - leave absences, training, etc.). However, it is prudent to build in a certain reserve but there must be transparency on how the reserve is compiled to ensure that there is no double counting and to identify where savings can be made.

Output

The opening and closing times of positions and sectors.

Guiding Principles

- Transparent, clearly understood information and justification should be available on how the ORs are compiled.
- The cost implications and impact on the budgetary process of ORs not reflecting the real requirements should be clearly understood and communicated.
- Feedback and continuous monitoring of the actual requirements should take place to ensure accurate figures of future demand are derived.

Policy Recommendations

- Policies should indicate phases where staff involvement from OPS in estimating ORs is required.
- A policy is recommended on the establishment of management control points.

Guideline 2: Analysing Air Traffic Demand to Determine ORs

- To aim that at any given time, there are neither more nor less controllers present in the OPSroom according to the OR specification.
- ORs estimations should never be based on peaks but on a sensible average of opening and closing times of sectors.
- A realistic margin should be established reflecting realistic future requirements.
- A continuous process of feedback should be established to monitor how the estimated ORs reflect the real situation.
- Constructive discussions should take place with adjacent centres to ensure that real requirements are taken on board.

3.4.3 Estimating the Number of ATCOs Required**Definition**

The number of ATCOs required is a balance between the minimum and maximum number of ATCOs needed to run a position.

Objective

Given the estimated ORs, to determine the number of controllers needed to be assigned to what positions at what times.

Required Input Data

- Estimated ORs;
- current practices and trends in the rostering and shift management. For example, the duration of a shift, the maximum time at a position without a fatigue break, the number of night duties permitted, the length of the shift cycle are all items that influence the time an ATCO will not be available at the working position;
- policy regarding including break times as working time or not;
- local working conditions for supervisors (i.e. the split between management tasks and position time) and ATCOs.

Process

Various approaches are used within the ECAC region to calculate the OR. In EATCHIP, (1988d), two calculation methods are illustrated. Firstly, the commonly known International Civil Aviation Organisation (ICAO) method calculating the minimum number of ATCOs needed (Multiplication Factor) and secondly the calculation method based on the actual number of duties to perform during a certain period of time (Manning Calculation Method).

The Minimum Number of ATCOs Required

The total position time per year divided by the **effective** hours per ATCO per year gives the minimum number of ATCOs actually needed (see [Formula 1](#)).

Formula 1: The minimum number of ATCOs required (Multiplication Factor)
--

$\frac{\text{Total Position Time / year}}{\text{Effective hours per ATCO / year}} = \text{Minimum number of ATCOs required}$
--

This formula indicates a simple way of calculating the number of ATCOs needed. It will lead to the **minimum** number of ATCOs needed without taking into account e.g. safety margins.

The challenge to MPs resulting from this approach is to cope with unexpected staff shortages in OPS and in staff requirements for OPS in training and projects.

The Maximum Number of ATCOs Required

[Formula 2](#) shown below, is more 'advanced' since it takes into account the roster cycle and other roster-related factors, leading to the **maximum** number of ATCOs needed (Missault and Niesing, 1995).

The challenge to MPs resulting from this approach is how to plan and allocate operational staff to other related duties outside OPS in times of staff surplus in OPS.

Formula 2: The maximum number of ATCOs required (Manning Calculation Method)

$$\frac{\text{N° of duties per day} \times 365}{\text{Effective working days per ATCO / year}} = \text{Maximum number of ATCOs required}$$

The task of MPs is to find the right balance between the two results. Both calculation methods assume that all elements of the calculation are evenly spread over the year, like the leave and sickness days. It is also assumed that the regulatory number of weekly working hours will always be accommodated in the rosters, independent from the roster cycle in use. These assumptions do not reflect reality because of the following reasons:

- There will be time leakage because duties cannot be perfectly fitted into an existing roster in a way that adheres to working conditions / regulations and, at the same time, that the regular number of working hours requirement is completely met.
- The effective time for breaks is assumed to be 100% accommodated (e.g. exactly 22% of the working time), although breaks are rarely spread evenly and for example more breaks / longer breaks are needed in a night shift than during the day.
- Leave, sickness and other staff absence are not evenly spread across a whole year as evidence from staff absences calculated on a weekly / monthly basis.

Consequently, the time leakage will lead to having additional staff to cover leakage. Time leakage as described in the bullet points above, needs to be balanced. The difference between the calculated number of hours (contractual hours) and the number of hours needed in a given roster (which will be higher) is called "balancing losses".

Balancing ATCO Requirements

The Multiplication Factor calculation (Formula 1) establishes the absolute minimum number of staff, required in order to operate a "smooth" running and stable roster for any given OR. However, in practise it will not smooth the roster for a given OR. Rosters are something "stable" (normally) but the ORs change from day to day. Consequently, sometimes the rosters will fit the ORs and sometimes not. The Manning Calculation method (Formula 2) establishes a maximum number of staff.

The true number of staff needed shall be in between the minimum and the maximum. However, from experience, it tends to lean in the direction of the maximum figure. Therefore, balancing losses (i.e. higher number of hours than calculated) are inevitable to some extent due to:

- working conditions (e.g. to schedule staff according to an average weekly working time even if on a particular day this number of hours is not operationally required);
- breaks;
- briefing balancing losses (e.g. in team rosters);
- additional duties.

It is one of the tasks of management in operations to monitor and control the time leakage and find agreed ways to minimise them. One way of optimising work schedules in this respect is by using more sophisticated time management and work allocation systems, in order to get a better fit between the roster and the actual ORs whilst sticking to the agreed working conditions and rules. Exaggerated estimates at the early stages of planning can lead to extreme over exaggerations at the end of the process, which could result in a perceived shortage when actual staff requirements are matched with actual staff availability.

Output

A forecast of the number of ATCOs required to man positions for the planning period.

Guiding Principles

- The number of ATCOs required should be a figure somewhere between the minimum and maximum calculated.
- A feedback process should be in place to capture the use of overhead staff on a daily basis in order to validate figures used in establishing ATCOs required.
- Information on time leakages and consequently balancing losses should be transparent to ensure that the leakage is not exaggerated.

Policy Recommendations

- Policies should be adopted to manage balancing losses effectively and should be based on transparent information on time leakages.
- Transparent policies should be available on the use of supervisors and ATCOs (including requirements for other duties).

Guideline 3: Estimating the number of ATCOs Required

- Not to strive for the maximum or minimum number of ATCOs but a balanced figure derived from a consensus of all parties involved.
- Awareness should be developed on time leakage factors so as to fine-tune the efficient calculation and management of ATCOs required.
- Awareness of the possible overhead involved in the daily presence of ATCOs above the minimum required (e.g. sickness, leave, training and other demands).
- Sickness should not be weighted heavily in the calculation, as it is unpredictable and not possible to accurately estimate.

3.5 Estimating the Number of ATCOs Available

3.5.1 Introduction

MPs have to deal with three "flows": those who come into the system ('in-flow'), those who are in it ('through-flow') and those who leave it ('out-flow'). The first and the last flows are (or at least should be) to some extent more predictable (see EATCHIP 1998d).

The throughflow is more exposed to sudden changes. ATCOs can have a change in their career, lose their licence due to medical reasons, or due to a lack of minimum operational hours, or be tempted to take an early retirement due to changes in working conditions or resign or die.

Estimating the number of ATCOs available, at any given time in the future, requires an understanding of the inflows, throughflows and outflows affecting the pool of ATCOs available i.e.:

- projected number of current ATCOs available to man positions in the OPSroom;
- plus the *ab initio*s in training who are expected to succeed;
- less the number of ATCOs expected to retire;
- less the expected number of ATCOs who have transferred out of operational positions;
- less the expected number of ATCOs who may have resigned from ATMOs etc.

The following paragraphs describe the factors required to project inflow, throughflow and outflow estimates to determine the estimated number of ATCOs available.

3.5.2 Inflow

Definition

Inflow is the number of ATCOs still in the pipeline before entering the pool of qualified ATCOs.

Objective

To identify the number of ATCOs coming on stream via recruitment, training and OJT processes, to meet current and future ATCO requirements.

Required Input Data

- The planned recruitment of *ab initios*;
- average number of applications;
- selection ratios;
- the number of *ab initios* at the various stages of training;
- the estimated failure rate of *ab initios* during the various stages of training;
- the training capacity at the academy;
- simulator capacity places (pre OJT);
- the number of OJT places available.

Process

The number of *ab initios* in the recruitment, selection, stages of training and OJT phases determines the number of ATCOs flowing into the system during a certain planning timeframe.

The difference between the projected ATCOs required and the expected ATCOs available provides the recruitment requirement. If this number of people are trained, traffic growth is as expected, the success rate in training is as expected and every other parameter in the MP process is fixed, the demand and **supply** of operational controllers should be in balance in the future.

However, a number of factors need to be taken into account:

Success Rate in Training

An adjustment needs to be made for the success rate of *ab initios* during the training stage. *Ab initio* trainees who are currently in training at different stages will have either succeeded or failed or will still be in training by the time that the new intake commences training. The expected number who will succeed and obtain licences is calculated from the number at each stage and the probability for success at this and all subsequent stages. This estimate needs to be matched with the number of ATCOs available and the number required for the planning period. The result indicates the **training requirement** for the planning period.

Training Capacity

The recruitment intake necessary to fill the training requirement will be restricted by the capacity of the training academy and the number of OJT places available. If the recruitment requirement exceeds the number of OJT places and simulator capacity (pre OJT) available. It will normally not be possible to reduce the shortfall by increasing the frequency with which courses are run. In such cases it might be worthwhile to consider a higher intake in one year to cope with anticipated training capacity shortages in following years. Whatever the planning time horizon, it is advisable with regard to training capacity to look at the normal planning time horizon plus one or two years.

Traffic Growth

If traffic is growing and the number to train is based on the **current** shortage of controllers instead of the projected shortage, the number available will always lag behind the number required. This is because the training period is normally two years or more and traffic will have grown significantly by the time the intake of *ab initio* controllers are operational. Thus, the number to be recruited for training needs to be higher for any period ahead. This is the **projected** ATCOs required.

