# Data Flow Analysis and Optimisation Potential from Gate-to-Gate

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## Abstract

**In the framework of the Joint Air Navigation Experiments (JANE) programme, a business process model of the current Air Traffic Management (ATM) processes was developed.**

A common understanding and process view among all involved organisations (Air Traffic Control, Airline, Airport) was achieved. The business process model considers the activities as being carried out by different departments of one "virtual company".

Areas are identified with potential for short term and long term improvements from a process oriented view in their global context: examples are the actual slot usage, "Start-up Given" and "Push-back Request" in the short term, Arrival and Departure Management in the long term view.

It is a general feature of the processes analysed that they lack communication, cooperation and coordination. They are regulated and interrelated solely by usage of central resources. All required information to optimise planning and to allow a better predictability of events is already available. Main problem is the current distribution of this information among the various partners and their different information systems.

The theoretical part of this study analyses reasons for a need in the change of the traditional process understanding by applying the principles of Collaborative Decision Making and a coupling between the planning and control phases (Replanning). A key to this guiding principles is the active control of the (limited) resources with a look ahead in time.

The simulation capability of this process model was used to adjust the model to the real world by use of statistical data from systems of the Airport, Air Traffic Control and the Airlines. It was proven that process simulations can further be used to:

- detect delays and capacity bottlenecks due to resource constraints
- detect dependencies between resource capacities and control procedures
- detect the upper capacity limit of the analysed ATM environment
- carry out What-If exercises to support fast time and real time simulations.

# 1 Overview

The main objective of the ”Joint Air Navigation Experiments” (JANE) is the evaluation and demonstration of a future ATM system and required components to provide support for decisions on new ground systems and avionics. Guidelines are the ideas established in the framework of the development of the European Air Traffic Management System (EATMS), the Gate-to-Gate concept, Collaborative Decision Making and Free Flight.

The program was initiated in 1997 in a joint effort by Deutsche Lufthansa AG (DLH) and Deutsche Flugsicherung GmbH (DFS).

Motive for JANE is the assessment of the potential for capacity improvement and benefit aspects by defining and carrying out studies, simulations and field trials with all involved parties, i.e. ATC, airspace users and airports.

The process modelling and simulation contributes in particular to the objectives of JANE by

- assessment of new concepts:
  from a business point of view all relevant ATM processes are analysed and optimisation potential could be assessed independent of the organisations and current roles of the partners; the business case is the airline request for passenger and/or cargo transportation
- proposal of scenarios for implementation:
  as a result of this business modelling and simulation the need and benefit for a new ”Local Decision Support System” (LDSS) has been clearly identified and the data interfaces and underlying methodology (implemented in the algorithms and decision rules) were deduced

## 1.1 Definitions

### *1.1.1 Business Process*

A *business process* is an activity which is relevant for achieving the business goals. Here, the business goal is the air-transport of passengers, cargo, or mail.

The *process*[1] is initiated by an event. The completion of the process itself is an event which triggers one or more succeeding processes thus forming a continuous sequence of process steps. A process usually requires time and resources to be performed.

[1] In an hierarchical view, a process can consist of a group of other processes which can be described in subsequent refinement steps.

### *1.1.2 Types of Processes*

- *(Organisational) Procedure*: Sequence of atomic operations performed by one operative person
- *Workflow:* Network of procedures at the group level thus involving the work of one or more operative persons
- *Business process*: Network of workflows and procedures at the level of a single organisational unit

The notation business process is also used in order to refer to an enterprise-wide or an enterprise-overlapping network of business processes, which involves one or more organisational units working together on a common task.

### *1.1.3 Functional, Information and Organisation View*

The method of business process modelling allows the creation of an organisational model which integrates three views of model descriptions:

- Function-view– describes the sequence of activities which are necessary to process a job
- Information-view – describes the information interchange among activities and between activities and information stores
- Organisation-view – shows the responsible organisational unit

The process model reflects the dynamic behaviour of the organisational system. This provides an easy-to-understand overview of interactions within complex organisational systems.

