ELEVENTH AIR NAVIGATION CONFERENCE

Montreal, 22 September to 3 October 2003

Agenda Item 4: Capacity-enhancement measures
4.1 Global measures
:

COLLABORATIVE DECISION-MAKING (CDM)

(Presented by Sweden)

SUMMARY

This paper addresses some of the actual problems concerning air traffic control/airport/airline operations and highlights examples where cooperation is beneficial to all involved. This cooperation is also referred to as collaborative decision-making (CDM). Furthermore, the papers indicate potential regional steps that are likely to add benefits for all involved.

Proposed action by the Conference is in paragraph 7.

1. INTRODUCTION

1.1 Over the past ten years, the Swedish communications, navigation, surveillance/air traffic management (CNS/ATM) strategy has undergone significant revisions. Based on ICAO guidelines, an operational concept has been developed by the Swedish Civil Aviation Administration (SCAA) in cooperation with various airspace users, airport operators and other organizations with an interest in the air transport sector. The joint vision has been placed in an operational concept document (OCD). The foundation for the concept is the development of advanced technology with a human centred approach based on user requirements. In the OCD it is clearly concluded that major changes in the way we operate today will be necessary if we are to maintain or enhance the present level of safety while increasing the ATM system capacity.

1.2 It may be obvious that collaboration should be the default when dealing with time critical operations such as air traffic control (ATC), airline operations and related activities. However, in the aviation industry, business competition limits the sharing of data and services, not allowing for flexibility and on time

delivery of services and hence optimisation of the usage of the resources. The only aspect that could be the driver for a common change process is the successful identification of mutual benefits and the subsequent follow-up and confirmation of benefits by adopting a systemic approach to air transport activities.

2. AIR TRAFFIC MANAGEMENT OPERATIONAL CONCEPT PANEL (ATMCP) SETTING THE SCENE

2.1 The future ATM system will depend on a number of partners, all of them with the same goal to produce and assure a safe and efficient ATM system for the benefit of fulfilling both the partners' and the ultimate customers' expectations of the system. To achieve such a goal it is necessary to move towards a system that is focused on strategic or pre-tactical interventions rather than tactical interventions.

2.2 To create a system that operates at a strategic level rather than a tactical level, one consequence is a system that is predictable enough to ensure that measures can be put in place in time for the benefit to be created; a system that is stable and fail-safe regardless of circumstances. How is it possible to create such a system? The sharing of information plays a key role in tomorrow's ATM system in order for all partners to perform according to expectations. The system's ability to dynamically change and to put contingency measures in place depends heavily on the availability of timely and correct information. Some of the aspects on the system can be expressed as follows:

a) **Air traffic management.** The dynamic, integrated management of air traffic and airspace, safely, economically, and efficiently, through the provision of facilities and seamless services in collaboration with all parties.

b) **Technology.** Advanced information management technologies are used to functionally combine the ground-based and airborne system elements into a fully integrated, interoperable and robust ATM system. This allows for flexibility across regions, homogeneous areas or major traffic flows to meet the requirements of the concept.

c) **Information.** The ATM community will depend extensively on the provision of timely, relevant, accurate, credible and quality-assured information to collaborate and to make informed decisions. When shared on a system-wide basis, the information will allow the ATM community to conduct its business and operations in a safe and efficient manner.

d) **Collaboration.** The ATM system is characterized by strategic and tactical collaboration in which the appropriate members of the ATM community participate in the definition of the types and levels of service. Equally important, the ATM community collaborates to maximize system efficiency by sharing information leading to dynamic and flexible decision-making.

2.3 The ultimate goal for an efficient and collaborative ATM system is that accurate information is shared in an open way and that technologies serve all users in a cost-effective way. However, a general problem with the air transport system is the unpredictable demand on the system in combination with rough data. Together, this results in an over-allocation of resources to handle the operations and the creation on non-wanted buffers to cover for the uncertainties in the system. There are two obstacles to the open sharing

of information, firstly, competitors do not normally cooperate with each other and neither do customers and service providers; and secondly, in several of the analyses carried out within the EUROCONTROL Airport Operations Programme it was found that nearly all the information needed to make a collaborative decision in order to improve the operations were available, but not distributed to the actors.

2.4 It is clear that the result of sharing consistent information between all actors in the air transport industry leads to a win-win situation for airlines, airports and ATM. Also, there are environmental benefits in the form of less fuel burn on the ground as well as in the air.

3. COLLABORATIVE DECISION-MAKING (CDM)

3.1 General

3.1.1 In a CDM process, all actors must be provided with the most accurate common set of data available. By providing one set of data for all, the uncertainties are minimized and, consequently, today's buffers in the system can be decreased, resulting in additional capacity while at the same time optimizing resources for particular activities. These data should be the basis for the planning, decision-making and follow-up activities of all actors.

3.2 Nordic CDM

3.2.1 In the Nordic region the operations at four major airports were studied from a CDM perspective. There is one dominant carrier operating at all the major airports in the region and consequently, the wish for harmonisation was strong from an airline point of view. The airport operators found that they all faced similar issues to tackle and cooperation was a fact. For the air navigation service (ANS) providers the benefits to collaborate are more obvious for the handling of en-route traffic than for harmonising the approach and airport procedures.

3.2.2 CDM with the objective to improve operations between city pairs is a very good example. By sharing information the operations become more predictive and the proper actions could be taken in due time by all actors. Airport authorities could allocate gates and by that enhance the activities associated with the turn-around process.

