

# The Business Side of CNS/ATM

David Allen  
Manager, CNS/ATM Projects  
Boeing Commercial Airplane Group

## Introduction

The air transport industry has developed a new operational concept for the Air Traffic Management (ATM) system which involves dramatic changes to the airplanes, infrastructure, and ground systems. The current ATM system (based on ground navigational aids, radar, and voice communications) will be unable to cope with expected air traffic growth. Some states which do not even have this infrastructure in place find themselves in a particularly bad way. The industry is literally strangling on its own success.

The industry has responded by developing an operational concept known as the Future Air Navigation System (FANS) which relies on space based navigation and communication to provide the improvements needed in Communication, Navigation, and Surveillance (CNS) to efficiently cope with future traffic levels and to provide a level of efficiency to current operations.

The FANS concept broke new technical ground as it required industry to consider ATM as a system with ground components, space components, and airborne components. The ICAO FANS committee also committed to certain technical solutions for improvements to CNS such as Aeronautical Telecommunications Network (ATN), GPS navigation, and satellite communications. However, since the adoption of the ICAO FANS committee suggestions, progress towards this new end state FANS has been slow. This ponderous movement towards FANS implementation is not due to any particular technical problem; it is due to the lack of consideration given to the business aspects of the problem. The Air Traffic Management system must not only be considered as a system; it must also be considered as a business. Lack of this consideration has slowed the economic drivers to the pace of the ICAO process.

The industry effort has been primarily focused on development of the technological case for CNS/ATM, with admirable results. However, the business case for CNS/ATM has primarily been addressed at an overview level, resulting in huge estimates of savings without many specifics. While these financial studies serve to sustain the technological case development; they do not meet the requirements of the financial analysts for the airlines and therefore do little or nothing towards the implementation of CNS/ATM applications. Since these financial analysts hold the "purse strings" for airplane upgrades, implementation is stifled until they are confident that the expenditures are justified. Basically, the industry needs to move from "notional" benefits to "data driven" benefits.

The time has come for industry to place equal or greater effort towards the development of an analysis and presentation methodology which can effectively communicate the CNS/ATM applications business case. How will we know our communication is effective? The airlines will spend their money on CNS/ATM upgrades (to gain the benefits) and the improved system will handle traffic growth for global economic benefit.

## Airline Procurement Evolution

Everyone recognizes that the severely competitive nature of the airline industry has driven changes into airline procurement practices. Every factor is carefully analyzed by the airlines financial people. The days of technology for technology's sake are over. During the development of the 747-400, a series of aircraft changes were collected and were offered as an upgrade called Package B. There were over 50 functional upgrades contained in that package including: Global Positioning Satellite (GPS) integration, Aeronautical Telecommunication Network (ATN), Controller Pilot Data Link Communication (CPDLC), Automatic Dependent Surveillance (ADS), Company Data Link, and a host of flight crew requested functions. Very few airlines bought the package and it was later withdrawn. The airlines felt that the lack of mature

benefits coupled with the cost of Package B could not justify the purchase of the package. The economic benefits suffered because of the lack of infrastructure to support ATN and other advanced features.

The FAA recently performed a survey of U.S. domestic airline chief financial officers. The purpose of the survey was to discover what criteria each chief financial officer used to measure their companies success. The airline responses are summarized as follows:

- Obtain investment grade rating
- Be in top 10% of carriers in pre-tax profit margin
- Obtain BBB or better credit rating
- Shareholder return in the top 25% of Standard and Poor

The above goals are not met easily in today's environment. As stated earlier, competition is unrelenting and airline investment dollars must be carefully managed. CNS/ATM upgrades must compete for airline investment dollars with Cabin System upgrades, training programs, ground side upgrades, maintenance upgrades, and every other airline investment. Further complicating matters is the dependence of airline CNS/ATM benefits on ground infrastructure development. This puts a critical dependency out of the airlines' direct control. The existence of competing technologies adds further confusion. To top it off, fleet upgrades are expensive and only represent a portion of the cost (training, spares, aircraft downtime). High level analysis which concludes that CNS/ATM will save the industry \$100,000,000 a year will not communicate effectively to our target audience (the financial decision makers). Airline (and airframe manufacturer) financial analysts simply won't believe it because it is not in sufficient detail to apply their own factors to the case.