# 2 The ATM Process Model

The scope of this model with its main process groups is explained. The focus has been shifted from the Gate-to-Gate view to a new process oriented view. While preserving the central idea of the Gate-to-Gate approach this eases to identify possible bottlenecks of the whole ATM system.

## 2.1 Scope of the Model

### *2.1.1 Overview*

The model describes presently existing processes of Air Traffic Management in the approach and departure sector, ground control and handling

procedures at the airport and other air transport activities between approach and departure phase of a flight. Organisations involved are Airlines, Airports and Air Traffic Control.
The processes are related to a single flight. Multiple instances of this abstract flight interact through usage of resources. The full scenario is triggered by external events representing the entrance and exit of flights.
The model covers normal operational procedure. Parameters allow to represent a wide range of normal operating conditions; these can be covered in simulations. Process performance can be investigated by various measures. However, it does not include specific descriptions for deviations from procedures under exceptional conditions.
Simulation in the sense of this model can be efficiently applied to validate consistency, to quantify resource usage, to identify bottlenecks and to analyse measures of the overall process performance under different scenarios. Therefore, it could be a useful instrument in a preparatory analysis phase for fast-time or real-time simulations.
Simulation as used here represents a typical flight event. It may not be employed to analyse effects depending on details of the properties of a particular flight or the correlation between consecutive flights. It is especially unsuited to predict the singular features of a specific series of events on a particular day of operations.
The model is generic and can in principle be applied to other airports. The actual situation of a specific airport has to be provided for simulations. Different scenarios can easily be incorporated on the specific process levels. These scenarios can be described by varying parameters inside the existing specific model or by modifying the process organisation.

### *2.1.2 The ATM Context Level*

The context level is the abstract description of the entire ATM processes. It consists of three main process groups:

*1. Dispatch and Consolidate Flightplan*
This service process is a necessary pre-condition for each single flight. It contains:

- dispatch of an operational Flightplan by the airline or the handling agent
- check and distribution of the Flightplan by ATC
- Air Traffic Flow Management measures

*2. Handle, Support and Operate Flight*
This is the core process group of the ATM processes. It contains

- the ground handling part
- the ground movement part
- the airborne part

*3. Optimise Usage of Air Traffic System*
This support process comprises measures for global optimising procedures in order to achieve a collaborative decision making.

The Flight Related Information Store is introduced in this level. It is an abstraction of all information systems which are used to store all information during the realisation of the processes. On the more detailed levels this abstract store is replaced by specific information systems.
The external entry-points

- "Scheduled (Planned) Flights Departure",
- "Actual Arrivals"[2] and
- "Time-Event"[3]

are used to create the number of events with respect to the simulation.
The external exit-point "En-Route" describes the end of the ATM process with respect to the focus chosen for this project. It can be used as an interface to other process models describing the En-Route phase in detail.

## 2.2 Gate-to-Gate View and Process View

Tasks were identified together with experts, based on the JANE reference scenario [JANE9709], [JANE9711]. They have been selected and grouped according to objectives and methodology of the project.
Accordingly, the tasks highlighted in grey in figure 1 were selected to fall within the scope of the ATM process model.
Reasons for this choice were:

- focus on operational procedures (the pre-operational planning phases generate state

[2] Arrivals of flights into the process model from the en-route phase.
[3] A time trigger initiates a process which is not started by an event generated by precursor process steps.

parameters for the external inputs inside the ATM model)

- aim at preparation for collaborative decision making process during the phases where *all* partners are involved
- avoid complexity beyond the objectives of the JANE process modelling

