International Civil Aviation Organization

WORKING PAPER

INTERNATIONAL CIVIL AVIATION ORGANIZATION

SOUTH AMERICAN OFFICE

ICAO SPECIAL IMPLEMENTATION PROJECT (SIP)

WORKSHOP ON THE DEVELOPMENT OF BUSINESS CASE FOR THE IMPLEMENTATION OF CNS/ATM SYSTEMS

(LIMA, 10 − 14 NOVEMBER 2008)

Agenda Item 5: Hands-on exercises for the development of business case

GUIDANCE MATERIAL FOR THE DEVELOPMENT OF BUSINESS CASE ANALYSIS FOR THE IMPLEMENTATION OF CNS/ATM SYSTEMS

ILLUSTRATIVE APPLICATION

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GUIDANCE MATERIAL FOR THE DEVELOPMENT OF BUSINESS CASE ANALYSIS FOR THE IMPLEMENTATION OF CNS/ATM SYSTEMS

Draft version 1.2
Date: July 2006

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CHAPTER I

Introduction

1.1. BACKGROUND

In order to progress the implementation of the CNS/ATM system, a plan of action was needed. The first such effort was the Global Coordinated Plan for transition to the ICAO CNS/ATM System. In 1996, the Council of ICAO determined that CNS/ATM system had matured and a more concrete plan was needed which would include all developments and possible technical solutions, while putting the focus on regional implementation.

Further steps in the planning and implementation of CNS/ATM Systems need to be addressed to meet the challenges of integration, interoperability and harmonization of the system thus leading to a Global Air Traffic Management (ATM) System. The operational concept and the global plan provide a road map for the next twenty-five years for use by States, sub-regional groups, and planning and implementation regional groups (PIRGS).

Global cooperation is paramount to ease congestion and cope with future traffic growth in the skies. It is believed that without global cooperation a saturated ATM system will not be able to cope with the aircraft volume that is expected to double in the next 20 years. Air traffic service providers and regulators have a focus on balancing user needs. A worldwide ATM system is vital for the future of the air transport industry.

The implementation of communications, navigation, surveillance and air traffic management (CNS/ATM) systems is progressing worldwide. It is a complex process, involving multiple stakeholders and partners such as air navigation services providers, airlines, air traffic management equipment and avionics suppliers and aircraft manufacturers, telecommunication services providers and passengers. The various stakeholders would need to be convinced of the benefit of such implementation on the system as a whole and on them individually. A thorough analysis and evaluation work is required to bring them into consensus.

Cost benefit analysis (CBA) would be the first step in this process. The cost-benefit analyses carried out by states and air navigation service providers have shown the implementation of CNS/ATM systems to be beneficial, but benefits may not be realized by the investors. In the case of State investments, benefits are generally accrued by the users, and investments are generally justified on the basis of benefits for the users.

The implementation of CNS/ATM systems calls for air navigation service providers to invest in ground and satellite-based infrastructure, while airlines must invest in CNS avionics. Air navigation services providers impose user charges to finance their investments. Both service providers and airlines may require external funding or loans to finance the implementation of the new systems.

This implementation will put a significant financial burden on air navigation services providers requiring them to look for alternative funding. When seeking financing for the implementation of CNS/ATM systems from a commercial source, a CBA alone would not be sufficient to convince potential lenders of the financial viability of the project. This is mainly due to the fact that a CBA assesses the project from a purely economic perspective, including non-cash and/or external costs

and benefits. The CBA has to be taken to the next level in order to provide a cash flow analysis illustrating the ability of the borrower to pay back the loan. A risk analysis has also to be performed in order to demonstrate to the lenders the long term viability of the investment. This is the main goal of the business case.

The advantage of the business case approach is that it presents the project from a business perspective and integrates cost-benefit analysis, cash flow analysis and risk analysis. While the cost benefit analysis shows the economic justification of the capital investment, the cash flow analysis demonstrates the viability and benefits of the project to the investor and/or the lending institutions.

There must also be a disciplined process for the development of business cases that are available to all stakeholders. It must be adapted to a particular air space with specific traffic flows.

The guidance material consists of two components:

- the documentation in which the business case concept is defined, explained and illustrated;
- the software which allows the user evaluate the alternative implementation options for CNS/ATM systems.

1.2. DEFINITION OF A BUSINESS CASE

A business case is a management tool that supports planning and decision making by positioning the investment decision in the content of business objectives. A sound business case should provide an analysis of all costs, benefits and risks associated with the proposed investment and should offer reasonable alternatives.