Initially, it should be noted that a growth in traffic does not necessarily imply that more ATCOs are required. This depends, as outlined before, on whether additional traffic can be handled by the sectors and positions. However, over time as new measures are taken to cope with the traffic growth i.e. creating new sectors, additional ATCOs will be required.

Output

The projected number (minimum and maximum) of ATCOs entering the pool of available ATCOs.

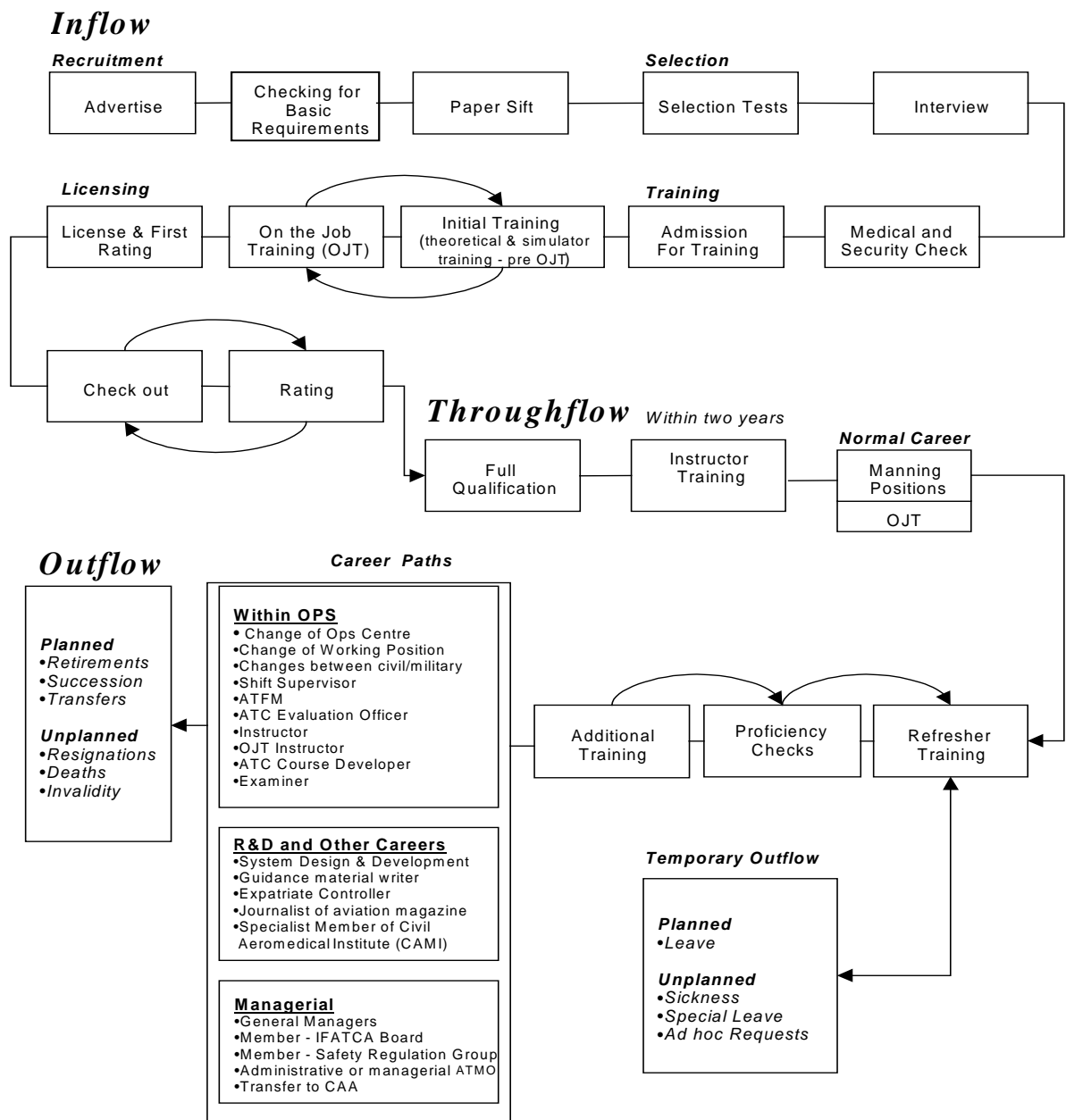


Figure 7: Process Map of inflow, throughflow and outflow

Guiding Principles

- The training process should be arranged so that the failure rates are minimised as much as possible. Training failures - if they happen and cannot be avoided - should occur preferably in the early stages of training. Training failures require more trainees to be taken from the initial recruitment process to avoid shortfall at a later stage and under-utilisation of OJT places available.

- Opportunities should be sought to minimise the processing time for recruitment, selection, training and OJT results to enable people to move through the system quicker and thus having qualified controllers available earlier and lowering overhead costs required for training.
- To minimise training failures, a norm should be introduced that training and OJT is based on the principle of "training for success" e.g. (building on *ab initio* self esteem) with effective coaching and mentoring schemes providing *ab initio* with regular feedback during the training duration. However, this could mean an increase in training time in some cases.
- A flexible approach should be adopted towards the possibility of retraining in the case of failure balanced with the point where the trainee is in the training cycle compared with the loss if the trainee is dismissed (cost benefit ratio).
- Certain people require a gradual development to become a confident and competent ATCO i.e. moving from a quiet position to a busier position. In addition, some ATCOs perform better in different ATS environments (busier or quieter units). Therefore, relocation opportunities should be identified to facilitate ATCOs working in sectors or units that best fit their performance capability.
- Recruitment, selection and training processes of *ab initio* trainee controllers should not be easily switched on and off. A temporary surplus should not necessarily lead to a stop in recruitment activities and a small temporary shortage should not necessarily end up in massive intakes into training.
- A go-stop-approach will cause an uneven age distribution, and leads to backlogs in OJT and possibly a lengthening of training due to "catch ups" in recruitment. Unused or under-utilised training places at the academy should instead be marketed.

Policy Recommendations

- Recruitment, selection and training should be continuous even if there is no direct need to ensure continuity in training process quality. If the training capacity is not utilised fully, a policy should be in place to offer spare capacity to other ATMOs.

Guideline 4: ATCO Inflow

- To strive for a balanced age distribution in the ATC centre.
- Inflow processes should be monitored carefully to ensure that they are optimised to enhance effective MP and HRM.

Guidelines on selection are provided in EATCHIP (1998e) MP (p40), Selection policy (p38).

3.5.3 Throughflow

Definition

Throughflow is the actual number of ATCOs that are principally available in the pool of ATCOs. Throughflow does not take into account inflows or outflows (as defined) to the pool.

Objective

The objective of MP of throughflow is to determine the absence of staff in the pool of ATCOs due to leave, training and other demands on ATCOs for the planning period, which impact the actual number of ATCOs available for manning positions.

Required Input Data

- Expected periods of leave (e.g. annual leave, special leave, study leave, maternity leave);
- average number of sick days (possibly on a monthly basis and broken down by age and gender);
- average training days (e.g. OJT, system upgrade training, refresher training, language training, qualification training, conversion training);
- average days for career development training (e.g. instructor and examiner courses, management courses, airspace management and systems training);
- other requirements (medical examinations, licensing check, health, safety and welfare work);
- associated duties (staffing training centre, expert team participation, participation in projects, industrial relations activities).

Process

The core task of ATCOs is to provide ATC and OJT and fulfil other demands which are peripheral (refresher training, transition and career development) but associated with their work.

Throughflow processes deal with the fact, that the number and composition of staff available in principal for duties in OPS will vary due to absences for reasons of training, leave, sickness etc. These absences are for a certain time period only (not permanent in which case it needs to be considered as an "outflow") and staff will normally be available for scheduled duties after this period of absence.

However, to arrive at a realistic forecast of ATCOs available provision needs to be made for the following factors, which affect the availability of ATCOs to man positions together with some suggestions as to how this could be done:

Leave and Absences

Annual leave can vary and may be based, for example on age. The distribution of leave over a year is certainly not even and provision should be made well in advance to avoid periods where not enough staff is available for duties (e.g. during school holidays).

Local differences might exist due to public holidays. Administrative measures should be adopted which encourage taking leave outside peak times. For example, in one ECAC State bonus leave days are given if the major part of the leave taken is outside the holiday season.

Casual uncertified sick and certified sick leave (calculated on a statistical basis) should be taken into consideration. The age / gender profile, workload increase and social climate may influence the incidence of sick leave. Introducing proactive preventive measures should increase the health and welfare of ATCOs.

In addition, provision should be made for **study leave** and attendance at examinations where these are relevant to career development plans.

Training Requirements

Training requirements are defined as both receiving and providing training conducted outside the OPSroom.

- **System upgrade training** is an irregular feature consequent on the introduction of new equipment or software. The training duration depends on the magnitude of the change but in any event is time consuming and must be carried out - at least partly - independently of day-to-day operations.

The use of temporary staff may be beneficial in alleviating the time taken or overtime used. Good training documentation, Computer Based Training (CBT) and simulators will minimise system upgrade training time.

- **Refresher training** normally has to be done on an annual basis. Different approaches are used in different States but overall the need for refresher training will grow. Contributors to this need are task stability (the boredom factor) and the need to maintain expertise in dealing with unusual incidents. Between 4 and 7 % of extra staff will be needed (around 1 week per annum per controller). The constantly evolving European ATM system will almost certainly result in considerable modification and expansion of the rating / endorsements as defined by ICAO, with a resulting adjustment in training. Time spent on ratings / endorsements courses varies due to the number of ratings / endorsements required, complexity of ratings / endorsements and training capacity to complete the ratings.
- In many States there will be a requirement for extensive **English language training**. The amount of training needed depends on the entry standard. For example entry on Cambridge 1st certificate will require up to 200 additional hours training (ref. Project Supervision Team on 'Proficiency in English Language for Air Traffic Controllers' (PELA)).

