[EN-001] Potential Impact of Data Variance on the Prediction of Key Performance Indicators (KPI) as a Decision Variable for Airport Pretactical Decision Making within a Total Airport Management (TAM) Airport Operations Center (APOCH)

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Abstract: This paper introduces to the basic concept of Total Airport Management that proposes a paradigm shift towards a performance based and holistic airport management approach to enable the future Air Traffic Management System as proposed by SESAR. The importance of Key Performance Areas and Indicators and their inclusion into the Total Airport Management planning philosophy are explained, leading to a correlation with the key element Airport Operations Plan. The basic and principle assumption of being able to adjust traffic patterns or individual events at and around an airport before the event occurs is mirrored against the feasibility the proposed technical enabler offers and its importance to enable control functions in the Airport Operations Center. Taking the Airport Collaborative Decision Making concept element Variable Taxi Time Calculation as a technical example, the feasibility of the control window concept will be discussed. Judging from the discussion’s outcome the areas of application of the control window concept will be sketched and the open issues that need further research described.

Keywords: TAM, APOCH, VTTC, AMAN, DMAN, SMAN, KPA, KPI, TOP, TAPAS, holistic, hierarchy, management, airport, stakeholder, agent, ATC, airlines, prediction, compliance, variability, adherence, variance

1. INTRODUCTION

TAM – Total Airport Management

TAM introduces a new hierarchical and holistic airport management philosophy ([1][3][4]). Unlike previous conceptual approaches (e.g. Airport Collaborative Decision Making A-CDM [2][17]), TAM considers processes not only from the airport airside (e.g. all flight operation related processes) but as well those of the airport landside (e.g. processes within the airport terminals) and the intermodal traffic network around the airport (covering the ground access, e.g. directly connected train, subway or road networks). It defines the Airport as a holistic System of Systems.

Within one pillar (airside, landside, ground access, see Figure 1) TAM differentiates between four temporal phases, generally with fluent transitions between them. The majority of processes occur at execution or ad-hoc level (e.g. turn-around processes that are pursued from now up to e.g. the next few minutes). This amount of process related data is aggregated and passed to the corresponding operation centers. These will analyze the situation and take corresponding steps to adjust the processes to cope with the goals defined for the medium term/tactical phase. These decisions are reflected back to the field agents that are involved in the execution phase processes who will adjust their immediate work if necessary.

In order to achieve a performance based air traffic system, as prescribed by SESAR ([9]), components of this new system need to be performance based as well. At the airport, this performance enabler will be provided by TAM’s third planning phase (medium term/pretactical). If long term/strategic planning will be pursued by TAM as a fourth phase may be depending on the individual configuration or expectations of the airport partners. Strategic or long term decisions are usually decisions that
will introduce a major impact on airport operations (e.g. building of a new concrete runway system or the seasonal flight planning process).

**TAM APOC**

TAM introduces the AirPort Operations Center (APOC), the central installation for representatives (also called agents) of all airport stakeholders to jointly work and decide specific aspects of future airport operations (covering medium term and eventually long term decision levels). It is paramount that the APOC is equipped with sophisticated software support tools, giving the APOC agents the required tools to explore decision making possibilities. This exploration is called *what-if-probing*. Each agent will have a custom-made system that will interact with central planning support tools (e.g. Total Operations Planner TOP) and with the corresponding back-office operations center suite. TAM does not prescribe a central APOC, decentralized or even hybrid variants are currently believed feasible as well.

Required data the support tools and new novel systems will use is gathered from currently existing and comparably novel operational systems at the airport. The data is stored in a centralized airport wide information management system (Airport SWIM).

The decision making of APOC agents will be influenced by the outcome of computations based on the analysis and diagnosis of this data and a prediction of future expectations.

One of the key decisions being taken in an APOC is the definition of the airport’s target performance that will then be submitted as a commitment to the air traffic network for consideration into its planning processes.