A business case sets out the context of the problem or situation being addressed and provides a thorough description of the proposal, including the rationale for its selection among other alternative options and a comprehensive assessment of the associated benefits, costs and risks. The scope of the analysis should cover all the stakeholders and partners involved in and/or affected by the proposal. It is also desirable to analyze the alternative options, not retained by the proposal and to outline their associated benefits, costs and risks.

The business case also provides an analysis that measures the influence of each of the primary factors in order to provide guidance on minimizing uncertainties. The business case document in general should include an identification of the stakeholders/partners, a cost-benefit analysis, a financial analysis and a risk management study.

1.3. DEVELOPING A BUSINESS CASE FOR THE IMPLEMENTATION OF CNS/ATM SYSTEMS

The primary influences on investment decisions are financial in nature and a solid business case for the implementation of CNS/ATM systems is the prime determinant. This business case should aim at bringing the various stakeholders/partners into consensus on the financial aspects of the project. It serves as a justification for the required investment and the business plan, acts as a borrowing document, provides requisite information for potential investors, and may provide support in budgeting and control.

Once the operational concept is developed, the requirement for airplane and infrastructure upgrades can be developed and implementation commitments made. The development of a business case for the implementation of CNS/ATM systems has to focus on an homogeneous air traffic management area. It needs to take into account current and forecast traffic flows and densities, the operational requirements and the alternative facilities/equipment configurations suitable that meet those operational requirements. Such analysis could be carried out at State, sub-regional or regional levels.

Given the existence of multiple alternative implementation options, a procedure allowing for their identification, definition, evaluation and ranking has to be put in place. The definition provides the facilities/equipment configuration. The evaluation and ranking are performed both on an operational and financial basis. For every option, the operational merits are identified and the costs and benefits analyzed.

Business cases for CNS/ATM systems have to be addressed from different perspectives, specifically those of the major stakeholders or partners. While business cases may be performed jointly or separately**,** an integrated business case, which takes into account both perspectives, would be the most desirable.

The business case document serves as a tool for marketing the CNS/ATM concept to those providing funding that may include States or financial institutions. Funding for the required investment may come in various forms such as accumulated profits, government contribution, commercial debt financing (including loans and leasing), bond issues and equity financing. The business case should emphasize the areas that investors consider the most critical. It should offer to meet measurable goals and objectives that are of a particular value to those investors.

The credibility of the business case must be emphasized. A solid business case should provide an analysis that measures the influence of each factor to provide guidance as to what uncertainties should be minimized. Clearly if the major influence in a business case has the greatest uncertainty and the uncertainty cannot be controlled the business case is considered weak.

Once the business case is completed and accepted by the appropriate final decision makers, an integrated development plan can be established.

1.4. TARGET AUDIENCE

The target audience of the business case document for the implementation of CNS/ATM systems would be major stakeholders/partners and mainly the funding sources.

1.5. MAJOR STAKEHOLDERS/PARTNERS, THEIR OBJECTIVES, NEEDS AND CONCERNS

There are two major stakeholders/partners in the implementation of CNS/ATM systems at the global level: the air navigation service providers and the airlines.

Other stakeholders may include passengers, suppliers and financial institutions. Passengers who constitute the main focus of governments, airlines and air navigation service providers would be affected by the implementation. It is assumed that there is no need to directly include them in the analysis since their interests would be taken into consideration by the air navigation services providers and the airlines. Although air traffic management equipment and avionics suppliers and aircraft manufacturers represent an important and integral part of the stakeholders/partners, they are concentrated in a few States and their inclusion in the analysis depends on the State or the

region concerned. Financial institutions would provide funding, only if convinced, by the means of a solid business case, of the viability of the project at hand.

While the objectives of the major stakeholders/partners are common, their needs, concerns and motivations may be different.

The main objective for an air navigation services provider is to meet its air traffic management objectives and the associated operational requirements. Its basic concern from a financial perspective is to be able to recover the investment through the provision of air navigation services. Any increase in possible user charges by the airlines would be off-set by the operational efficiency gained. Even in the cases where air navigation services are not provided on a commercial basis, it is recommended that an evaluation be conducted to assess the financial impact.

The main objective of the airlines is to meet their preferred flight profiles and to reduce operational costs by reducing flight time and eliminating delays.

1.6. PREREQUISITES TO THE CNS/ATM SYSTEMS BUSINESS CASE ANALYSIS

The following are all important prerequisites for a business case analysis:

a) the boundaries of the homogeneous ATM area subject of the business case have to be clearly defined (State/service provider, group of States, sub-region, region, etc.);

b) a consultation and coordination effort between service providers in adjacent areas;

c) the need for the new technology in order to meet the operational requirements and to achieve the overall air traffic management objectives;

d) a consensus among the stakeholders/partners regarding the need and requirements for new technology;

e) the availability of the new technology's facilities and equipment;

f) the knowledge of the expected costs of equipment and operations with an acceptable margin of uncertainty;

g) the recognition and awareness of international cost recovery policy for air navigation services (ICAO's Policies on Charges for Airports and Air Navigation Services, Doc 9082/6);

h) the establishment of an effective cost and revenue accounting system;

i) a sound methodology for determining the cost basis for the charges; and

j) an effective mechanism for the collection of the charges.