- **Controller relocation** requires varying amounts of **conversion training**. The organisational policy on relocation must be taken into account.
- The time required for ATCO **career development training** and participation in additional duties must be allowed for if a career plan exists. Career training of ATCOs could include e.g. coaching courses, examiner courses, and supervisory courses. Provision must also be made to enable an ATCO to pursue career development outside of operational duties. This may include full-time management or administrative duties.

Career development for a proportion of the staff will require training in organisational procedures, airspace, airspace management, liaison with national and / or international organisations, licensing, HRM and training for participation in complementary duties (e.g. attending meetings, participating in workshops, projects etc.).

Nowadays, the time required to meet training requirements is often underestimated and if not, in reality often easily deferred or cancelled due to the current shortage of ATCOs.

Preparedness for change to ATCOs role due to technology changes can only be achieved through provision of time being actually made available to ATCOs to participate in the necessary training courses, which will have long-term qualitative benefits. Therefore, time required for attendance at training courses should not be easily dismissed and overall training should be seen as an investment rather than a cost.

In addition, it is necessary to have predefined career path options for ATCOs; however a dilemma does arise in meeting the ORs of the centre and personal career plans of ATCOs. A priority system should be established to ensure that both the needs of the operations and ATCOs are achieved. (See EATMP 2000 which provides details of personal and career development for ATCOs).

Other

- ATCOs are required to undergo regular **medical examinations**. Normally, staff under the age of 40 is examined every two years while those of 40 or older are examined every year.
- Some staff may be released on a regular basis in order to fulfil their health, safety and welfare training obligations at work.

Associated Duties

- Professional credibility of training centre staff is best obtained by rotating operational ATCOs to / from the training environment. Revalidation of ratings / endorsements requires time and therefore additional staff.
- Career development, which encourages ATCOs to participate in complementary duties such as project work, attending meetings etc., requires extra staff.

- The time required for an ATCO to participate in system development projects must be allowed and include attendance at meetings, participation in project work etc.
- Allowance must be made for ATCOs with responsibilities in staff associations, unions and professional bodies to participate in regular and irregular meetings.

In establishing plans for training and associated duties it is necessary to consider the following factors and adjust plans accordingly:

- What is the minimum time to keep ratings / endorsements?
- What extent do associated duties need to be carried out by licensed ATCOs or could they be done by other qualified personnel?
- What is the percentage of ATC work to be performed out of the total working time?
- What is the impact of flexible part time possibilities to ATCOs?
- What are the social impacts of poor flexibility and being short on staff?

OJT

In theory OJT itself is not supposed to affect manning but in reality it might affect capacity. However there are some factors that need to be considered which influence the duration of OJT:

- In many instances particularly in the early OJT stages, the capacity of the student will be less than the capacity of the fully qualified OJT.
- A sector may also be opened earlier than usual in order to enable OJT in this sector under low traffic conditions or to create additional OJT training capacity, if necessary.
- Traffic volume may be too high at certain times for OJT for trainees just starting training.
- The length of OJT until final qualification may be different, depending on whether newcomers have a smooth start. For example, in autumn with low traffic or are forced to deal with traffic peaks right from the beginning when starting OJT in late spring.

Outputs

A detailed estimate of the average days required for training, other demands and associated duties, which impact the number of ATCOs available to man positions.

Guiding Principles

- Provision should be made and controllers should be allowed the time to participate in refresher training. This will result in maintaining the service quality.
- A feedback loop should be established to monitor the factors to understand the reasons for absences from duties due to training, leave etc. and to understand their impact on the work schedules.

- A reserve buffer (e.g. a number of budgetary posts without funds) between inflow / outflow should be available due to the fact that often the budgetary number of staff will be limited or fixed for a specific budgetary year.

Policy Recommendations

- The policies on refresher training, career development and normal leave should be adopted and agreed with staff to ensure that absences on duties can be planned with some certainty and distributed over time in a way which would allow that the day to day duties are not hampered.

Guideline 5: ATCO Throughflow

General

- Feedback and monitoring processes should be introduced to track what actually happens in reality regarding the factors that impact throughflow of staff resources in terms of absences from duty.
- Statistics should be detailed enough to see the number of staff and the amount of time staff were absent from duties due to training requirements, sickness, leave etc.

Leave and Other Absences

- Absences from duties due to leave, training etc. should be planned whenever possible, in such a way that best ensures that sufficient staff is available for day to day ATCO duties.
- Leave planning should be made well in advance to avoid periods where not enough staff is available for the duties due to leave.
- Administrative measures should be adopted which encourage taking leave outside peak times.
- Data should be retrieved from statistics on previous periods, but feedback should also be taken from performed rosters to review if current practice matches with forecasts and how the duty rosters have been affected.

Training Requirements

- Time required for attendance at training and career development courses should not be easily dismissed and overall training should be seen as an investment rather than a cost.

3.5.4

Outflow

Definition

Outflow is the number of ATCOs permanently leaving the available pool of ATCOs.

Objective

To determine the number of ATCOs who will depart during the planning timeframe.

Required Input Data

- The age range over which controllers are expected to retire;
- the average number and age of ATCOs who
 - resign for jobs outside the ATMO;
 - transfer / promoted to non operational jobs;
 - are not allowed to work in operational posts for medical reasons;
 - special leave for a period they do not hold a valid rating/endorsement;
- number of ATCOs who go on early retirement.

Process

Estimating the number of ATCOs leaving the system for any particular timeframe requires making provision for ATCOs who will retire, resign for jobs outside the ATMO and other permanent transfers to non-operational jobs. Provision should be made in throughflow (see [Sub chapter 3.5.3](#) on throughflow) for the number of ATCOs not allowed to work in operational posts due to medical reasons or on special leave (which may or may not be permanent).

The age distribution and early retirement regulations are factors, which influence actual retirements. The age distribution needs to be monitored and needs to be translated in the manpower plans to capture when and what number of new staff need to be recruited.

The following unpredictable issues or difficult to determine factors influencing outflow:

- The rate at which licences are lost is normally unpredictable but factors such as the age and medical fitness of the staff will have a major impact. Poor operational performance may result in some States withdrawing the licence.
- It is important for MPs to monitor the turnover rate of ATCOs permanently leaving the pool of available ATCOs of an operational unit i.e. ATCOs resigning or moving to other jobs outside the OPSroom or moving to another unit. It is also important to determine exactly why ATCOs leave. It might be necessary to carry out exit interviews and record reasons for leaving. MPs should be involved in developing plans to reduce turnover. Success in the task of reducing turnover goes a long way to ensuring that ATMOs have the right number of ATCOs with the right skills.
- On the other hand, it is widely recognised that on average 14-20% of the ATCO workforce do not spend their whole working life as ATCOs. This figure is expected to grow. Many ATCOs move career mainly into the training, systems or management domains. When these career moves take place, they are generally haphazard and can have a severe impact on MP. It would be helpful to have formalised succession plans so that a

contingency is made for ATCOs moving out of operations into alternative careers. Formal succession plans for ATCOs involves an examination of strategic long-term plans, HR forecasts and the data on the potential of all ATCOs for other career(s). It includes the determination and clarification of alternative career paths and requirements and the development of plans for meeting future alternative career opportunities based on real requirements. Detailed career development guidelines and planning considerations will be provided in EATMP deliverable 2000.

Output

An estimate of the number of ATCOs leaving the pool of available ATCOs for a given period of time.

Guiding Principles

- Contingency plans should be established to anticipate ATCOs moving definitely out of the pool of available ATCOs.
- Clarification and identification of real requirements in relation to alternative career paths for ATCOs should be established.
- Reliable statistics on turnover rates and reasons why ATCOs resign from operational jobs should be established.
- The age distribution of ATCOs should be monitored and translated into manpower plans.

Policy Recommendations

- Transparent policy is required on succession planning.
- Transparent and agreed policies are required with regard to early retirement possibilities.
- Policies are required on Personal and Career Development that lead to jobs outside OPS (see EATMP deliverable 2000).

Guideline 6: ATCO Outflow

- Reliable statistics and feedback on exit interviews should be introduced on why ATCOs resign from operational posts.
- Plans should be developed to counteract trends in ATCO departures, which should result in long-term efficiency and benefits.
- Formal succession plans should be established to offset haphazard departures of ATCOs from the pool of available ATCOs.

4. MANPOWER PLANNING MANAGEMENT

4.1 Introduction

Carrying out the MP process is not an easy task for MPs to manage, as it requires juggling many factors in order to arrive at a balanced and adequate estimated view.

The following paragraphs address issues related to managing the MP process and cover the areas shown in [Figure 8](#) below.