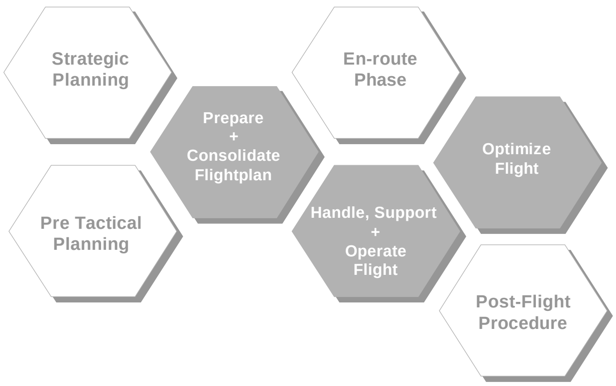


*Figure 1: Task areas within the JANE reference scenario [JANE9711].*

### *2.2.1 The Process oriented View*

The objectives of the project necessitate a deviation from the conventional view on the flight process from Gate-to-Gate. The following reasons demand a view of the flight process from En-route to Airport to En-route (refer also to figure 2):

- All participants are involved during the arrival, ground handling and departure phase.
- The creation of a process model with the focus on the en-route phase requires an investigation of at least two airports. This would require a higher effort without increasing general information content.
- The goal of the process modelling project is the creation of a generic model. Therefore it is not necessary to distinguish between different airport infrastructures and airport-specific variables.
- The interaction of departing and arriving flights at the airport is an important criterion for identification of potentials.
- En-Route and ATFM processes are dealt with but not modelled per se.

Although the En-Route phase has not been modelled per se the process interfaces are available. A detailed En-Route investigation is more suited to fast time and/or real time simulations which, on the other hand, provide limited capabilities in terms of airport and ground process activities including ATFM.

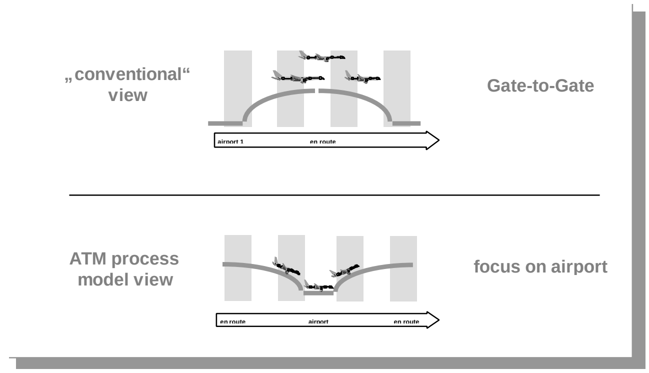


*Figure 2: Different views on the ATM process.*

# 3 ATM Process Model Simulations

An overview is provided of the simulation capabilities and the benefits and limitations of a process simulation.

## 3.1 The Simulation Concept

Process Simulation is a part of process optimisation. Simulation is the transition from the single process analysis to the multiple event analysis. The realisation of a process is called a process instance. In the ATM process model each process instance reflects a single flight event. Every process instance is created at an external input ("Scheduled (Planned) Flights Departure" and "Actual Arrivals" in ATM process model). A flight event created at an entry-point runs through the whole process and its refinements. The duration between entry-point and exit-point is the sum of total handling times, total waiting times, total transport times and total set-up times. Waiting times occur when physical resources, human resources or information required are unavailable. An analysis based on a simulation run can reveal:

- resource interdependencies (resources can not be used independently) and relations among the partners ATC, Airports and Airlines

- deficiencies caused by process synchronisation (required information was not provided on time by activities performed simultaneously)
- delays caused by high transport times of information
- bottlenecks caused by limited resources (several activities use one resource)

Note that the process instances interact exclusively via resources, a fact that is central to the understanding of multiple event analysis.

### 3.2 Dynamic Process Analysis

The dynamic process analysis consists of three major steps:

- In a first step several simulation runs were performed for calibration of the process model by varying process parameters, such as distribution of processing times. Simulation data were compared to real-world data to find the optimal adjustment.
- In the second step the calibrated model was analysed with respect to:
  - detecting capacity bottlenecks of resources (e.g. load of the runways during one day of operation)
  - detecting dependencies between resource capacities and control procedures (e.g. different procedures for the coordination of arrivals depending on runway capacity)
  - detecting delays due to resource unavailability (e.g. physical resources such as the taxi-way or human resources such as handling personnel)
  - detecting the upper capacity limit of the analysed ATM environment (e.g. maximum number of arrivals and departures)
- After the identification of weaknesses, What-If-analyses were used to create alternatives in order to find an improved solution. Examples for What-If-analysis are:
  - variation of certain process scenarios (within the scope of this study this was used for testing the model's consistency)
  - variation of input data (section 3.3)
  - variation of process parameters (e.g. aircraft separation or runway capacity)