3.2.3 The Nordic CDM initiative involves all the entities required to ensure a successful evaluation and implementation of an ATM process optimizing a controlled air traffic *flow* in the sense of priority. The shift from pure *first come — first served* to a prioritized service with *on time — first served* has the potential to drastically improve the efficiency of airlines' hub and spoke operations. The scene of the Nordic countries offers possibilities to act as an evaluation and test area in terms of large-scale research trials, integration of technological platforms and procedures development. The players are accomplished; the ANS providers and the major airline operating in the area have participated in several ATM research and development projects. Furthermore, technical developments have led to the flexible infrastructure, which is in place; the Nordic service providers have homogeneous, highly capable ATM systems.

3.2.4 However, the most important prerequisite in place is the willingness to change. The Nordic CDM project aims at bringing all entities together by using dormant capabilities in the current system. The objective is also to introduce airborne generated data to the processes of the airport operators, airline

operators and ATC/ATM as well as in the individual and overall CDM process. This will generate increased predictability, controllability and robustness of the en-route to en-route traffic flow in the Nordic environment.

3.2.5 The disseminating of information on position and trajectory from the aircraft to the ANS providers, airports as well as the main operator will impact the entire handling process of flights, in terms of controllability and predictability. The Nordic CDM initiative will, among other things, introduce the ability to sequence aircraft arrivals based on operator preferences (crew and aircraft rotation, connecting flights for passengers, etc.) through collaborative decision-making processes.

3.2.6 The main objectives with introducing a CDM process based on the distribution of aircraft derived data with high accuracy and integrity are:

a) increased flexibility to sequence aircraft in a collaborative fashion, i.e. slot swapping;

b) enable on time — first served operations;

c) improved efficiency and follow up of the turn around process;

d) improved use of optimal flight profile (4D) in Nordic airspace; and

e) real time awareness of airline fleet at any site connected to the network.

3.3 Required time of arrival (RTA)

3.3.1 To demonstrate the required time of arrival (RTA) concept, Required Time of Arrival Evaluations for Time-based ATM Environment, 2001, was carried out with participation of the ANS provider, the regulator, avionics industry and the Scandinavian Airlines System (SAS). In 33 flight trials with Boeing 737s, the ability was demonstrated to guide the aircraft in a four dimensional trajectory to the initial approach fix within +/- 4 seconds, and to landing on the runway within +/- 7 seconds from the time predicted on departure. The *on time – first served* paradigm was then tested as flights applied continuous decent approach procedures using the best 4D information available. ATC will also be aware of the information needed and work according to *on time – first served* and consequently, the likelihood for operations in accordance with the timetable increases. It should be noted that such a timetable would be dramatically revised as compared to the existing, i.e. the block times would be more realistic reflecting the actual flying time.

4. ENABLERS

4.1 The last ten years of CNS development and standardisation has to a large extent made the fundamentals of CDM possible if correctly implemented. The availability of the global navigation satellite system (GNSS) provides accurate positioning but more importantly for CDM, a possibility to get a common time reference for all users and stakeholders. The key to CDM benefits lays in the use of time derived from GNSS Co-ordinated Universal Time (UTC). Also, users must exchange information based on data coming from the source, i.e. aircraft derived information shall be used when available and extrapolation and interpretation of data shall be kept to a minimum. To support the criticality and time requirements, information

shall be distributed directly between users. This leads to the need for concepts like automatic dependent surveillance – broadcast (ADS-B). For more strategic information air-to-ground data links can be used.

4.2 From a ground perspective the need to assemble information from a specific region in something that could be called a CDM server is crucial. This information pool will require a certain degree of openness from stakeholders. Again, the common time reference will be UTC and the aircraft's position and intent related to information is the most sought after information from all stakeholders. Further, it is anticipated that not yet known synergies will arise as a function of the sharing of data.

5. INTERFACES

5.1 The emerging technology of ADS-B data link is seen by all parties to be the means for connecting the airborne system to the ground network. The Swedish CAA as well as the European Commission have stated their commitment towards use of aircraft derived data (ADD) communicated to the ground local area network (LAN) system via a wideLAN (WLAN) type of data link as the source for tactical information in the future ATM system. The Swedish CAA is currently realizing ADS-B through the set up of a VDL Mode 4 network. The data link will be used for ground vehicles as well as aircraft.

5.2 However, technology alone will be of very limited assistance in improving efficiency and capacity. It is the willingness to change from air traffic control to air traffic management, from unilateral to collaborative decision-making that is crucial. The transition to use ADD instead of ground predicted data in the Nordic airspace is seen to be the catalyst for this change. These data will first be used to feed different CDM processes at airline, ATC and airport operators. The inclusion and use of the true trajectory in the ATC tools will enable cost efficient service to be delivered to the airspace user. Further, the implementation of ADD will add stability to the concept of mega-sectors, and enable multi-sector planning, i.e. larger sectors that capitalize on the increased predictability and accuracy.

6. CONCLUSION

6.1 It is obvious that a step-by-step and collaborative approach is required for these kinds of activities. The indications are that significant benefits can be reached at modest investments in many cases. That is, early benefits and return of investments are likely to occur as a consequence of investments in CDM. These early benefits are sought after by all actors, not only for economic reasons but to get the guidance for taking the next step, which will set demands for additional commitment and resources. Accordingly, the benefits are likely to be of the same magnitude, thereby creating a sustainable business for the actors in the future. The participants of the Conference are encouraged to initiate a CDM thinking in their air transport system and assess the relevance of the following steps in relation to the prerequisites available:

a) seek collaborators and identify mutual interest and incentives/improvements areas;

b) look for experiences, learn from other CDM activities;

c) do the CDM analysis;

d) implement improvements, think regionally when making local improvements;

e) follow up on the operations; and

f) report back to the air transport community.

7. ACTION BY THE CONFERENCE

7.1 The Conference is invited to:

a) note the information provided in this paper; and

b) recommend that ICAO take steps to amend the Technical Work Programme of the Organization in the Field of Air Navigation in order to more comprehensively address collaborative decision-making.

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