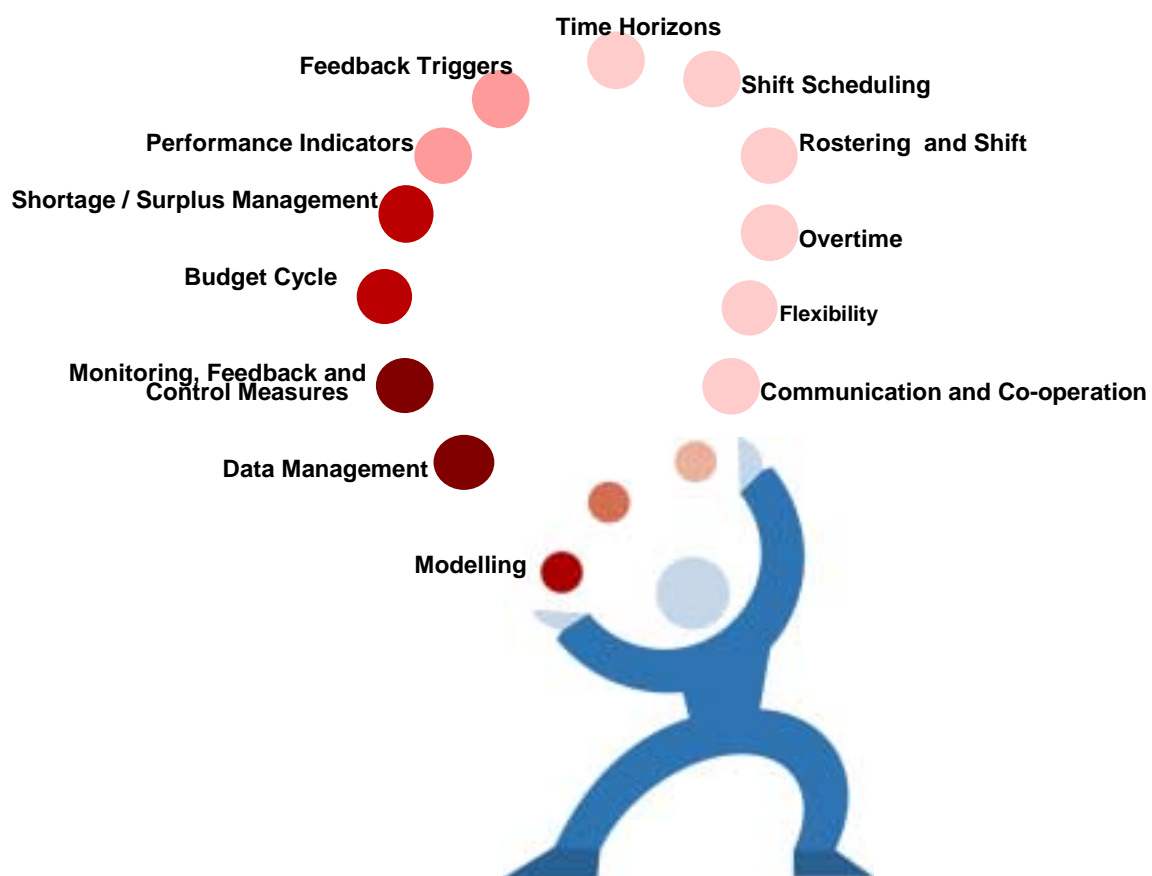


Figure 8: Factors affecting MP Management

4.2 Managing Across Many Time Horizons

Planning of staff resources in ATS is a task that demands a long-term (greater than 5 years) perspective is taken, whilst dealing with the demands in the short to medium term. The following paragraphs outline the characteristics relevant for the various planning horizons i.e. short, medium and long-term.

4.2.1 Short Term Planning

- Timeframe is up to 1 year;
- demand and supply of resources can be predicted with some certainty on the basis of well known facts and data;
- HR objectives are easy to state in quantifiable terms i.e. the number of *ab initio*s that will be recruited, selected and trained for that year;
- design and implementation of short-term HRM programmes should have immediate payoff.

4.2.2 Medium Term Planning

- Timeframe - 2 to 5 years;
- demand and supply of resources can be predicted with less certainty;
- predicting future manpower demands requires having an accurate model of the factors that will influence demand and being able to predict the state of all the major variables in that model. This will not be the case for at least some of the variables and thus MPs need to assess the likelihood of several scenarios and their impacts to reduce this uncertainty;
- attention needs to be paid to the issue of the qualities (skills and abilities) that future staff will need thus the development of sound future orientation job analysis methodologies are needed;
- not only is it necessary to generate an inventory of current supply (number of people and their skills and abilities) but it is also necessary to predict how the supply will change over time;
- medium HR objectives are more likely to include readjusting ATCO skills, attitudes and behaviours to fit major changes in the needs of the ATMO as well as adjusting HR practices to fit changes in the needs of staff. Training and retraining programmes are often the methods of choice for achieving medium term objectives;
- changes in the wider system which might happen (e.g. overall working time reduction, increase of retirement age etc.).

4.2.3 Long Term Planning

- Timeframe is greater than 5 years;
- demand and supply of resources can be predicted with even less certainty;
- succession planning should form part of the MP;
- environmental and organisational changes must be expected on the job of the ATCO;
- identifying business opportunities or investigating additional opportunities for co-operation with adjacent ATMOs;

- flexible working conditions - balancing the needs of the individual with the needs of the organisation.

Chapter 2.3 covers in detail this planning horizon under the strategic perspective.

Guideline 7: Managing Across Many Time Horizons

- The maximum data needed should be available to ensure that informed decisions are made across the many time horizons.

4.3 Feedback Triggers

MP does not only spread across different time horizons but also takes place at different levels within the ATMO organisation. Most ATMOs operate on four levels of management ranging from the highest level dealing with long-term (strategic planning) to the working level dealing with daily shift rostering (tactical planning) that takes account of each task assigned to each individual (task assignment) at a certain moment in time.

Planning for one time horizon typically has implications for another. Longer-term objectives influence short-term plans and the results achieved through the implementation of HRM programmes can influence the business plans. In addition, the evaluation of results obtained for shorter term HRM programmes often lead to re-evaluation of longer term projections of the availability of manpower which in turn may prompt adjustments in HRM programmes designed to meet longer term needs.

To effectively manage the various time horizons, planning activities within the various time horizon need to be linked together into a dynamic system where feed forward and feedback triggers are required to connect the different phases of planning.

Annex A provides an overview of the triggers and symptoms during the different planning horizons with diagnosis, indications and suggested possible actions.

Guideline 8: Feedback Triggers

- Feedback triggers should be established to monitor planning across different time horizons.

4.4 Performance Indicators

To have adequate information flows to monitor and control feedback on trends and performance, requires performance indicators to be defined for various levels within the organisation.

Table 1 provides an example of some of the performance indicators that can be defined at individual, team, organisation and at ATM system levels. For example, a strategic perspective requires MPs to focus more on the Organisation and ATM System levels to identify where improvements can be made which have a high impact in the long-term.

Guideline 9: Performance Indicators

- Performance indicators should be defined at different levels and should be monitored as a means of measuring the performance related to MP.

Process	Individual	Team	Organisation	ATM System
Recruitment	Application form Completed.	Applicants.	Selection ratio; Lead time.	Public image and attractiveness
Selection	Test score.	Average test score and standard deviation.	Validity method; Cost; Fairness; Lead time; Resource utility.	Potentials; Match of potentials; Homogenous staff population.
Training	Examination score.	Pass / failure rates.	Training efficiency; Lead time.	ATM capacity; Harmonisation; Seamless work procedures.
Licensing	Endorsement.	Available Staff.	Flexibility; Qualified staff.	Safety assurance; Availability.
Staff Development	Career and personal development plan.	Staff to meet changing requirements.	Turnover; Lead time; Adaptability to meet changes.	Fitness and adaptability; Motivation.

Table 1: Example of Performance Indicators

4.5 Shortage and Surplus Management

Shortage or surpluses of ATCOs might occur because of deficiencies in the planning process - or be caused by reasons beyond the manpower planner's control. For example, the start up of new projects involving ATCOs without informing the MP department, more retirements due to medical reasons than foreseen, a higher than expected request for early retirement etc. (see EATCHIP, 1998b).

From an efficiency and effectiveness point of view a permanent shortage or surplus or an oscillating manpower that varies from shortage to surplus along a time line hampers the operation of an ATMO. Inflow of ATCO staff should be carefully managed in order that a desired level of staff can be maintained over a period of time.

In choosing a MP policy, MPs need to answer four important questions:

1. What are the real shortages? - (e.g. Central Flow Management Unit (CFMU) monthly reports increasingly showing delays due to restrictions caused by staff shortages).
2. Where are the bottlenecks? (e.g. OJT positions, age structure etc.)
3. What is the cost optimum (e.g. small shortage below peak traffic demand which can cause acceptable level of delays and loss of some revenues but still not at a level where a further shortfall of ATCOs will be cost inefficient, or a slightly / fair / significant spare supply of ATCOs (higher than traffic demand) but yet one which is not too costly)? In other words, what is exactly the optimum number of ATCOs, which still provides a positive added value?
4. What actions need to be taken toward achieving this cost optimum?

Guideline 10: Shortage and Surplus Management

- Inflow of ATCO staff should be carefully managed in order that a desired level of staff can be maintained over a period of time.

4.6 Budget Cycle

Budget cycles often do not follow planning which hampers severely the implementation of plans. A constraint arises between the budget, which is fixed for a specific period (12 months), and the planning cycle, which is a continuous process, which follows the dynamics of an evolving system. This requires a contingency to be incorporated in staff budgets to manage manpower overlap in inflows / outflows to ensure the adequate and timely manning of positions. An extreme example is when the budgetary cycle runs from January to December, a trainee qualifies in January and the controller retires in December thus a contingency is required to cover this gap. To manage the planning cycle vis-à-vis the budget cycles a flexible approach is required when budgeting to allow a contingency for the unexpected. Efforts should be made to ensure enough flexibility in the budgeting process to allow manpower plans to be adapted to current, short-term needs. In fact, budget planning should follow MP and not vice versa.

Guideline 11: Budget Cycle

- A flexible approach to budgeting to allow contingency for the continuous planning cycle.
- Budget planning should follow MP and not vice versa.

4.7 Monitoring, Feedback and Control Measures

MPs must monitor the system and obtain feedback on the effectiveness of HRM programmes over time, to identify deviations and take actions in time to

correct plans. For example, the following are some key factors the MPs should pay particular attention to when monitoring manpower plans:

- Increase of available but unused staff or longer breaks as indicators of an emerging or existing surplus. This could lead to plans to use staff in other positions (sectors or other functions) within or outside OPS.
- Development and implementation of technological innovations. These could have an impact on staffing levels due to training requirements (more staff needed) for a certain period or reducing staff after the training and familiarisation phase due to increases of traffic handling capacity.
- Absenteeism and an unseasonal increase in sick leave which could be related to high workload, strain leading to stress and finally burn out. It could also be due to a newly appointed supervisor; for example, who has not yet fully understood how to use the staff resources according to their performance levels.
- Accumulation of remaining annual leave days, overtime or postponement of refresher and / or other important training courses. This also could indicate a lack of staff or the need for revising work schedules.
- Lack of ATCOs for further development either in other careers or in projects where their input is urgently needed.
- Turnover cost, requests for transfers and unexpected resignations could be an indication of high workload, strain leading to stress and loss of motivation and / or burn out.
- ATCO reduction effects from early retirement programs.