### 3.3 Example: Variation of Input Data

This is an example of a What-If-analysis by variation of input data. The aim is to analyse the dependency between distribution of arrivals and occurrence of waiting times caused by sequencing and required separation standards.

Figure 3 shows the frequency distribution of actual arrivals per hour based on real world data from the DFS Statistical Analysis System STANLY at Frankfurt airport (EDDF). The diagram reveals that the maximum number of flights per hour does not exceed 42. Four peaks can be identified.

Figure 4 shows the distribution of process waiting times ("delays") based on the distribution of arrivals shown in figure 3. The diagram reveals that for 348 of the 538 flights no waiting times exists (refer to first column) and for the most part the remaining flights waiting times do not exceed 60 seconds. This

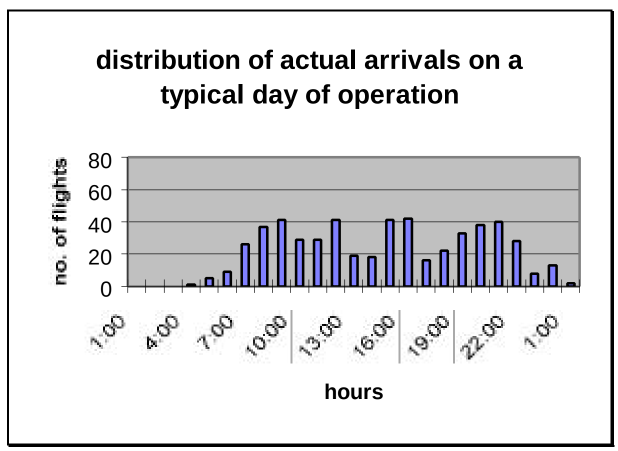


*Figure 3: Distribution of actual arrivals on a typical day of operation (538 arrivals in total). Each column represents the number of arrivals within an interval of one hour.*

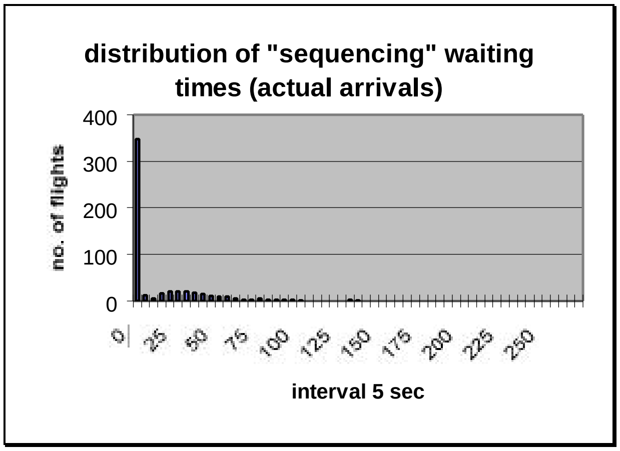


*Figure 4:* *Distribution of process waiting times caused by sequencing of aircraft. Each column represents the number of flights within an interval of 5 seconds (first column: no waiting times).*