In addition, the following points need to be addressed:

a) air navigation services' planning is operationally driven and not technology driven;

b) all stakeholders/partners do not have the same motivations and benefits;

c) the transition to the new systems will be a gradual process and wil occur at different rates across each airspace and region concerned;

d) the new technologies will complement rather than replace existing technologies; and

e) a multi-national cooperation among provider States and users will be essential to minimize investment costs, compatibility and avoid duplication of effort.

1.7. DEVELOPMENT PROCESS OF THE BUSINESS CASE

The development process of a business case for the implementation of CNS/ATM systems has to be a consultative process in which all major stakeholders/partners are involved. Planning for the implementation of the CNS systems includes several steps beginning with the definition of homogeneous ATM areas and the development of forecasts for the major traffic flows and traffic densities. With this information at hand, further steps involve setting the ATM objectives, determining the operational requirements, identifying the various technical solutions and performing an economic analysis. Finally, planners must decide on a set of performance objectives, such as the optimum air route structure, supported by the global plan initiatives and project management techniques.

Since it is expected that air navigation services providers will bear most of the implementation costs, they can start by developing an initial analysis covering all major stakeholders/partners, which will subsequently be shared with the other stakeholders/partners. Inputs and comments on the methodologies adopted should to be sought from them prior to the analysis. Two consultation processes are available for sharing the business case analysis among stakeholders/partners. The first process is to send the initial analysis report to the various stakeholders/partners in order to seek their views and opinions. The analysis is then revised to take into consideration, to the maximum extent possible, the views and opinions expressed. This should be an iterative process until an agreement is reached. The second consultation process is to discuss the initial analysis report during one or several open meetings or workshops in which would take part the various stakeholders/partners. Participants to such meetings/workshops would agree on a series of recommendations, which would be taken into account by the air navigation service provider in order to improve the analysis.

1.8. MAIN IMPEDIMENTS TO A SOUND BUSINESS CASE

There are many possible impediments to a credible and reliable business case including:

a) Lack of interest or cooperation amongst the stakeholders/partners;

b) the lack of coordination and consultation between service providers with adjacent areas of responsibility within the homogeneous ATM area concerned;

d) the non-homogeneity of areas selected and redundancy of facilities and equipment;

e) Difficulties associated with acquiring data.

1.9. ECONOMIC ASSESSMENT

A cost benefit analysis should be performed and included in the business case document. Cost benefit analysis is usually performed by policy makers when contemplating a new project or policy. A cost benefit analysis gives an indication of the total economic welfare effects of a project by comparing all costs and benefits and provides a logical and consistent framework for assessing a particular project. A credible assessment must cover all costs and benefits, both quantitative and qualitative as well as external, where possible. The cost benefit analysis may also serve as a starting point for the financial analysis. Guidance material for the development of cost benefit analysis for the implementation of CNS/ATM systems is provided in ICAO Circular 257:"Economics of satellite based air navigation services".

1.10. FINANCIAL ANALYSIS

The financial analysis section of a business case shows the expected cash flow profile of the project proposal and includes the assumptions, methods and rationales used for estimating revenues and expenditures. It should include estimates of the component costs (facilities and equipment, operation and maintenance, etc.) of each distinct part of the over-all project, the funds required to make disbursements at various stages, the currencies in which payments are to be made and the sources from which funds are to be generated.

Several techniques are available to perform the financial analysis including the payback period, the accounting rate of return, the internal rate of return and the net present value. The latter is most widely used.

Each technique would require a set of assumptions and the provision of certain parameters. Given the uncertainty associated with the assumptions and parameters used, a sensitivity analysis is required.

1.11. FINANCING REQUIREMENTS

The cash flow analysis of the project provides an excellent forecast of when funding is required. Typically, cash disbursements would start with the project but cash receipts will not occur until

the services are provided on a continuous and reliable basis. The main outcomes of the business case analysis will be an assessment of financing needed and the sources and application of funds. The business case associates a financial source for each financial requirement which can be shareholder equity, bonds, loans, etc.

In the case of loans, possible collaterals/guaranties have to be identified and described in full detail. Also to be emphasized is the importance of the availability of data showing the trend in the financial situation of the air navigation services provider concerned over recent years, as well as anticipated developments over the period of debt repayment.