Annex B, provides details of additional factors, which can explain differences in prediction accuracy of ATCO supply, which fall into four groups: i.e. initial conditions, policy variables, demography and resources. Each factor should be weighted by Subject Matter Experts (SMEs) (e.g. experts in human behaviour, experts in analysing airspace structure, traffic patterns, flow and sector regulations) regarding the extent to which they have an impact on staff availability and human performance at a later stage. Each factor can explain differences in predicted shortages, based on actual differences.

Guideline 12: Monitoring, Feedback and Control Measures

- Appropriate means should be established to ensure that MPs have access to a wide variety of information on staffing issues and can verify the causes and effects on staff requirements and availability.
- Processes should be introduced to monitor the manpower to allow MPs to compare what was planned with what is actually happening.

4.8 Data Management

Availability and accuracy of data, statistics and statistical techniques for establishing current staffing and forecasting future supply and demand levels depends entirely on the accuracy of the supplied figures about the status of ATCOs that are likely to flow through the ATMO.

In addition, the accuracy and validity of the statistical model used to transform current supplies / demands into predicted future supplies / demands is critical to MP. MPs must maintain an up to date reliable and valid database of the ATCO workforce.

ATCO data which help MPs determine future manpower needs as illustrated in Figure 9 will include a well designed skills inventory which contains much information not directly related to on the job skills and performance but essential information for succession planning and future job requirements in the OPSroom.

Key factors in effective data management are that the database is kept up to date and that standard terminology is used and understood by all parties concerned.

Guideline 13: Data Management

- A database on ATCOs should be maintained which is confidential and kept up to date by one authority on an ongoing basis.
- Standard terminology should be used which all parties concerned understand.

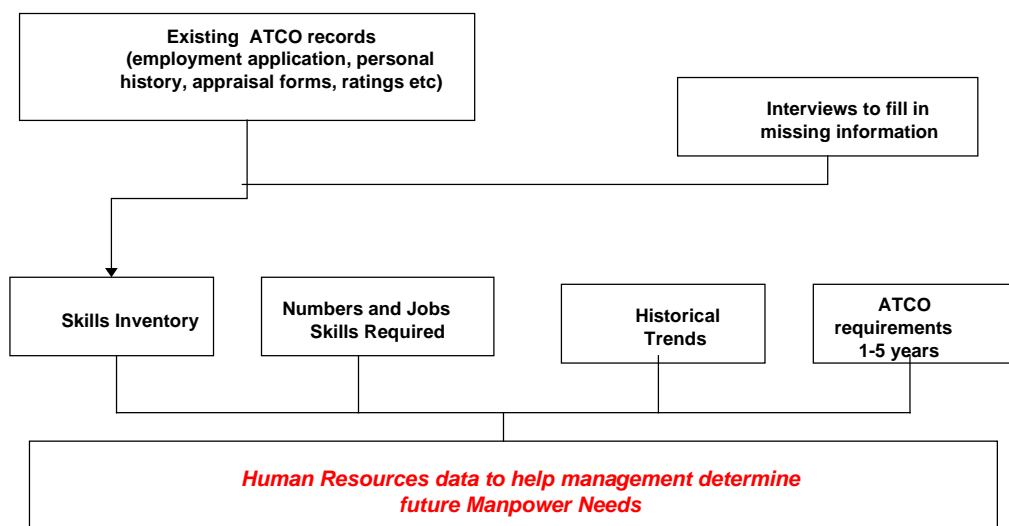


Figure 9: Information required for determining manpower needs

4.9 Modelling

Computer models can be used to model the manpower system exactly and quantitatively. Modelling can provide management with important information about the implications of manpower strategies to support business goals and objectives. For example, manpower modelling can be applied to simulate supply scenarios i.e. modelling the flow of ATCOs through the ATMO for a planning period, which can further define manpower implications of business plans, manpower strategies and actions.

The role of MPs is to use modelling to assess the implications of various scenarios, which will allow the supply of ATCO to meet ATCO demand requirements. It is important that MPs focus their modelling on addressing business needs. The output of MP modelling needs to add value and provide relevant information to aid management decision making process.

The EATMP Manpower Sub Programme is in the process of validating a reasonably complete model of ATCO MP for the current ATM system. This model will enhance the MP process. The two deliverables in preparation are as follows:

- LAMPS (Long Term ATCO Manpower Simulation) User Guide - HRS/MSP-003-REP-01
- LAMPS Generic Prototype Model SWP (Simulation Software Package) - HRS/MSP-003-SWP-01

Guideline 14: Modelling

- Any model that is used **must** be credible and valid - or at least capable of being validated through empirical data collection and testing.
- Models should be capable of enhancing the decision-making ability and should demonstrate a number of attributes such as, manageability, flexibility and a capacity for interactive use.
- MPs should focus their modelling on addressing business needs where the output of their modelling provides added value and relevant information for management decision making processes.

4.10 Communication and Co-operation

Good results in managing the MP system require that as many perspectives as possible are taken into account. Thus, effective communication and collaboration channels need to be used. A manpower plan needs the direction of senior management on the premises and factors related to the ATMO objectives which need to be clearly communicated to MPs at the beginning of the planning process.

To ensure an integrated approach in formulating the manpower plan, the plan in fact should be developed as a common undertaking between planners, operations managers, HR managers and management in the stages of design, estimation and / or revision.

Staff involvement is necessary at a certain stage (mutually agreed or laid down in staff regulations) well before management has taken final decisions. In addition, to ensure transparency and acceptance the planning results of senior management decisions must also be clearly communicated to the lowest level involved in the planning process.

Guideline 15: Communication and Co-operation

- Effective processes and communication channels should be in place to ensure the involvement of all necessary parties (senior managers, operations managers, planners and HR managers) in the planning process.
- Senior management should ensure that the premises or factors of the ATMO objectives and strategy are communicated to planners at the beginning of the planning process.
- To ensure acceptance and compliance to the plans and to aid implementation and operations, staff representatives should be involved in the planning process (as mutually agreed or as laid down in staff regulations).
- Senior management should ensure that the results of planning decisions are clearly communicated to all members involved in the planning process.

4.11 Flexibility

One of the shortcomings in planning is that plans are inflexible and do not allow for later changes. It is advisable that planners consider more than one option in their plans and explore other likely scenarios in order to get a better grip on existing uncertainties ('what if' scenarios). This could reveal any risks in the plans; migration strategies to be followed in these cases and could lead to alternative solutions that can be followed if the original plan fails. The likelihood is that scenarios will differ. However, scenario planning will help management and MPs to reduce uncertainty in planning.

Guideline 16: Flexibility

- Contingency plans should be developed which have explored other scenarios and should counteract shortcomings in implementing manpower plans.

4.12 Overtime

If there is an imbalance between ATCOs available and ATCOs required overtime could grow to such an extent having a negative impact on the provision of safe air traffic control. The use of overtime should be limited to very special cases as an exception. From a safety point of view, there are areas of risk related to the use of overtime on an ongoing basis as an integral part of the rostering.

Guideline 17: Overtime

- The use of overtime should be limited to very special cases as an exception.

4.13 Rostering and Shift Management Effectiveness

4.13.1 Minimising Balancing Losses in Rosters

Balancing losses in rosters occur due to a combination of practical habits and legal constraints e.g. agreed working conditions, which might not be in line with ORs. Agreed working conditions and labour laws, varying between States, greatly influence rosters and thus roster cycles need to be in line with these laws etc.. The amount of losses which occur depends on the restrictions from working conditions and regulations partly since it will impose restrictions as to which rosters are principally in line with the working conditions and partly on the fact that a stable roster cycle cannot cover the ORs perfectly.

One of the important tasks for MPs is to minimise the balancing losses and thus the number of staff needed in a roster by monitoring and evaluating the key factors, which impact balancing losses. At the same time, MPs need (on a case by case basis) to estimate and (subjectively) judge whether a certain principally achievable quantitative gain or benefit in the roster is sufficiently balanced by qualitative gains / benefits. In addition, care needs to be taken that these quantitative benefits can be achieved without impairing safety, staff morale and company culture.

Guideline 18: Minimising Balancing Losses in Rosters

- MPs should monitor and evaluate the key factors, which impact balancing losses in order to minimise them and thus the number of staff needed in a roster.
- MPs should (on a case by case basis) estimate and (subjectively) judge whether
 - A certain principally achievable quantitative gain or benefit in the roster is sufficiently balanced by qualitative gains / benefits and
 - These quantitative benefits can be achieved without impairing safety, well being and staff moral or company culture.

4.13.2 Balancing the Distribution of ATCOs Outside the OPSroom

Having established the minimum number of staff needed for operating ATC positions and the number of staff essential for associated duties, one could start deducing how many 'spare' ATCOs (i.e. above the required minimum) are available on a certain day. Operational staff capable and necessary for other functions should be monitored on a regular basis. However, for a healthy and cost effective HR system the additional costs of 'spare' ATCOs, must be justifiable, unavoidable and accepted and mutually agreed with social partners and supportably communicated to the customer.

Guideline 19: Balancing the Distribution of ATCOs Outside the OPSroom

- MPs should monitor on a regular basis how many 'spare' ATCOs (i.e. above the required minimum) are available on a certain day.
- MPs should be aware of the cost of "spare" ATCOs and should endeavour to minimise this occurrence as far as possible.

4.13.3 Staffing Factors Anomalies

It should be noted that anomalies (e.g. different systems for calculating leave weeks and working weeks, uneven distribution of work cycles, rostering schemes used, to name but a few) might occur which could render a standard staffing factor inadequate. MPs should monitor on a regular basis anomalies that might render a standard staffing factor inadequate. MPs should try to achieve the best, most flexible staffing roster e.g. allowing highest individuality but at the same time ensuring a team approach.

Guideline 20: Staffing Factors Anomalies

- MPs should monitor on a regular basis anomalies that might render a standard staffing factor inadequate.
- MPs should try to achieve the best, most flexible staffing roster e.g. allowing highest individuality but at the same time ensuring a team approach.

4.13.4 Balancing the Needs of the Business with Individual Needs of ATCOs.

Experience in some ATMOs shows that combining additional duties with operational work simply does not function on a routine daily basis. Leaving the OPSroom to attend to other business during a rostered work period can also create a conflict of loyalty for many individuals.