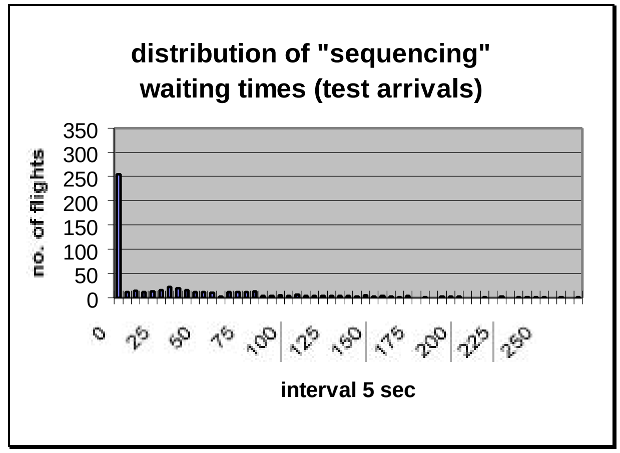


*Figure 6:* *Distribution of process waiting times caused by sequencing of aircraft in the test scenario. Each column represents the number of flights within an interval of 5 sec. (first column: no waiting times).*

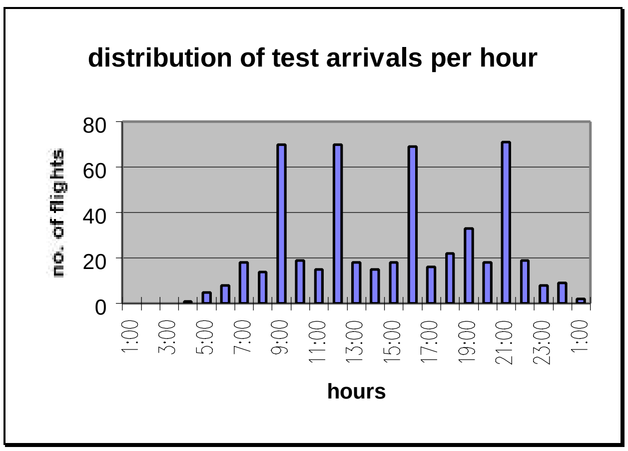


*Figure 5:* *Modified distribution of arrivals per hour (538 arrivals in total). Each column represents the number of arrivals within an interval of one hour.*

indicates that the traffic situation on this particular day was very stable.

Figure 5 shows a test scenario in which the number of flights within the four peaks were artificially increased to approximately 70 flights per hour while the sum over the entire day is kept unchanged to demonstrate the possible effects of ”bulk” arrivals.

The new distribution of process waiting times (shown in figure 6) was calculated with the simulation results using the distribution of the test scenario as input. The number of aircraft delayed is greater than in figure 4. The diagram reveals that for 255 from 538 flights no waiting times exists (refer to first column) and for most of the remaining flights waiting times do not exceed 80 seconds.

A comparison of figure 4 and figure 6 shows that the artificial redistribution of flights with a significant increase of flights within the peaks led to an increase in process waiting times.

This variation of input data shows that bulk arrivals does not cause a serious problem for the sequencing processes. However, possible disturbing effects for airport and/or airline operation could be revealed by extending this exercise to other processes (e.g. effects on taxiway utilisation or gate allocation).

# 4 Identification of Potentials

Operational areas with potential for short term and long term improvements are identified from an process oriented view by taking into account the interdependencies to other processes from other partners. They depend in their concrete form on the specific situation at Frankfurt airport which is regarded as rather typical.
They serve as examples for how the process modelling led to identification of areas for improvement. They constitute candidates for further investigations into specification of process modifications which could furnish business benefits for the overall ATM process at the airport.

## 4.1 Processes with short Term Improvement Potential

### *4.1.1 Start-up Given and Push-back Requested*

The sequence of process steps around "Start-up Given" shows that the main purpose here is a coordination between flight crew and tower and a consolidation of flight related information in order to adjust eventual remaining discrepancies. This could well be automated.
The issuing of start-up and push-back clearances by the apron controller depends on the traffic situation around the aircraft position. A "first come - first serve" principle prevails. The ordering of push-back clearances issued does not reflect the most effective sequencing appropriate for aircraft to arrive for take-off at the runway. Furthermore, the apron controller lacks information on short-term slot alterations or about priority situations within the queue of flights ready for departure.
For the timely availability of push-back vehicles at the gate it would be beneficial to have an advance indication about 10 min ahead of the push-back request. This is an example for usefulness of proactive control.
Again, as long as no agreements have been reached how to guarantee fairness among airlines, at least within those geographic areas on the airport used primarily by one airline and among the flights of one airline, the concerned airline should be contributing to an optimised sequencing by providing a list of priority rights.
*Necessary information to arrive at an optimised sequencing is available in principle. It needs to be delivered to decision makers together with optimisation criteria provided by collaborating participants*.