1.12. RISK MANAGEMENT

Since the implementation of CNS/ATM systems involves new concepts that might lead to significant changes in the way air navigation services are provided, several risks of technical, operational, political, economic, financial or managerial nature may be present. Risks such as a lower traffic growth than forecast (implying lower revenues), an extended transition period leading to higher costs, a failure in integrating existing systems with new systems could have an impact on the outcome.

The objective of risk management is not to eliminate risks but to identify and evaluate them in a comprehensive manner in order to improve the awareness of decision makers of such risks and help them reduce their effects through the development and implementation of appropriate mitigation plans. Risk management encompasses risk analysis and evaluation and the development of risk mitigation plans. Risk analysis involves the identification of risks, the estimation of their likelihood and the determination of their possible causes and potential impacts. Risk evaluation aims at ranking risks according to their potential impact on the project and the likelihood of their occurrence. Judgment has to be made in order to decide which risks need to be managed. Typically risks with significant potential impact and high probability of occurrence are considered major risks. The risks associated with the various aspects of the project can be analyzed through the use of alternative scenarios.

CHAPTER II

Model outline for a business case document

In this analysis, it should be kept in mind that the reader is not necessarily a specialist in the field of civil aviation and that there is a need to briefly explain the various concepts involved whenever possible and to cite to the appropriate reference documents.

2.1. INTRODUCTION

This section describes the context of the project for which the business case analysis is being prepared. It starts with a brief description of the geographical scope of the analysis and an overview of the air navigation services provided and their respective functions, highlighting their vitality to air transport and to civil aviation in general. The importance of the civil aviation sector in support of the economy needs to be emphasized. The main issues facing air navigation services provision in the area should be described and the air traffic management objectives and the operational requirements need to be briefly introduced. In the case of the implementation of CNS/ATM systems components, the limitations of the conventional systems in terms of safety, reliability, capacity, cost or others ought to be stressed. All these elements are then combined in order to justify the need for the project.

2.2. EXECUTIVE SUMMARY

This section is the most important in the entire business case document since most readers would read it first and would not need to read the rest of the document. It should provide the reader with a brief description of the project proposal, its main components, the rationale for its selection among other alternative options, its impact on the organization undertaking the project and on the various stakeholders/partners involved. The associated costs and benefits, the funding requirements as well as the potential sources of funds should be briefly described. The main risks involved and the critical success factors need also to be introduced.

2.3. THE AVIATION INDUSTRY

This section briefly introduces the aviation industry to the reader.

2.3.1. Main characteristics of the industry

It should be emphasized that aviation industry is a growth industry and that air traffic is in general closely related to the economic activity and that both are cyclical. It should also be stressed that on a global basis, air traffic growth has consistently outpaced economic growth. To illustrate this to the reader, some historical growth rates or charts representing the growth trends for both air traffic and the economic activity for the State or the region concerned, might be included. In addition, since air traffic is highly seasonal in most regions of the world, air traffic growth combined with cyclicality and seasonality raise air navigation services and airport capacity planning issues. Designing the systems to handle the peak traffic might be costly and creates overcapacity most of the time. A careful study of the peak period parameters is therefore required during the planning process in order to avoid any unnecessary expenditure.

Air traffic is also very sensitive to the safety and security aspects. A brief assessment of the safety and security risks in the State or region concerned might serve in the project risk analysis.

Buying aircraft, building or expanding airports and implementing air navigation facilities and equipment are costly and often require some form of external financing. Technological developments affect the ability of this industry to respond to traffic growth and continuous innovation influences the ways and means through which services are provided. The latter feature of the industry might also render some equipment technologically obsolete relatively quickly, although the impact might be limited given the fact that investment is operationally driven rather than technologically driven. The fact that the aviation industry is also capital and technology intensive raises the issue of the availability of funds and the urgent need to look for alternative sources of funds.

2.3.2. Importance of aviation to the State or region economy

Aviation plays a significant role both economically and socially. It facilitates business, trade and tourism and helps create jobs, revenues and opportunities. It serves as a bridge between people and nations. The economic and eventually social importance (impact) of civil aviation for the State or for the region concerned should be emphasized.

2.3.3. Environmental aspect

Aviation growth raises some environmental concerns and the environmental aspect of civil aviation is closely monitored and protection measures are progressively introduced. The implementation of CNS/ATM systems might provide great environmental benefits through the implementation of shorter routes and the resulting reduction in aircraft engine emissions. An estimation of such benefits resulting from the project proposal would be a good support for the business case.