After the demise of Package B, a group of airlines approached Boeing requesting a small subset of the functions; basically the FANS 1 package. This reduced the number of required functions from 50 to 5 functions. This was accomplished by matching aircraft proposed functions to those required by the airspace operational concept and identifying specific fuel savings associated with that function. It was decided to use the existing communication infrastructure rather than wait for ATN (with its yet to be determined cost).

Boeing developed the FANS 1 offering, but the process paused once more. Even though FANS 1 was initiated by zealots within some airlines, the airline financial people needed to concur before they would authorize release of funds to purchase the FANS package. They needed a business case.

The airlines and Boeing developed business cases based on specific route structures which had committed development programs for the required infrastructure to support specific operational enhancements. This was the key to success. Boeing was able to use the business case to authorize the initiation of the FANS 1 development. The airlines were able to use that business case present a credible report to their financial departments and obtain authorization to purchase FANS 1.

### **Lessons Learned**

The following could be referred to as the FANS 1 Lessons Learned.

- Develop an operational concept for the airspace which can be supported by the infrastructure.
- Develop a phased introduction of that operational concept where the operational benefit associated with each step outweighs the cost.
- Make sure technological maturity does not outstrip business case maturity.
- Do not allow "gold-plating" of Air Traffic Management functionality.
- Assure maximum integration with the ground environment.

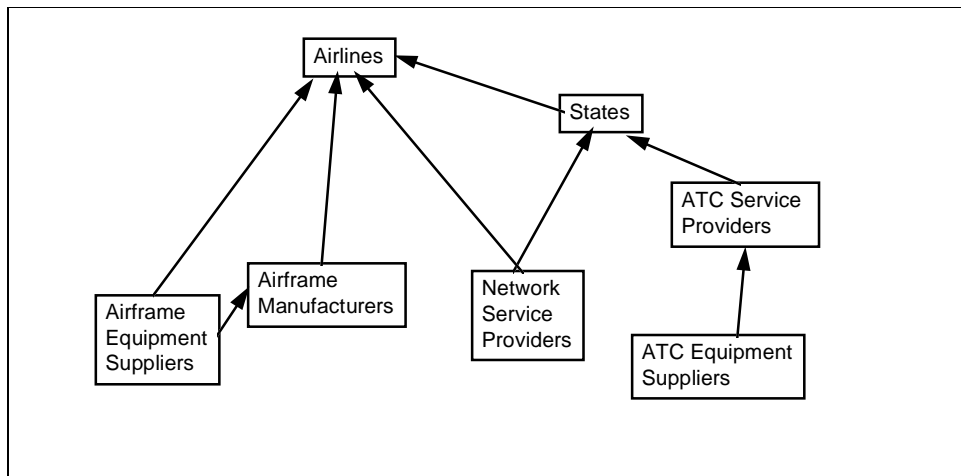
Certainly, the ICAO plans contain the ultimate operational concept. However, investment dollars are not available to allow a “grand switch” to be pulled and have the concept realized in one step, world-wide. So, phased introduction of that concept needs to be carefully developed. It needs to be done “carefully” because if a single phase does not meet the cost/benefit criteria; the whole process stops. Each step must have an adequate business case which can stand on its own merits.

The CNS/ATM Industry is primarily populated with engineering and flight operations personnel. That leads the industry committees to concentrate on technical maturity. The industry is getting to the point, however, where the achievement of business case maturity may be more important than technical maturity. Certainly, we engineers and flight operations people would rather continue to ever improve the technical implementation; but it is time to prove the business case and implement. There needs to be a concerted effort to bring business and financial people into consensus regarding the CNS/ATM realm. Bringing the business people into the process will also help keep industry from “gold plating” (over-engineering) the solution. It is clear that we can always make the technical solution a little better. By bringing in the business people, we can apply sound business evaluation practices to the process and assure that we are not over-implementing the application.