### *4.1.2 Actual Slot Usage*

The actual usage of CFMU slots as opposed to planned slot usage leaves slots unutilised due to extensive pre-planning times and the lack of replanning.
This occurs when delayed aircraft cannot use their planned slots. No regulated process of requeuing these unused slots exists here. A kind of "short term trading" would remedy this situation. Also, prioritisation according to importance of afflicted flights, in particular their impact on hub-connectivity, should be included. While, from the ATC point of view, a equal treatment of all airlines has to be guaranteed, this prioritisation could, without taking further measures, at least be performed amongst flights of one airline with involvement of this airlines operations control centre.

## 4.2 Processes with long Term Improvement Potential

### *4.2.2 Actual Position and Gate Allocation*

At the planning level, the allocation of positions and gates is coordinated.
However, when deviations occur in actual operations, there is only ad-hoc distribution of available resources. The information necessary for prioritisation is not available for decision making at this time.
By providing this information and by implementing coordination, improvement could be achieved here. Optimisation goal for gate allocation is close positioning of flights with high flow of transfer passengers.

### *4.2.3 Arrival and Departure Management*

The present ground handling processes are orientated towards maintaining departure punctuality.
However, this is not a primary business goal from the point of view of customer services an airline provides. What is called for is on-time arrival for the passenger reaching the final destination and maintaining connectivity for the connecting passenger.
Therefore, an integrated and coordinated arrival and departure management which guarantees arrival

punctuality taking into account flow management, departure and arrival control, ground movement and ground handling aspects while being flexible with respect to departure time could help to limit the impact of delays on other flights and to secure hub-connectivity.[4]

*Necessary information to arrive at an optimised arrival and departure management is available in principle; it needs to be delivered to decision makers together with optimisation criteria.*

## 4.3 Need for Change in Process Understanding

It is a general feature of the processes analysed that they lack communication, cooperation and coordination between process instances and among actors while being regulated and interrelated solely by the usage of central resources.

Insights gained on the basis of the process model underline the necessity of a fundamental change in the process understanding. Guiding principles are Collaborative Decision Making and a better coupling between the planning and control phases (Replanning).

### *4.3.1 Need for Process Improvements*

Process improvements are in particular required because of insufficient coordination.

The missing procedural interdependencies inside the control phase and *between control and planning phase* lead to local optimisation decisions which might have global ramifications of a disturbing nature. To overcome this global suboptimality, appropriate coordination and information exchange steps need to be implemented.

This situation is aggravated by the fact that different phases from different process instances overlap in time, i.e. planning phases for later flights are executed at the same time as control steps for earlier flights. Disturbances in the actual operations caused by deviations from the planned course of events influence the leeway for future planning steps due to tight resource constraints and complicated time sequencing patterns. The process execution and the information of these time interleaved planning and control phases stay separated whereas the target of the operational planning is changing due to impact from the actual course of events.

The information base for decision making in the planning phase is not updated by actual operational data. Short term planning often occurs in a situational unawareness from the actual operational status.

### *4.3.2 Limitations of Traditional Process Organisation*

Several instances of the process "flight" as understood here in the ATM process model are solely coupled via resources. They interact indirectly by making use of the same resource[5]. This is not a limitation of the methodology employed or the tools used but a feature of the real processes as they are designed and/or have evolved.

Deficiencies in actual process organisation occur mainly in coordinating activities where the coordinating agent is unaware of goals and optimisation criteria of other parties affected[6].

A particular aspect is the lack of well defined process termination triggers. It occurred as a problem to describe interdependencies between process steps involving several participants. The process can not be terminated before all subprocess threads involved are finished.