2.4. ORGANIZATION AND MANAGEMENT OF THE AIR NAVIGATION SERVICE PROVIDER

Air navigation service providers form an integral part of the aviation industry. They provide en-route and/or terminal air navigation services to various airspace users including airlines, general aviation and the military. The services offered encompass communications, navigation, surveillance and air traffic management. Airlines are by far the main airspace users of such services and therefore represent their main customer and the main stakeholder/partner in any air navigation systems implementation project.

The business case should present the organization providing the air navigation services including its institutional format, its capital structure, its principal shareholders and its management. A special attention has to be given to the description of the financial situation of the organization.

2.5. IDENTIFICATION OF MAJOR STAKEHOLDERS/PARTNERS

The major stakeholders/partners should be identified before embarking on the development of the business since they should be involved in the whole process. The stakeholders/partners would include in addition to the air navigation service providers, the airspace users (the airlines serving the airspace, business aviation, general aviation, military, etc.) and the potential funding sources.

2.6. PROBLEM DEFINITION

The current conventional air navigation systems might have several limitations, which would depend on the State or the region concerned. Such limitations have been outlined in several ICAO documents and are due essentially to three factors:

a) the propagation limitations of current line-of-sight systems and/or accuracy and reliability limitations imposed by the variability of propagation characteristics of other systems;

b) the difficulty, for a variety of reasons, of implementing present CNS systems and of operating them in a consistent manner in large parts of the world; and

c) the limitations of voice communications and the lack of digital air-ground data interchange systems to support automated systems in the air and on the ground.

A clear definition of the problem(s) encountered is required. It provides the basis of the justification of the project proposal to all stakeholders/partners.

2.7. THE PROJECT PROPOSAL

2.7.1. Definition of the geographical scope of the project

The business case is normally prepared for an FIR or a set of FIRs representing a homogeneous area. A homogeneous air traffic management (ATM) area is "an airspace with a common air traffic management interest, based on similar characteristics of traffic density, complexity, air navigation system infrastructure requirements or other specified considerations wherein a common detailed plan will foster the implementation of interoperable CNS/ATM systems".

2.7.2. Air Traffic analysis and determination of the major traffic flows

Once the geographical scope of the project is defined, an air traffic analysis in terms of passengers and aircraft movements, for the area concerned, is required in order to determine the main characteristics such as the major traffic flows, traffic density, seasonality and peak period parameters. A major traffic flow "is a concentration of significant volumes of air traffic on the same or proximate flight trajectories".

As part of the traffic analysis, a detailed analysis of past traffic over each major traffic flow needs to be performed. The analysis might cover the following data:

a) total traffic movements, including:
   1) outbound flights;
   2) inbound flights;
   3) overflights;
   4) crossing flights;
   5) direction of flights;

b) flight level distribution according to performance category (turbo-jet, turboprop, piston);

c) category of flight:
   1) commercial;
   2) military;

3) other.

In order to determine the peak period traffic, traffic data has to be provided by day of the week and by hour of the day. Typically, such detailed data is only required for a specific week selected on the basis of the analysis of the distribution of traffic over the entire year.

This air traffic analysis will be instrumental in the development of traffic forecasts.

2.7.3. Current requirements and existing systems

A presentation of the existing systems covering facilities, equipment, personnel, methods, techniques, safety, reliability, capacity, efficiency and impact on the environment, may be required. As part of the planning process and based on the current traffic volume and density, an operational analysis helps identify the current operational requirements. The comparison of these requirements to the capabilities of the existing systems helps identify the shortcomings.

2.7.4. Future traffic outlook

A detailed traffic forecast has to be performed in order to estimate for each major route group the future peak period parameters such as the peak day and the peak hour for the planning horizon. These parameters form the basis of the planning process, which comprises the air navigation operational analysis, the definition of ATM objectives and the establishment of CNS support requirements. The forecasts horizon must be longer than or equal to the project time horizon.

2.7.5. Future requirements

The traffic forecasts provide the future evolution of traffic volumes and densities on the major traffic flows. An operational analysis helps identify the future requirements and objectives. A comparison of these requirements to the capabilities of the existing systems is necessary to determine if there is need to increase these capabilities through the improvement of the existing systems or the implementation of new systems.

If the assessment of the ability of the existing systems to respond to the future operational requirements leads to the need for increased capabilities, several alternative implementation options might be available. Each option would consist in the implementation of new facilities, equipment, new methods and new techniques and would imply new personnel requirements (in terms of numbers and qualifications). All available options need to be identified and described in order to allow a better choice. In addition to the comparison of options on technical grounds, a summary economic or financial analysis in the form of cost benefit analysis, financial analysis and risk analysis can be used in support of the selection process. These sections constitute the core of the business case document.