Finally, we must always keep in step with the ground implementation. This means integration both functionally and schedule-wise. CNS/ATM functions are implemented at the Air Traffic Management level, not the airplane or ground level. Without simultaneous and well integrated development and implementation efforts, major benefits will be lost.

### What’s Next

There is a FANS Stakeholders Group which exists today, but for the purposes of this paper; FANS stakeholders refers to all of those entities which have a stake in the implementation of FANS. It is important to recognize the each stakeholder does not have equivalent roles, motivations, and benefits. It is important to recognize the differences between the stakeholders in order to understand how the FANS concept can be more efficiently implemented. The stakeholders are: airlines, states, airframe manufacturers, airframe equipment suppliers, ATC service providers, network service providers, and ATM equipment suppliers.

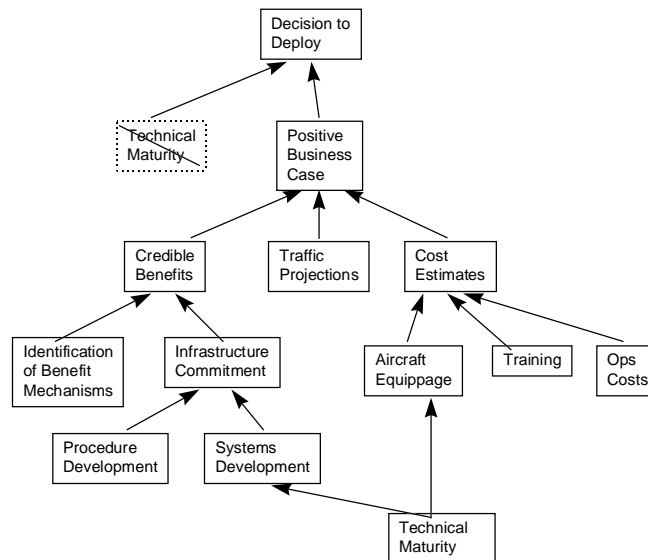


However, the stakeholders with the major influence are the states and the airlines. Figure 1 above gives a sense of stakeholder relationships. The airlines and the states are at the “top of the food chain” but the airlines are at the very top because, in the last analysis, the state is providing an ATC and airport service to the airlines (for which the state gets paid). The rest of

the stakeholders provide equipment or services to the two *main* stakeholders. While the *supporting* stakeholders might pace the implementation of FANS through performance or non-performance, the investment decisions are made by the airlines and states. So, if the airlines are the prime drivers in the implementation of the FANS concept and their participation in industry development indicates interest, why isn't more progress made? What is lacking? In most cases, the missing element is an adequate business case to support procurement decisions.

### Airline Business Case

It is important to understand the factors which influence an airline's decision to deploy technology. The following Dependency Diagram illustrates some of those factors.



The purpose of this diagram is to illustrate some of the factors which are used in the investment decision to deploy. The industry, as illustrated by the content of industry meetings, seems to assume that the major factor or dependency is “technical maturity”. This is not the case. Technical maturity is a factor, but only as it relates to the positive business case.

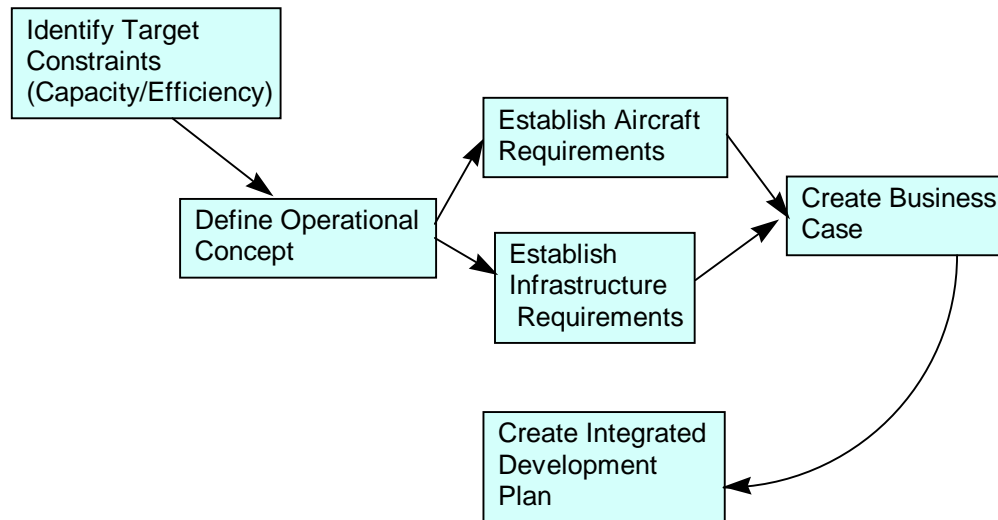
Again, much of industry tends to focus on the development and state of Technical Maturity. Most industry groups exist to enhance technical maturity through the development of requirements and operational concepts. While you can see from this diagram that if technical maturity does influence the decision, it does so indirectly. The primary influences are financial in nature and in the last analysis, Financial Maturity (through a **solid** Business Case) is the prime determinant.