**Influencing traffic**

Concerning flights, a TAM key assumption is the possibility of influencing an individual flight or individual processes as it may become necessary to comply with the decisions taken. The intensity of possible influence depends on the lead-time of the decision against the moment of the event’s execution. For example, an en-route aircraft may be slowed down or speed up a little to adjust the arrival time as necessary on a small scale, but before its departure, an additional waiting time until departure may be applied for a greater amount of time adjustment and at presumably less costs.

**2. KPIs and the AOP**

**2.1 Key Performance Areas and Indicators**

Key Performance Indicators (KPI) are defined to measure performance in Key Performance Areas (KPA). KPAs categorize performance subjects related to high level ambitions and expectations. KPIs quantitatively express past, current and expected performance levels ([5]). SESAR has defined and grouped 11 areas ([7]):

1. Societal Outcome (*Safety, Security, Environment & Sustainability*),
2. Operational Performance (*Capacity & Delay, Cost Effectiveness, Efficiency, Flexibility, Predictability & Punctuality*) and
3. Performance Enablers (*Access/Equity, Interoperability, Participation*).

A number of KPIs has been defined by EUROCONTROL’s ATMAP Framework program ([8]) in accordance to the above mentioned KPAs. These include mainly KPIs that are used to assess the airports’ performances, e.g. “KPI Handled Traffic” or “KPI Service Rate”.

Depending on the specific KPI addressed, a variety of data is required to compute the specific values. For the remainder of this paper the KPIs used belong to group 2, although the KPIs *Efficiency, Flexibility* and *Predictability* are not focused within this paper. There is an approach to
define these terms by [12], if a solid definition is completed and the data that is required for assessment will become available, these KPIs will be included into consideration for APOC decision making processes. Other groups’ KPIs are disregarded but their importance is acknowledged.

KPIs not only measure historical events, they can be used for prediction likewise. Unlike historical data evaluation, prediction always is introducing imprecision and uncertainty, the severity of uncertainty depending upon the variance of the individual events under consideration.

2.2 The Airport Operations Plan AOP

The Airport Operations Plan is the plan of all airport operations conducted within the time horizons of execution, short and medium term phases that is jointly developed by all airport partners. It is an airport specific view of the network operations plan (NOP) that is concurrently developed by SESAR and later maintained by the Air Traffic Flow and Capacity Management (ATFCM, EUROCONTROL’s Central Flow Management Unit (CFMU) follow-up), enriched with airport specific operational data.

The AOP will contain operational data that is available today at airports and all partners. Data that will be provided by novel planning systems like a TOP (Total Operation Planner) and additional decision support systems, e.g. Arrival (AMAN), Departure (DMAN) or Surface Management Systems (SMAN), further supplements the AOP. An AOP will include all required data that influence planning of airport resources, e.g. capacity data for the airport resources themselves. The AOP may contain optional data fields, e.g. for passenger related data, that eventually will not be exchanged between all stakeholders.

The AOP is a hierarchically organized and layered plan. The planning result of a higher level planning is a soft planning constraint to all lower levels in the plan, e.g. the lower levels’ planning should respect the goals set in the higher level. If the planning outcome differs it still is the optimal solution under all given constraints and will be established (if agreed-upon by the stakeholders).

In the ongoing TAMS project ([18]), recent discussions in the project’s second iteration stage about what is included on which planning level of the AOP converged to the following view, taking into account the definition in [11] (TAMS is supported by the German Ministry of Economics based on a decision by the German Bundestag. The operational concept document will become available after closure of the project):

- **Performance Level**: The dynamically agreed set of performance goals is the highest level of the AOP. The key task of the airport partners is to define and agree on the KPIs that represent the main parameters of the airport performance (performance targets). Later, the AOP will be supplemented by the set of values for those KPIs the stakeholders at the airport have agreed on to achieve.