One solution to this problem is to roster the individual on both additional work and operational work separately, allowing a concentration on the work hours when in the OPSroom and a concentration on the other duties when not scheduled for the OPSroom.

In rostering for single individuals, the manpower planner has to take into account the number of days the individual has spent employed on other duties outside of the OPSroom environment when rostering a person for a duty cycle in the OPSroom. In addition, the number of hours required by ATCOs, working outside the OPSroom, to keep their licence / rating / endorsement also needs to be taken into account by MPs.

Guideline 21: Balancing the Needs of the Business with Individual Needs of ATCOs

- MPs should roster the individual on both additional work and operational work separately, allowing a concentration on the work hours when in the OPSroom and a concentration on the other duties when not scheduled for the OPSroom.

4.13.5 Qualitative Considerations in Rostering

It should always be borne in mind that staffing methodology cannot (and should not) be based solely on staffing formulae and other numeric calculations. For example, there may always be some sectors where ATS must be provided based on agreed principles of being a service provider even if this is not fully cost-effective.

Qualitative factors (e.g. prolonged duration of breaks, measures to avoid boredom etc.) are equally important as quantitative factors. Therefore, MPs need to estimate and subjectively judge whether a certain principally achievable quantitative gain or benefit is sufficiently balanced by qualitative gains / benefits or whether these quantitative benefits can be achieved without impairing safety, staff morale or ATMO culture.

Guideline 22: Qualitative Considerations in Rostering

- Qualitative aspects and efficiency in staff distribution should be taken into consideration with planning rosters and shift schedules.
- MPs should estimate and subjectively judge whether a certain principally achievable quantitative gain or benefit is sufficiently balanced by qualitative gains / benefits or whether these quantitative benefits can be achieved without impairing safety, staff morale or ATMO culture.

4.13.6 Automated Scheduling Software

Planning rosters and shift schedules is a highly complex task of accommodating all constraints, regulations, parameters and preferences. It is also not static but dynamic as it is subject to alterations, e.g.

- opening and closing times of sectors vary from day to day;
- the flow of traffic is not steady and continuous;
- peak and low traffic periods within each sector occurring at widely differing times;
- ad hoc requests from staff on changes to their individual duty roster.

Sophisticated automated scheduling tools can assist in optimising the coverage of all duties and absences within the statutory number of working conditions. Software tools can increase efficiency by reducing planning time, recognise general constraints and parameters set by MPs, calculate the minimum legal rest, providing warnings on violation of constraints or legal requirements, highlighting warnings on under-coverage of staffing requirements or indicate the impact of granting annual leave.

However, it should be noted that scheduling software is an assistance tool to the manpower planner who already possesses the full knowledge and understanding of all circumstances, rules, regulations and policies to be applied. Such tools should not be the final means of planning but allows shift data to be easily retrieved and modified.

Guideline 23: Automated Scheduling Software

- Software tools for planning rosters and shift schedules should increase the efficiency of the planning process and thus allows shift data to be easily retrieved and modified.
- Software tools should not be the final means of planning but are an assistance tool to the manpower planner who already possesses the full knowledge and understanding of all circumstances, rules, regulations and policies to be applied.

4.14 Qualitative Shift Scheduling

The workload and complexity of the work reflected in the shift schedule, breaks etc. can contribute to strain and lead to stress of ATCOs. An even distribution of work amongst staff might not be a sensible solution since performance levels will depend on the age and experience etc. of ATCOs. The shift pattern does need to be fairly predictable and stable over a long period of time to enable ATCOs to arrange their social life. The issues mentioned above if optimised and balanced will have a positive impact on the performance of ATCOs.

Guideline 24: Qualitative Shift Scheduling

- MPs when scheduling shift work for ATCOs should take into account the distribution of workload vis-à-vis experience and age of ATCOs.
- MPs should aim for steady shift patterns, which are fairly predictable and stable over a long period of time to ensure optimal performance from the staff allowing a certain flexibility to achieve a balance between individual and customer needs.

5. SUMMARY OF GUIDING PRINCIPLES

Strategic ATCO MP

- MPs should carefully anticipate changes in Operational Requirements (ORs) and their consequences to ATCO requirements and systematically plan for meeting these requirements far in advance.
- Strategic MP requires that a broad focus be taken which ensures that all HRM components are planned for (e.g. recruitment, selection, licensing, training, and development).
- The strategic manpower plan should be formalised and indicate both the quantitative and qualitative HRM programmes that are required to meet the strategic plans. The necessary documentation and data should also support the plan.
- MPs should be aware of the cost implications of proposed HRM programmes in their strategic plans and endeavour to seek value for money whilst at the same time ensuring that quality is not hampered.
- Information should be available to facilitate the strategy formulation decision making process. An effective HR information system provides valuable information to decision-makers and alerts them to potential future problems or opportunities.
- Line managers and MPs should work in partnership to develop business plans and determine a manpower plan.

Analysing Air Traffic Demand to determine ORs

- Transparent, clearly understood information and justification should be available on how the ORs are compiled.
- The cost implications and impact on the budgetary process of ORs not reflecting the real requirements should be clearly understood and communicated.
- Feedback and continuous monitoring of the actual requirements should take place to ensure accurate figures of future demand are derived.

Estimating ATCOs Required

- The number of ATCOs required should be a figure somewhere between the minimum and maximum calculated.
- Feedback process should be in place to capture the use of overhead staff on a daily basis in order to validate figures used in establishing ATCOs required.
- Information on time leakages and consequently balancing losses should be transparent to ensure that the leakage is not exaggerated.

Estimating the number of ATCOs Available

Inflow

- The training process should be arranged in such ways that the failure rates be minimised as much as possible. Training failures - if they happen and cannot be avoided - should occur preferably in the early stages of training. Training failures require more trainees to be taken from the initial recruitment process to avoid shortfall at a later stage and under-utilisation of OJT places available.
- Opportunities should be sought to minimise the processing time for recruitment, selection, training and OJT results to enable people to move through the system quicker and thus having qualified controllers available earlier and lowering overhead costs required for training.
- To minimise training failures, a norm should be introduced that training and OJT is based on the principle of "training for success" e.g. (building on *ab initio* self esteem) with effective coaching and mentoring schemes providing *ab initio* with regular feedback during the training duration. However, this could mean an increase in training time in some cases.
- A flexible approach should be adopted towards the possibility of retraining in the case of failure balanced with the point where the trainee is in the training cycle compared with the loss if the trainee is dismissed (cost benefit ratio).
- Certain people require a gradual development to become a confident and competent ATCO i.e. moving from a quiet position to a busier position. In addition, some ATCOs perform better in different ATS environments (busier or quieter units). Therefore, relocation opportunities should be identified to facilitate ATCOs working in sectors or unit that best fit their performance capability.
- Recruitment, selection and training processes of *ab initio* trainee controllers should not be easily switched on and off. A temporary surplus should not necessarily lead to a stop in recruitment activities and a small temporary shortage should not necessarily end up in massive intakes into training.
- A go-stop-approach will cause an uneven age distribution, which lead to backlogs in OJT and possibly a lengthening of training due to "catch ups" in recruitment. Unused or under-utilised training places at the academy should instead be marketed.

Throughflow

- Provision should be made and controllers should be allowed the time to participate in refresher training. This will result in maintaining the service quality.

- A feedback loop should be established to monitor the factors to understand the reasons for absences from duties due to training, leave etc. and to understand their impact on the work schedules.
- A reserve buffer (e.g. a number of budgetary posts without funds) between inflow / outflow should be available due to the fact that often the budgetary number of staff will be limited or fixed for a specific budgetary year.

Outflow

- Contingency plans should be established to anticipate ATCOs moving definitely out of the pool of available ATCOs.
- Clarification and identification of real requirements in relation to alternative career paths for ATCOs should be established.
- Reliable statistics on turnover rates and reasons why ATCOs resign from operational jobs should be established.
- The age distribution of ATCOs should be monitored and translated into manpower plans.

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6. SUMMARY OF GUIDELINES

Guideline 1: Strategic ATCO MP

- The manpower plan should be fully integrated and be consistent with the overall strategic plan. ATMO strategy should be determined first, and then manpower strategy should be developed.
- Outside influences of economic conditions, technology, the labour market and so on should be explicitly considered when developing the manpower plan.
- Changes in job design should be explicitly recognised in the plan, the plan should not assume that the structure of jobs in the future will be the same as they are today.
- Estimating future shortages or surpluses or skill category should use computer techniques and quantitative models as appropriate in order to manage the process more effectively.
- HR information systems should be used as a decision support system and should alert managers to problems and / or opportunities.
- MPs and line managers should work in partnership in formulating all points in the MP process.
- The manpower plan should be kept flexible and adaptable so that it can be changed as condition change. In particular, the strategy formulation process should remain flexible and readily adaptable to change. Flexible planning, which is continuously smoothed and adjusted to the supply and demand of staff is a key to MP success.
- It is necessary to monitor and control feedback on qualitative information and trends, which may impact different levels of planning, and time horizons.

Guideline 2: Analysing Air Traffic Demand to determine ORs

- To aim that at any given time, there are neither more nor less controllers present in the OPSroom according to the OR specification.
- ORs estimations should never be based on peaks but on a sensible average of opening and closing times of sectors.
- A realistic margin should be established reflecting realistic future requirements.

- A continuous process of feedback should be established to monitor how the estimated ORs reflect the real situation.
- Constructive discussions should take place with adjacent centres to ensure that real requirements are taken on board.

Guideline 3: Estimating the number of ATCOs required

- Not to strive for the maximum or minimum number of ATCOs but a balanced figure derived from a consensus of all parties involved.
- Awareness should be developed on time leakage factors in order to fine tune the efficient calculation and management of ATCOs required.
- Awareness of the possible overhead involved in the daily presence of ATCOs above the minimum required (e.g. sickness, leave, training and other demands).
- Sickness should not be weighted heavily in the calculation, as it is unpredictable and not possible to accurately estimate.