2.7.6. Project proposal: The implementation of a CNS/ATM systems project

The selected option (project proposal) has to be detailed (facilities, equipment, methods, personnel requirements, etc.) and the main arguments for its selection explained. The benefits of the implementation of the project proposal in terms of impact on safety, reliability, capacity, efficiency, impact on the environment have to be emphasized.

The project proposal might be implemented at once or piecewise. The planner is therefore required to establish an implementation strategy and timing. In doing so, it is important to keep in mind that the timing has a significant impact on the benefits and the costs of the project proposal.

2.8. FINANCIAL ANALYSIS

Since the final decision regarding the implementation of a CNS/ATM systems project has to take into consideration the financial impacts on the major stakeholders and given that these impacts are interrelated, the financial analysis should cover air navigation services providers and airspace users simultaneously.

The financial analysis is carried out for a specific implementation option, usually the project proposal. It is therefore assumed that the planner has already defined the homogeneous ATM area concerned and knows the major traffic flows and their associated traffic in terms of aircraft numbers and movements. It is also assumed that the operational analysis has already been undertaken and that the facilities and equipment required and the timing of their implementation (implementation scheme) are defined. The financial analysis takes into consideration the life cycle costs and revenues cash flow streams. Lifecycle costs for the facilities and equipment are acquisition and installation costs as well as operation and maintenance costs.

2.8.1. Main steps in the financial analysis

The following steps can be followed for the development of the financial analysis:

Main assumptions and parameters

1. Establish the project time horizon through the determination of a start of analysis year and an end of analysis year for the project;
2. Define a base year for the analysis;
3. Establish traffic forecasts for the major traffic flows in terms of aircraft movements, flight hours and aircraft numbers (the time horizon for the traffic forecasts should not be shorter than that of the project);
4. Select a rate for the cost of capital;
5. Select an efficiency rate for airspace users (in terms of flight time reduction); this rate would vary among route groups;
6. Select an average aircraft operating cost per hour for the fleet crossing the homogeneous ATM area;
7. Establish a start year and an end year for the cost recovery period which will serve as a basis for the estimation of the required increase in user charges;

Analysis for the air navigation services provider

8. Establish the cash flow streams for the expenditures of the air navigation services provider on the basis of the facilities and equipment implementation scheme and the associated operation and maintenance costs;
9. Establish the cash flow streams for the revenues of the air navigation services provider in accordance with the user charges determination procedure described below;
10. Based on the analysis above, calculate the net present value and the benefit to cost ratio of the project and determine the payback period for the air navigation services providers.

Analysis for the airspace users

11. Establish the cash flow streams for the expenditures of airspace users on the basis of the avionics implementation scheme and on the user charges established by the air navigation services provider;
12. Establish the cash flow streams for the benefits of the airspace users aircraft movements forecasts and selected efficiency rates;
13. Based on the analysis above, calculate the net present value and benefit to cost ratio of the project and determine the payback period for the airspace users.

2.8.2. Establishment of cash flow streams for expenditures incurred by the air navigation services provider

The cash flow streams for the expenditures incurred by both the air navigation services provider and airspace users can be classified by major component of CNS/ATM systems: communications, navigation, surveillance and air traffic management. For each component, two categories of costs have to be calculated: facilities and equipment costs and operation and maintenance costs. The cash flow stream should be provided on a year-by-year basis and should cover the project time horizon.

2.8.3. Estimation of the required increase in user charges

In order to estimate the required increase in user charges, several options are available. For example, it can be assumed that the air navigation service provider would contract a loan to finance the project, the amount of which is equal to the calculated present value of expenditures, at a rate equal to the selected cost of capital. The present value of the expenditures incurred by the air navigation services provider is calculated on the basis of the cash flow stream and a discount rate. The applied discount rate does not need to correspond to the cost of capital. This procedure may not be easy to implement and might not be acceptable to other stakeholders/partners. In such cases, a compromise solution has to be reached.

2.8.4. Estimation of avionics costs

The estimation of avionics costs is based on the number of aircraft crossing the ATM homogeneous area and the unit cost of the avionics equipment. Avionics costs include two categories: avionics equipment costs and operation and maintenance costs. Aircraft equipage would occur over time according to the implementation scheme and the predicted growth in aircraft numbers. Consequently, the cash flow stream would start low and grow progressively until the project time horizon is reached or the number of aircraft equipped attains its maximum.

2.8.5. Estimation of flight efficiency benefits

The analyst provides a flight efficiency rate, an average aircraft operating cost, the predicted growth in terms of aircraft movements and or flight hours. Using these inputs, it is possible to calculate on a year-by-year basis, the efficiency benefits achieved by the airlines through more direct and shorter routes.