There is emphasis on the credibility of the business case. As illustrated by the chart, the benefit mechanisms are influenced by many factors. These factors introduce **uncertainty** into the analysis. A solid business case must provide an analysis which measures the influence of each factor to provide guidance as to which uncertainties can be minimized. Clearly, if the major influence to a business case has the greatest uncertainty and that uncertainty cannot be controlled; it leads to a weak business case. Unfortunately, this is the position in which many CNS/ATM enhancements find themselves. For example, the benefit mechanism of reduced

longitudinal separation using CNS/ATM enhancements requires the implementation of changes on the aircraft and in the ground infrastructure. While the aircraft equipage and equipage rate is under the control of the airline, the development of the ground infrastructure and procedures is clearly not under their control.

### Disciplined Process for Business Analysis

As development engineers, we are proud of the disciplined engineering process which is used to develop technical upgrades. We must also have a disciplined process for the development of Business Cases.



This business analysis process has to occur with all of the stakeholders. It also needs to be adapted to a distinct airspace with specific traffic flows. While the Operational Concept needs to be consistent with growth to the full ICAO plan in order to support interoperability; the concept needs to be applied to distinct airspace regions. The constraints of a region's operation dictate the infrastructure upgrade commitments necessary to provide a deterministic benefit for financial analyst review. Once the Operational concept is developed, the requirements for airplane upgrades and infrastructure upgrades can be developed (and commitments made). This becomes the basis for the business case. Once the business case is complete and accepted by the appropriate financial decision makers, an integrated development plan can be established which supports the operational concept and the business case.

The preceding paragraph may seem a little simplistic, however, we often get these tasks out of sequence. Package B established the airplane requirements and was supported by only vague requirements for the infrastructure. There was no operational concept, no airspace/infrastructure commitments at the traffic management level (needed to support a business case), and finally no business case. The FANS 1 development didn't get all of these done in the right order, but for the most part it went in that sequence.

## Industry Pressure

As stated earlier, there are intense pressures on the airlines and governments to provide improvements to the Air Traffic Management System. There are several sources for this pressure:

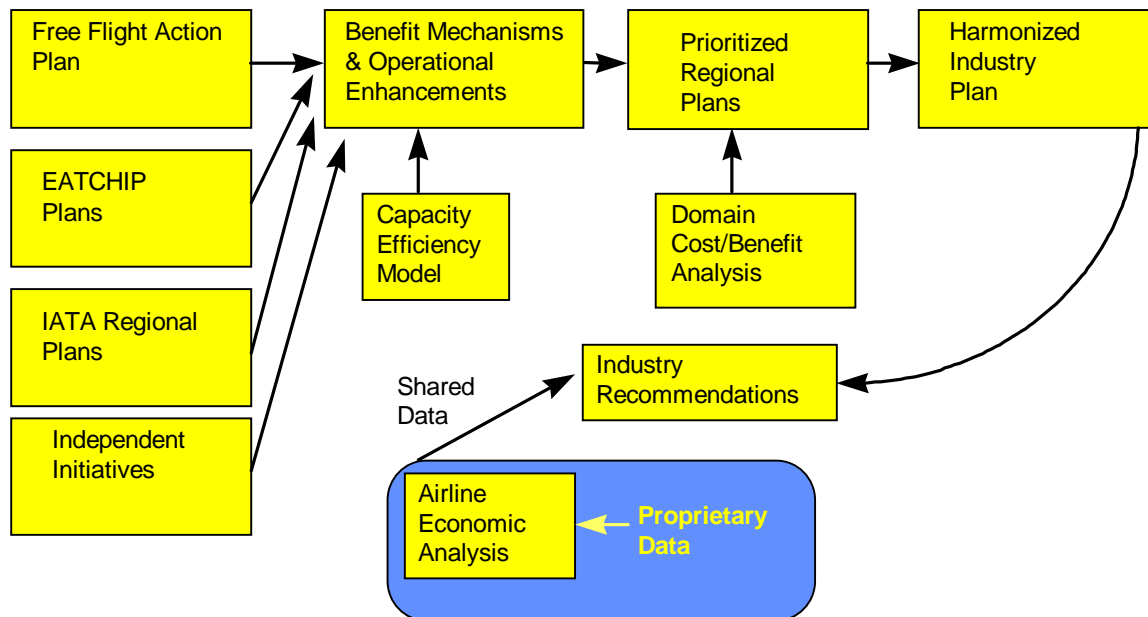
- The ATM system is becoming antiquated
- Airline need for increased efficiency and capacity
- Multiple parties advocating particular solutions.

While in some respects this pressure is good, the divergence of potential solutions complicates the decision making process. Clearly, the airlines/states cannot afford to implement everything. These potential solutions often compete for the same potential savings and drive different investments. As stated earlier, successful implementation requires simultaneous implementation by multiple states and airlines. It all ends up presenting a pretty confusing picture to the airline procurement people.

## CNS/ATM Focused Team

The CNS/ATM Focused Team (C/AFT) was formed to deal with these issues. It is currently comprised of airframe manufacturers (Airbus, Boeing, and Douglas), and airlines (American Airlines, British Airlines, QANTAS, and United Airlines). This is not a new industry group which exists to develop a new technological widget. The mission of this group is to develop a methodology to identify constraints to capacity and efficiency and identify those operational improvements which can remove the constraints. This is a very difficult task as the analysis must be done system wide as the removal of one constraint may only move the inefficiency to the next constraint. This analysis must also be done in terms of traffic flow areas; as the conditions in different parts of the world create different constraints. A good example of this is the approach area constraints. In the United States, in good weather conditions (VMC), a close spacing is used. This is not done in Europe. This gives the U.S. airports more capacity, but makes them vulnerable to marginal weather conditions.

The C/AFT is avoiding creation of new operational concepts as well. They are using existing industry plans as their inputs. The following diagram illustrates the analysis methodology.