Estimating the number of ATCOs Available**Guideline 4: ATCO Inflow**

- To strive for a balanced age distribution in the ATC centre.
- Inflow processes should be monitored carefully to ensure that they are optimised to enhance effective MP and HRM.

Guideline 5: ATCO Throughflow**General**

- Feedback and monitoring processes should be introduced to track what actually happens in reality regarding the factors that impact throughflow of staff resources in terms of absences from duty.
- Statistics should be detailed enough to see the number of staff and the amount of time staff were absent from duties due to training requirements, sickness, leave etc.

Leave and Other Absences

- Absences from duties due to leave, training etc. should be planned whenever possible, in such a way that best ensures that sufficient staff is available for day to day ATCO duties.
- Leave planning should be made well in advance to avoid periods where not enough staff is available for the duties due to leave.

- Administrative measures should be adopted which encourage taking leave outside peak times.
- Data should be retrieved from statistics on previous periods, but feedback should also be taken from performed rosters to review if current practice matches with forecasts and how the duty rosters have been affected.

Training Requirements

- Time required for attendance at training and career development courses should not be easily dismissed and overall training should be seen as an investment rather than a cost.

Guideline 6: ATCO Outflow

- Reliable statistics and feedback on exit interviews should be introduced on why ATCOs resign from operational posts.
- Plans should be developed to counteract trends in ATCO departures, which should result in long-term efficiency and benefits.
- Formal succession plans should be established to offset haphazard departures of ATCOs from the pool of available ATCOs.

Manpower Planning Management**Guideline 7: Managing Across Many Time Horizons**

- The maximum data needed should be available to ensure that informed decisions are made across the many time horizons.

Guideline 8: Feedback Triggers

- Feedback triggers should be established to monitor planning across different time horizons.

Guideline 9: Performance Indicators

- Performance Indicators should be defined at different levels and should be monitored as a means of measuring the performance related to MP.

Guideline 10: Shortage and Surplus Management

- Inflow of ATCO staff should be carefully managed in order that a desired level of staff can be maintained over a period of time.

Guideline 11: Budget Cycle

- A flexible approach to budgeting to allow contingency for the continuous planning cycle
- Budget planning should follow MP and not vice versa.

Guideline 12: Monitoring, Feedback and Control Measures

- Appropriate means should be established to ensure that MPs have access to a wide variety of information on staffing issues and can verify the causes and effects on staff requirements and availability.
- Processes should be introduced to monitor manpower to allow MPs to compare what was planned with what is actually happening.

Guideline 13: Data Management

- A database on ATCOS should be maintained which is confidential and kept up to date by one authority on an ongoing basis
- Standard terminology should be used which all parties concerned understand.

Guideline 14: Modelling

- Any model that is used **must** be credible and valid - or at least capable of being validated through empirical data collection and testing.
- Models should be capable of enhancing the decision-making ability and should demonstrate a number of attributes such as, manageability, flexibility and a capacity for interactive use.
- MPs should focus their modelling on addressing business needs where the output of their modelling provides added value and relevant information for management decision making process.

Guideline 15: Communication and Co-operation

- Effective processes and communication channels should be in place to ensure the involvement of all necessary parties (senior managers, operations managers, planners, and HR managers) in the planning process.
- Senior management should ensure that the premises or factors of the ATMO objectives and strategy are communicated to planners at the beginning of the planning process.
- To ensure acceptance and compliance to the plans and to aid implementation and operations, staff representatives should be involved in the planning process (as mutually agreed or as laid down in staff regulations).
- Senior management should ensure that the results of planning decisions are clearly communicated to all members involved in the planning process.

Guideline 16: Flexibility

- Contingency plans should be developed which have explored other scenarios and should counteract shortcomings in implementing manpower plans. MPs should try to achieve the best, most flexible staffing roster e.g. allowing highest individuality but at the same time ensuring a team approach.

Guideline 17: Overtime

- The use of overtime should be limited to very special cases as an exception.

Guideline 18: Minimising Balancing Losses in Rosters

- MPs should monitor and evaluate the key factors, which impact balancing losses in order to minimise them and thus the number of staff needed in a roster.
- MPs should (on a case by case basis) estimate and (subjectively) judge whether:
 - A certain principally achievable quantitative gain or benefit in the roster is sufficiently balanced by qualitative gains / benefits and
 - These quantitative benefits can be achieved without impairing safety, well being and staff moral or company culture.

Guideline 19: Balancing the Distribution of ATCOs Outside the OPSroom

- MPs should monitor on a regular basis how many 'spare' ATCOs (i.e. above the required minimum) are available on a certain day.
- MPs should be aware of the cost of "spare" ATCOs and should endeavour to minimise this occurrence as far as possible.

Guideline 20: Staffing Factors Anomalies

- MPs should monitor on a regular basis anomalies that might render a standard staffing factor inadequate.
- MPs should try to achieve the best, most flexible staffing roster e.g. allowing highest individuality but at the same time ensuring a team approach.

Guideline 21: Balancing the Needs of the Business with Individual Needs of ATCOs

- MPs should roster the individual on both additional work and operational work separately, allowing a concentration on the work hours when in the OPSroom and a concentration on the other duties when not scheduled for the OPSroom.

Guideline 22: Qualitative Considerations in Rostering

- Qualitative aspects and efficiency in staff distribution should be taken into consideration with planning rosters and shift schedules.
- MPs should estimate and subjectively judge whether a certain principally achievable quantitative gain or benefit is sufficiently balanced by qualitative gains/benefits or whether these quantitative benefits can be achieved without impairing safety, staff morale or ATMO culture.

Guideline 23: Automated Scheduling Software

- Software tools for planning rosters and shift schedules should increase the efficiency of the planning process and thus allows shift data to be easily retrieved and modified.
- Software tools should not be the final means of planning but are an assistance tool to the manpower planner who already possesses the full knowledge and understanding of all circumstances, rules, regulations and policies to be applied.

Guideline 24: Qualitative Shift Scheduling

- MPs when scheduling shift work for ATCOs should take into account the distribution of workload vis-à-vis experience and age of ATCOs.
- MPs should aim for steady shift patterns, which are fairly predictable and stable over a long period of time to ensure optimal performance from the staff allowing a certain flexibility to achieve a balance between individual and customer needs.

ANNEX A: ATCO MANPOWER PLANNING TIME HORIZONS TRIGGERS

(EATCHIP 1998d)

Planning Time Horizon	Triggers	Diagnosis	Possible Action
Short Term - up to one year	Traffic volume or other conditions have changed.	Shortage of ATCOs to man positions.	<p>Postpone refresher training courses.</p> <p>Reassign ATCOs from other areas.</p> <p>Increase supervisor's time handling air traffic.</p> <p>Use any available staff, even with limited ratings/endorsements.</p> <p>Tighten annual leave schedules.</p> <p>Cancel participation in associated duties outside the OPS Room.</p> <p>Increase work scheduling (i.e. overtime).</p> <p>Temporarily raise ATCOs' pay for overtime.</p>

Planning Time Horizon	Triggers	Diagnosis	Possible Action
Medium Term 2-3 years	Refresher training delays.	Emerging shortage.	Using overtime, group bonus or reassignment of ATCOs from other areas; increasing supervisors time handling air traffic.
	Reduced supply of trained staff. (increase in training failures)	Ineffective or invalid selection tools in use, or training schemes/process.	Revision of selection tests, selection of instructors.
	An ever increasing use of Acs.	The workload has required more and more periods where ATCOs needed some relief, which was provided by the ACs.	Resectorisation may be needed.
	An unseasonable increase of the average number of days spent on sick leave, or an increased use of special leave.	Dissatisfaction of staff, a newly appointed supervisor has not yet found the right balances or has neglected some other important managerial aspects.	A training course for the supervisor may be needed.
	Leave carry overs or accumulation of remaining annual leave.	An emerging shortage.	Using overtime, group bonus or reassignment of ATCOs from other areas; increasing supervisors time handling air traffic.
	Longer breaks than previously foreseen.	An emerging surplus or MP error. The available number of ATCOs is greater than the minimum number of ATCOs required. There is an underutilisation of staff.	Using Flexible time schemes, conducting refresher training earlier than foreseen.

Planning Time Horizon	Triggers	Diagnosis	Possible Action
Long Term > 5 years	Business impact and privatisation.	Close examination of costs, quality and performance indicators.	ATMO streamlining.
	Flexibility of ATCOs to meet changing business requirements.	Rigid Working Conditions that do not encourage flexibility.	Review of working conditions vis à vis flexibility.
	Introduction of new technology and improved ATM procedures e.g. RVSM, 8.33.	New skills required for ATCOs and time for training.	Assessment of current skills mix and how this will change. What type of training is required and for how long to fill the gap?

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ANNEX B: ATCO MANPOWER PLANNING MONITORING FACTORS

(EATCHIP 1998d)

INITIAL CONDITIONS

- Peak traffic figure in the past 12 months for the sectors and positions;
- Present and future traffic volumes, including revised operational demands;
- Complexity of regional traffic characteristics;
- Statutory number of working hours;
- Number of annual leave days and any additional days granted for age or travelling and any special leave days;
- Number of public holidays;
- Expected number of days for military service, court appearance, or elections;
- Expected number of days for professional activities in unions, staff committees, International Federation of Air Traffic Controllers Association (IFATCA) etc.;
- Expected number of days for participation in simulations, tests, working groups and *ab initio* training (other than OJT in the OPSroom);
- Government restraint measures (e.g. hiring freezes, downsizing or reducing overtime);
- Staff unionisation level which can affect the frequency and duration of any strikes;
- Selection ratios and validity of selection tools;
- Training capacity and success rate in training;
- Flexibility of the training institute to re-use a lost seat;
- Number of seats at the training academy and seat time on radar displays available to OJT as a potential (delay-causing) bottleneck;
- Enhanced success rate for OJT due to pre-recruitment preparation courses;
- Constraints due to the necessity to allow ATCOs to work at least the minimum number of hours in order to keep their rating/endorsement.