It is expected that the outcome of analysis would be very sensitive to the assumption regarding the flight efficiency rate. Therefore, it is highly recommended that this assumption be based on a thorough analysis and be agreed upon by the airspace users.

2.8.6. Sensitivity analysis

Given that many parameters used in the financial analysis are based on judgment, it is recommended that a sensitivity analysis be performed. The sensitivity analysis is based on the fact that such parameters have a range in which they could vary and that the value used is the most likely. Performing the analysis using the extreme values of the range would provide an indication of the sensitivity of the outcome (Net Present Value, profit to cost ratio, payback period, etc.) to the parameter under consideration. The sensitivity analysis may support the risk analysis through the identification of the parameters having the most significant impact on the project outcome.

2.9 Financing requirements

On of the main outcomes of the financial analysis is the determination of the financing requirements and their timing. In fact, the cash flow analysis would show when there is a deficit of cash implying a need for funds. Funds might be generated from several sources including accumulated profits, government contribution, commercial debt financing (including loans and leasing), bond issues and equity financing. In identifying the potential sources, it should be kept in mind that each funding source would have its specific cost of capital and acceptable risk margin, which in turn would have an impact on the outcome of the analysis.

2.10 Risk Management

Risk management encompasses risk analysis, risk evaluation and the development of mitigation plans. Risk analysis includes risk identification, estimation of the probability of occurrence of risks, and the estimation of the potential impact of risks. Risk evaluation aims at ranking risks according to their potential impact on the project and the likelihood of their occurrence. The development of risk mitigation plans includes also the determination of the potential causes.

2.10.1. Risk Analysis

Risk identification

The identification and description of risks constitutes the basis of risk management. The identification of risks is based on the definition of specific goals, requirements or specifications associated with the implementation option under study and relating to technical, operational, political, economic, financial or managerial aspects. In a perfect environment, one would expect these goals, requirements or specifications to be fully achieved or met. But in the real world, several factors might cause a deviation from the expected outcome. In order to identify risks, the analyst should examine the goals, requirements and specifications one by one and identify the possible factors that might affect their realization. This is mainly a judgmental process.

Risks for the implementation of CNS/ATM systems can be broadly classified into six categories: technical, operational, political, economic, financial or managerial.

Technical risks

Technical risks include the risks stemming from a possible mismatch between the technical specifications and the actual performance of the system (or systems) to be implemented. Technical risks include also the installation risks associated with the possible difficulties in installing the new systems.

Operational risks

These risks are related to the success of the operation and maintenance of the new system. They may include:

- Integration risks: This includes a successful integration with the existing systems, which will continue to be operated.
- Maintainability risks: This is related to the complexity and cost of maintaining the new systems.
- Security risks: these relate mainly to the security of the sites and to information security, which is related the new system's vulnerability.
- Safety risks relate to the reliability of the new system and the likelihood of system related hazards.
- Human factors risks focuses on the effectiveness of the joint human-system interface and risks associated with making the system usable in an operating environment.

Political risks

These risks are associated with the Government policy and stakeholders support:

- Government policy risk is related to the likelihood of change in government support to the project. This support be quantitative in the form of subsidies, tax relief, customs duty relief etc.; or qualitative helping convince other stakeholders of the benefits of the project.

- Stakeholders support risk is the risk associated with various stakeholders supporting the implementation and operation of the option, such as the airlines, general aviation users, and possibly potential equipment and aircraft manufacturers.

Economic and financial risks

These risks are related to the uncertainty associated with the value of future benefits (or revenues) and costs (expenditures). They may include:

- Benefit estimation risk is associated with the difficulty in estimating benefits. This risk addresses the accuracy of the benefit estimate, including such issues as inadequate methods to estimate the benefits, lack of data to estimate benefits, whether the link of the implementation option to projected benefits is tenuous, and whether the implementation option is defined enough to estimate the benefits.

- Cost estimation risk considers the difficulty in estimating costs. This risk addresses the accuracy of the cost estimate, including such issues as inadequate methods to estimate the cost, lack of data to estimate costs, and whether the implementation option is defined enough to estimate the cost.

- Currency or exchange rate risk is linked to the uncertainty associated with future changes in the value of foreign currency with respect to local currency. This is particularly relevant when revenues or expenditures are specified in foreign currencies.

- Funding risk is related to the level of confidence that the required funds will be available on time from the sources identified in the implementation option.

- Inflation risk is associated with the chance that a general increase in the price level will undermine the real economic value of any agreement that involves a fixed promise to pay over an extended period.

- Interest-rate or cost of capital risk is related to the likelihood that a change in interest rate or cost of capital will affect the value of any agreement that involves a fixed promise to pay over a specified period.

Managerial risks:

These risks address the likelihood of undesired events associated with managerial decisions.