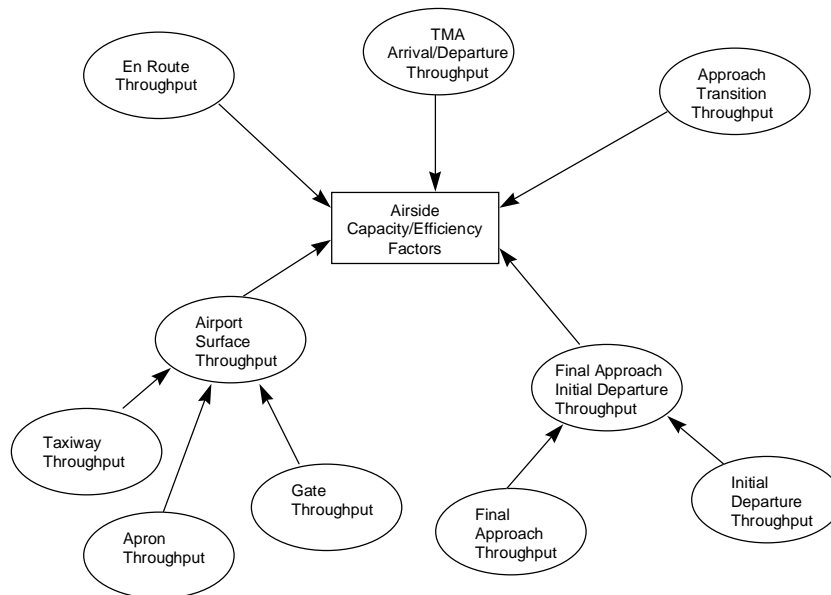


The group is using the Free Flight Action Plan, European ATC Harmonization and Integration Programme (EATCHIP), IATA Regional Plans, and additional independent initiatives. Initially most work was done with the Free Flight Action Plan, but the EATCHIP plans are now being added. The recommendations in each of these plans will be mapped to specific operational enhancements. We are finding that some recommendations support multiple operational enhancements and that each operational enhancement requires one or more plan. Next, the benefit mechanisms are derived from the operational enhancements. (Note: in a perfect world, we would identify the benefit mechanisms and then derive which operational enhancements would be necessary to enable that mechanism.) An example of a benefit mechanism would be Enroute Reduced Path Length. Examples of operational enhancements which support that benefit mechanism would be: FMS/RNAV, Opening of Special Use Airspace, surveillance enhancements, and controller tools.

Benefit mechanisms involve capacity and/or efficiency enhancements by phase of operation. The phases of operation used are:

- Airport surface region
- Final approach/Initial departure region
- Approach/Departure transition region
- Procedurally defined climb/descent (SIDS/STARS) region
- En-route region.

The throughput in all of these regions determine the capacity and efficiency of the total air traffic management system.



This analysis is being accomplished through the development of a capacity/efficiency model. This process (still under development):

- Establishes groups of initiatives (or recommendations)
- Collects capacity and efficiency benefit data for each grouping
- Evaluates relationships between the groups by establishing transition steps (or states) combining initiatives into operational enhancement steps.
- Creates capacity and efficiency phasing diagrams and impact-changeability diagrams.

These initiative groups are then built into regionalized plans which include transition steps for that region. A domain cost/benefit analysis is performed on those plans in order to prioritize the initiatives based on cost/benefit analysis. These prioritized regional plans will then be merged (as much as possible) into a harmonized industry plan. This plan will identify those elements which are common across regions. It will also identify those areas which may functionally overlap, but occur in a different sequence between regions. This plan will be used by airlines and airframe manufacturers to decide which enhancements can be considered. Airspace managers should use this plan to maximize the functional and timing commonalities between regions in order to facilitate cost effective introduction of ATM enhancements. This will not be an easy task; however it is vital if the airlines are to have an adequate business case for ATM enhancement introduction.

Industry recommendations for synchronized introductions of improvements will be based on the Harmonized Industry Plan along with the Airline Economic Analysis. This Economic Analysis will use a disciplined methodology which accounts for uncertainties. The methodology will be provided by the Focused Team. The methodology allows the airlines to insert their own proprietary data without sharing the results. Some data (or data ranges) might be made available to the C/AFT group for demonstration purposes. The economic analysis will use the Prioritized Regional Plans as their baseline.

The final result of this model will be a "straw horse" set of industry recommendations. The industry recommendations will probably be regionalized with phased introductions. Each phased introduction will be accompanied by a business case which supports its implementation along with the necessary ground infrastructure investment upgrade requirements. The business cases will account for uncertainties and will be targeted to senior financial officers.

This process will be validated through review with industry. It is anticipated that the initial reviews (of prioritized regional plans) will be held 1Q97.

### **Summary**

The main obstacle to further CNS/ATM enhancements is the lack of business cases which are acceptable to senior financial officers. Recognition of this deficiency led to the formation of the CNS/ATM Focused Team. This team is tasked with the development of a methodology to support business case development rather than technology.

We in industry tend to think of technical factors as being the prime determinant between competing initiatives for enhancements. In reality, the marketplace determines the "winners" based on economic factors. As CNS/ATM evolves, there will be new opportunities for airlines to compete for traffic. Those who best understand how to turn technical capability into competitive schedule advantage will thrive. The air traffic industry must recognize this environment. Economic factors may doom several "pet technological solutions". Rather than continuing to exercise those solutions, we must learn to either improve the business case or drop it and move on.