The situation emerged that the preceding process step lacks a clear termination signal and an indicator for when the termination signal is to be expected. The next process step with its waiting period may be on a time critical path of the overall process. This leads to intentional deviations from the designated course of events in order to speed up the overall process. This happens to ensure the timely entrance into succeeding

[4] Note that this insight is gained from the process model alone. It cannot be validated by simulation since it depends on processes at the departure and arrival airport. It would require to couple two instances of the process model to reveal this effect in simulations.

[5] The notion of resource is to be understood here in an abstract way in the wide sense - e.g. the tractor or the gate position is a resource as well as the tower controller communicating with the cockpit.

[6] As an example, consider process step "Sequencing" carried out by ATC controller in the approach phase which lacks prioritisation criteria according to urgency and importance while this aspect could be critical for hub-connectivity. Note that present ICAO regulations mandate a "first come - first serve" principle here. Current Priority regulations are due to emergency, SAR, etc. .

process steps but from a local perspective with limited information[7].

Required is a look-ahead in time based on an expected remaining duration of the prior process step. A well-specified process could be set up ensuring an optimum time efficiency for all pushback requests if

a) an improved interconnection of process steps would exist together with the required information exchange

b) the necessary look-ahead in time by early indicators could be made available.

### *4.3.3 Guiding Principles for Process Improvements*

Three principles are identified which will be useful to conceptualise the approach towards process redesign in the area of ATM.

1. Collaborative Decision Making

Collaborative Decision Making (CDM) is a paradigm for process organisation in a context where several organisational entities with different goals and decision horizons work together on a common task.

Traditionally, responsibility for each subtask and subgoal is delegated to one of the organisational units which decides according to its own priorities, based on its limited view on the process. The concept of CDM constitutes the principle of sharing (internal state) information relevant to the common process and coordinating decisions based on a balance of interests in a collaborative way, reconciling local restricted views and global common goals.

Each participant still has a limited information horizon while the joint decision must emerge from a consideration of all information relevant to the process. However, the possibility of readjustments and, for security reasons, override possibilities must be foreseen.

It should be decided case by case to what extent CDM will be implemented as a rule-driven process between autonomous actors or as coordinated by a central instance composed by all participants.

2. Replanning and Proactive Control

In air transport operations there is a continuous interleaving in time of planning and control activities. Operational planning is an ongoing activity with a typical time horizon of 2 hours[8]. The necessary information is available in due time as a planning information base. However, modifications of the planning assumptions due to deviations from plan during actual operations are not available.

No activities for readjusting planning assumptions and for performing a replanning could be identified. Actual status information about flight operations do not enter into the planning process for later flights despite the fact that they are available and used in other activities. If made available they would constitute valuable information to achieve a more realistic and up-to-date planning.

A crucial element to achieve the look-ahead in time (forecast of events) is the usage and availability of accurate and up-to-date estimated times for the occurrence of certain process states as input data for proactive control. While these exist in various information systems they are not formally collected for other processes.

The combination of both elements will allow to implement the principle of Replanning and Proactive Control (RPC).

3. Cooperating Intelligent Agents

The idea of active objects (Cooperating Intelligent Agents CIA) is applicable on several levels of the ATM and ground handling process. They should be equipped with the capability of targeted information transmission, ”autonomous intelligence” and local decision making capability for mutual coordination and partial planning.

As an example, the whole concept of Free Flight considers aircraft equipped with advanced flight management systems and data link as active objects, deciding autonomously on their preferred trajectories, actively engaging into communication with a ground control station and negotiating their assigned trajectories in a collaborative way.

As a process design paradigm CIA will be helpful to conceive the processes to be designed under the new procedural concept. As a software design paradigm CIA will constitute an element of interconnected

[7] Example of Pushback Request: Typically, the request is issued by the pilot even before all operational conditions are met because he knows from his experience that it takes a few minutes until the pushback car will arrive. With this ”Look Ahead” action he may gain valuable time for the next activities. However, this is not a systematical and predictable behaviour.