- Management risk refers to the complexity to manage the implementation option (e.g., number of sub-tasks and/or number of performing organizations) and considers the risks of obtaining and using applicable resources and activities, which may be outside of the option's control but can affect the option's outcome.

- Schedule risk considers the likelihood that the alternative will be completed within the specified schedule.

Estimation of the probability of occurrence

To every identified risk, a probability of occurrence level has to be associated through a well-defined rating scheme. The choice of the rating scheme and the assignment of these levels should be performed in a consultative manner. One simple scheme could be to assign low, medium or high probability of occurrence to each risk. Another scheme could be to assign a number ranging between 0 and 5 or between 0 and 10 or any other agreed range. The following methods, among others, maybe used in the estimation process:

- Expert interview: For each category of risk, one or more experts are identified and consulted on the probability of occurrence of such risks. The experts should naturally have a good experience in the field.
- Analogy: The implementation of a new project might have some similarities with previous ones. Some areas might even be identical. The estimation of the likelihood of occurrence of a given risk for the option concerned might be based on past experience and/or previous estimation.
- Review of implementation plans: Detailed plans are normally designed for the implementation of a specific project or option. The review of such plans in to order estimate the probability of occurrence specific risks is required.
- Delphi technique: A number of experts are initially consulted on the probability of occurrence of a list of risks within the framework of their expertise. Based on the first round of consultation, the expert view are analyzed and integrated (using for example averages or most suggested values) and distributed to the same experts to seek their feedback (whether they stick to their initial assessment or adjust it). The process can be iterated until a single value is reached.

Estimation of the potential impact

A measure or rating of the potential impact of each risk is required. This rating is performed in a similar manner to the rating of the probability of occurrence. One simple rating scheme could be to assign minor, moderate and substantial potential impact to each risk. Another scheme could be to assign a number ranging between 0 and 5 or between 0 and 10 or any other agreed range. The same methods described above could also be used in the estimation of the potential impact.

2.10.2. Risk evaluation

Assignment of a risk score to each risk factor

Each risk factor should be assigned a risk score. The score is a number, which provides an idea about the severity of the risk. Typically, risk factors with high probability of occurrence and substantial potential impact would have a the highest scores and conversely risk factors with low probability of occurrence and minor potential impact would have the lowest scores.

Assignment of weights to each risk factor

In order to come up with a risk score for the implementation option concerned, it is necessary to recognize that all risk factors do not have the same importance. Each risk factor should therefore be assigned a weight. The total of all weights should be equal to 1 and weights should not change from an implementation option to another. Weights could also be assigned by risk category.

Determination of a risk score to each implementation option

The risk score of an implementation option is equal to the sum of the products of the risk score of each risk factor by the corresponding weight.

Ranking of implementation options by risk score

Risk analysis could form part of the selection procession or may only be performed for the selected implementation option. In the former case, the severity of risks associated with each option is taken into consideration in the selection process. The ranking of options by risk score would help the decision maker make an informed choice.

2.10.3. Development of mitigation plans

Identification of the potential causes of risks

Once the implementation option is selected and in order to develop risk mitigation plans, it is necessary to identify the potential causes of the risks involved in the selected option. The identification of potential causes of risks may be performed for all other alternative options, but such identification is not required since it is mainly needed in the development of the mitigation plan, which is prepared only for the selected option.

Development of mitigation plans

An appropriate mitigation plan has to be prepared for the selected implementation option, in order reduce the impact of the potential risks through the implementation of properly defined actions if such risks materialize.

2.11. IMPACT ON THE ORGANIZATION AND MANAGEMENT OF THE SERVICE PROVIDER

The implementation of the project proposal might have an impact on the structure and management of the air navigation services provider organization. In general, three cases are possible:

1) Creation of a new organization

The business case document should describe:

- the institutional format of the new entity including whether it is public, private or a public-private partnership;
- its capital structure and principal shareholders;
- its management;
- the staffing requirements;
- the training requirements.

2) New department within an existing organization

The business case document should describe the management, staffing and training requirements for the new department as well as its relationship with the existing departments in terms of responsibilities, functions and work flows.

3) No impact on the organizational structure

The business case document should assess the impact of the project proposal on the staffing and training requirements of the organization.

2.12. IMPACT ON PARTNERS/STAKEHOLDERS

The impact of the implementation on each stakeholder/partner needs to be analyzed, evaluated and presented. The main partners/stakeholders are the airspace users who are interested in more direct and therefore shorter flights and shorter delays, and a seamless airspace. Airspace users have to be involved in the process since the planning phase. Continuous consultation and coordination between the users and the providers are essential to the success of the project proposal and the business case.