POLICY VARIABLES

- Contingency losses policy;
- Structured workload policy;
- Limited ratings / endorsements and endorsements policy;
- Offshore recruitment and 'poaching' policies;
- Maternity and paternity leave policies;
- Equal employment policy or legislation;
- Policy (or practice) regarding supervisors handling traffic;
- Policy regarding volume of deputy-supervisor, officer-in-confidence and training officer tasks handling traffic;
- Team / individual rostering policy;
- Policy of transfers to other sectors, transfers to tasks other than control;
- Policy of relocating less successful trainees;
- Relocation compensation policy;
- Reward and bonus systems;
- Promotion policy;
- Productivity / gainsharing policy;
- Policy regarding number of days devoted to staff development;
- Policy on frequency of refresher and other training courses;
- Staff development and career development policies.

DEMOGRAPHICS

- Staff age pyramid (e.g. of current controllers);
- Retirement age;
- Age of recruits and minimum educational requirements, mandatory military or civil service affecting this age;
- Life expectancy in a given State, which can affect the period of time the organisation will enjoy the services of staff, which it has invested in.

RESOURCES: INFRASTRUCTURE AND EQUIPMENT CAPACITY

- Airport, ACC and declared sector capacities (including safety buffers);
- Technological innovations (i.e. current level of equipment and impact of any future data processing system improvements on capacity);
- Procurement regulations which may limit the business flexibility;

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GLOSSARY OF TERMS

***Ab initio* Trainee Controllers:** Selected individuals, with no previous relevant qualifications, who are given basic instruction and training to enable them to obtain theoretical qualifications. Normally the *ab initio* phase ends after initial training before entering into OJT.

Airspace Capacity: The number of aircraft that can be fitted into ATC sectors, keeping in mind aircraft separation and safety standards, area navigation direct routings and other factors (EATCHIP, 1996b).

Air Traffic: All aircraft in flight or operating on the manoeuvring area of an aerodrome (ICAO Doc 9569 Definitions).

Air Traffic Management (ATM): The ground part of ATM comprises the functions of air services, airspace management and air traffic flow management. The air traffic services are the primary components of ATM.

Air Traffic Management Organisation (ATMO): An organisation that has the management of aircraft either in flight or on the manoeuvring area of an aerodrome vested in it and which is the legitimate holder of that responsibility.

Air Traffic Service (ATS): A generic term meaning variously, flight information service, alerting service, air traffic advisory service, ATC service (area control service, approach control service or aerodrome control service). (ICAO Doc 9569 Definitions).

Breaks: The time in a shift when an individual or group of individuals is not at the workplace. This includes meal breaks, rest breaks, relief breaks, and all other forms of workplace release from work for recuperation purposes.

Business Plan: The document or series of documents intended to determine the mission, goals and individual objectives of an organisation in preparation for implementation over some stated period of time.

Controller Capacity: The number of aircraft that can be handled by a controller within a certain period of time for a given sector size, i.e. the maximum workload of controllers (EATCHIP, 1996c).

Competence: The knowledge, skills and abilities that exist among and across staff and groups of staff.

Delay: The period between the CFMU departure and the first take off time requested by an operator.

Decision-Maker: Person(s) responsible for a judgement, conclusion or resolution reached or given.

Equipment Capacity: The maximum number of flights that can be handled by an ATC system e.g. the limited number of Mode C (or the future Mode S) identification (and flight level) codes that can be allocated at any time for a given sector size.

Feedback: The return of part of the output (as a signal or information) to the input in order to modify the output.

Goal: The middle level in the organisational ambition plan. A goal will be considered achieved once a series of per-determined objectives have been completed. May also be referred to as milestone in a project or programme.

Human Resources Management (HRM): The conscious and specific direction of effort towards the quality of the workforce in the short and long term. It involves all processes and activities aimed at managing the human resources of an organisation: MP, recruitment, training and development and career management.

Inputs: A generic term meaning the various components that are essential to any transformation process in order to produce an output.

Licence: An ATC licence indicates a controller's qualifications and includes a record of his competence at a particular unit together with his medical classification.

Management: Effective use and co-ordination of resources to achieve predefined objectives.

Manpower: The total supply of individuals available and qualified for service.

Manpower Modelling: A model used in conjunction with shift roster software in order to calculate the optimal number of shifts needed each day to provide adequate cover for the ORs.

Manpower Planning: To provide a sufficient number of qualified personnel, on a timely basis, to ensure the provision of air traffic control service.

Medical Assessment: The evidence issued by a Contracting State that the licence holder meets specific requirements of medical fitness. It is issued following an evaluation by the Licensing Authority of the report submitted by the designated medical examiner who conducted the medical examinations of the applicant for the licence. Reference: ICAO Doc 9669 Definitions.

Model: A description or analogy of a real or hypothetical situation, usually formal and simplified, which is used to develop understanding.

Night Duty: A period of not less than four hours between 22h00 and 07h00 next morning.

Objective: The lowest level in the organisational ambition plan. An objective will be considered achieved once a series of pre-determined tasks or work packages have been completed.

Off Time: The hours a particular individual or groups of individuals are not normally required to be at the workplace (Tepas and Monk, 1987).

On-the-Job-Training (OJT): The integration in practice of previously acquired job related routines and skills under the supervision of a qualified coach in a live traffic situation (EATCHIP, 1995). The training enables student controllers to check out as operational controllers at a specific operational unit.

Operational Requirements (ORs): Instructions, which define the opening and closing times of the sectors necessary to guarantee a safe and orderly traffic flow. They are determined by the traffic volume, distribution and complexity.

Operational Staff: The staff working in the operational environment of ATS comprising ATCOs, flight data assistants, flow managers, operations room supervisors and ATS support staff.

Outputs: A generic term meaning various products or services that occur as a result of inputs being applied to a process (or processes) undertaken by an organisation or an individual.

Overtime: The time during which a person works at a job in addition to the regular (statutory) working hours.

Process: A series of logical and normally sequential actions, which result in the transformation of an item from one state to another or some development.

Rated Air Traffic Controller: An air traffic controller holding a licence and valid rating/endorsement appropriate to the privileges to be exercised. Reference ICAO Doc 9569 Definitions.

Ratings / Endorsements: An authorisation entered on or associated with a licence and forming part thereof, stating special conditions, privileges or limitations pertaining to such licence. Reference: ICAO Doc 9569 Definitions.

Rest Time: Any period, which is not working time (Council Directive (CD), 1993).

Rostering: The allocation of human resources in order to ensure service for the scheduled working hours in accordance with legal and local procedures.

Schedule: The sequence of consecutive shifts and off time assigned to a particular individual or group of individuals as their usual work schedule (Tepas and Monk, 1987).

Sector: A specific area of controlled airspace.

Shift: The time of day on a given day that an individual or a group of individuals are scheduled to be at the workplace (Tepas and Monk, 1987).

Shift Break: Time within a shift when work is not required, usually a time period of less than 1 hour in duration. This includes meal breaks, rest breaks, relief breaks, and all other forms of workplace release from work (Tepas and Monk, 1987).

Shift Roster / Shift Schedule: The sequence of consecutive shifts and off time assigned to a particular individual or group of individuals as their usual work schedule.

Standby Duty: A period during which, by prior arrangement, controllers are required to be available to report at their workplace with the intention of providing an ATC service.

Strategic Planning: The longest range planning / goal setting / ambitions of an organisation.

System: A system tends to be a set of interconnected, interdependent parts, forming an identifiable, organised complex and dynamic whole. It may encompass elements, activities, people or ideas.

Systematic Feedback: A small portion of the system's output taken to and compared with, one or more earlier stage inputs on a regular and routine basis.

System Dynamics: A discipline, which illustrates the interdependencies within a current system and reveals a variety of potential actions to be taken.

Systems Model: A model created to try and help human understanding in respect of some situation where systems theory is being used to clarify matters.

Systems Theory: The sound underlying theory upon which all systems knowledge is based.

Team: A team in ATS is a group of two or more persons who interact dynamically and interdependently with assigned specific roles, functions and responsibilities.

Time Leakage: Unaccountable loss of time from working shift time.

Training: The planned systematic development of the knowledge, understanding, skill, attitude and behaviour pattern required by an individual in order to perform adequately a given task or job.

Working Time: Any period during which the workers are working, at the employer's disposal and carrying out their duties, in accordance with national laws and / or practice (after CD, 1993).

ABBREVIATIONS AND ACRONYMS

AC	Assistant Controller
ATC	Air Traffic Control
ATCO	Air Traffic Controller / Air Traffic Control Officer
ATFM	Air Traffic Flow Management
ATM	Air Traffic Management
ATMOs	Air Traffic Management Organisations
ATS	Air Traffic Services
CAMI	Civil Aeromedical Institute
CBT	Computer Based Training
CD	Council Directive (The Council of the European Union)
CFMU	Central Flow Management Unit
CIP	Convergence and Implementation Programme
EATCHIP	European Air Traffic Control Harmonisation Integration Programme
EATMP	European Air Traffic Management Programme
ECAC	European Civil Aviation Conference
EUROCONTROL	European Organisation for the Safety of Air Navigation
HR	Human Resources
HRS	Human Resources Programme (EATMP)
HRM	Human Resources Management
HRT	Human Resources Team
HUM	Human Resources Domain
ICAO	International Civil Aviation Organization
IFATCA	International Federation of Air Traffic Controllers' Associations

LAMPS	Long Term ATCO Manpower Planning Simulation
MP	Manpower Planning
MPs	Manpower Planners
MSG	Manpower Sub-Group
MSP	Manpower Sub-Programme
OPS	Operations
OPSroom	Operational Room
OJT	On-the-Job-Training
OJTI	On-the-Job-Training Instructor
OR	Operational Requirement
PELA	Proficiency in English Languages for Air Traffic Controllers
RVSM	Reduced Vertical Separation Minimum
SDE	Senior Director EATMP
SGAMI	Select Group for Assessing Manpower Issues
SMEs	Subject Matter Experts
ST	Specialist Task
SWOT	Strengths, Weaknesses, Opportunities and Threats
SWP	Software Simulation Package

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