[8] To be specific, we refer in this case to airport operations. The exact time horizon may be different for other organisational units.

decision support systems to implement the type of business processes envisaged for CDM.

CIA could supplement and support the two other paradigm, CDM and RPC. It may be successfully applied in long-term reorganisation as well as in short-term adjustment.

# 5 Conclusions

The main achievements with the present model are summarised. The possibilities of usage of this ATM process model are outlined, and a look into the future shows a first concrete use by supporting the development of the Local Decision Support System.

## 5.1 Achievements with the Present Model

What has been achieved with the present model for Air Traffic Management and ground handling processes at the airport can be summarised as follows:

- The approach chosen, i.e. to analyse the *process* ”flight” centred at the airport, and the methodology employed, i.e. to base the analysis in a coherent way on a business process modelling methodology concentrating on processes independent of organisational structures, has been successfully:
    - proven to be applicable to modelling ATM and ground handling procedures; all required information to optimise the overall ATM is available in principle and has been identified, but problems are caused by the different systems, different interpretation of data, and different time horizons.
    - used to identify areas for process improvements with high business value, both for short-term improvements through process adjustments and for long-term optimisation through process reorganisation.
- With this tool it can be shown how singular (process) improvements of one partner impact the operations of the other partners, e.g. whether there is an overall benefit if ATC increases the arrival/departure capacity, or if other bottlenecks arise which had not been taken into consideration before.
- The process model with its simulation capabilities can further be used to support fast time and real time simulations by What-If-analyses to show inter-dependencies of the *whole* ATM environment including airport and airline operations.

*Business process modelling has been applied in a coherent, rigorous and comprehensive way to ATM processes. The consistent application of the business process modelling methodology and the unified view on the complete process is the key to identifying optimisation potentials in the overall process beyond organisational boundaries and a prerequisite for future work on process reorganisation.*

## 5.2 Future Use of the Model

The model interfaces with the outside world, i.e. with surrounding processes not described explicitly in the model, through well-defined entry- and exit-points. It can be extended by replacing these with connections to other newly described processes. Typical extensions could be:

- Include the en-route phase explicitly.
- Form a complete ATM scenario by connecting different airports.

However, both from a practical point of view - to keep complexity of the model at a manageable level - as well as from a conceptual point of view it is desirable to extend the model not simply by enlarging it but by consolidating it on subprocess level.

In order to arrive at detailed analyses of particular subprocesses or specific aspects, the level of detail present in the model need to be refined. This would apply in particular when more information on subprocesses is to be gained through simulation, e.g. to evaluate scenarios for process improvement in particular areas, or if information flows between various IT systems involved were of interest.

The following topics have been identified as most promising to approach next:

- What-If-analysis: investigate how the distribution of peaks in the arrival frequency affects runway usage. This will be a preparatory analysis for fast-time simulations.
- Feasibility study: extend the model to cope with different runway configurations, standard arrival and departure routes, integration of detailed ground handling activities.

### 5.3 Outlook: The Local Decision Support System

The abstract concepts presented in chapter 4.3 (Collaborative Decision Making, Replanning and Proactive Control, Cooperating Intelligent Agents) will be shown to be applicable and useful in the context of JANE through fast time and real time simulations.

The ”Local Decision Support System” (LDSS) should close the gap between planning and control by supporting the following objectives:

- Optimise local airport throughput.
- Enable Collaborative Decisions by providing *common* situational awareness.
- Increase ATC capacity for approach and departure.
- Support Gate-to-Gate operations.

The LDSS uses a rather simple methodology to reach these objectives. All inbound and outbound flights are supervised and managed by time control related to the local airport runway capacity. Main parameters are the Required Time of Arrival and the Required Take off Time. The LDSS rules and internal calculations will take into account all relevant data like the runway configuration, CFMU slots, weather and a number of flight related information. Algorithms and optimal strategies can be chosen based on the results of theoretical studies and of the What-If-analyses mentioned above.

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A comprehensive list of the sources used in the study is included in [JANE9809].