- **Traffic Flow Level**: Different operational strategies can be applied to the operation of an airport, e.g. the selection of a runway configuration directly relates to traffic flows and therefore airport runway capacity is directly dependent on the selected runway configuration. Traffic flows depend on demand and on available capacity. Demand that was not handled yet, e.g. due to a lack of capacity, is kept in a Queue (and eventually will be processed later on). This AOP planning level deals with amounts of aircraft, passengers and baggage instead of the individual aircraft or the individual passenger. It will contain the operational strategy, airport resource capacities and planned traffic flows.

- **Event and Resource Level**: The event and resource level is the most detailed planning level stored in the AOP. It deals with individual objects, e.g. individual flights, individual aircrafts, crews, stands and baggage belts. Concerning passengers, only the relevant data that is available from airlines and that is required for airport operations planning will be included. The event plan defines the event-matrix of different resources by different objects, including schedules, estimates, planned target and actual times, e.g. for all flights’ their target milestones landing, in-block, off-block and take-off. The resource plan is a dualism to that, showing the usage of a certain resource by the events of different objects, e.g. the stand/gate allocation periods by different flights. Any traffic flow level intentions will find their limitations in situational resource availabilities.

For ease of understanding, the last few days’ historical event data is considered to be part of the active AOP. It is acknowledged that due to technical aspects, historical data needs to be removed from an active AOP after certain duration though.

The AOP covers, eventually only in parts, the complete planning horizon of a TAM managed airport.

2.3 Correlation of KPIs and AOP

Those KPIs that are computed on data available for events that have happened are derived from AOP data of the Event and Resource Level (e.g. actual on-block times).
The complementary prediction of these KPIs will be derived from either predicted events (e.g. target on-block times) on this level or from the more abstract Traffic Flow Level (e.g. for time periods beyond the availability of event prediction data). Variance of historical data is negligible, therefore KPI expressions based on this data are considered final. Variance only occurs on those KPI parts that are based on predicted AOP data.

Not only are the former two KPI types (historical and predicted) stored in the topmost level of the AOP planning data, the airport partners’ KPI goals are likewise stored and used for operational deviation monitoring and control.

3. APOC Pre-tactical Decision Making

3.1 Pre-tactical decision making

Pre-tactical decision making addresses decisions that will mainly come into effect after a certain amount of time has passed (e.g. possibly two or more hours or up to several days into the future). Unlike ad-hoc decisions (e.g. the controller decides to give taxing aircraft DLH1234 the control command to taxi via Alpha  Charly  Foxtrot to runway 34L) or tactical decisions (e.g. the arrival sequence on the airport final approach), pre-tactical decisions are a control method to influence processes to comply with the overall goals defined in the AOP performance level (two example use cases of how this may be established between APOC agents are given in [15]).

Decisions that can be taken vary, depending on the reason why an influence is necessary. For example, the airport partners can jointly decide when the best time slot for a runway check might be. Supported by the APOC tools the agents explore different scenarios. Finally, they will choose the period that offers the least impact on operations and that causes the smallest degradation of performance. Other examples of medium term decisions thinkable can be obtained from the recent Episode3 project ([10]) or from the TAMS project.

3.2 Triggers for Decision Making

The joint decision making process can be triggered by a variety of reasons. It is not necessarily reactionary by definition. There will be occasions when the APOC agents will have to deal with situations that endanger the airport’s performance contracts with the network. To adjust the stakeholders’ processes in order to create an improved handling of the situation-to-come is reactionary. The other option would be the “do-nothing-scenario” and knowingly accept the expected degradation of performance. Such situations may be caused by unexpected (e.g. failure of airport equipment, severe disruptions of road traffic or defects of aircraft) or expected events (e.g. adverse weather conditions or unions’ strike).

Another trigger for decision-making is pro-active management. As mentioned above in 3.1, the selection of the best suiting time of a runway closure is pro-active management.

Depending on the severity of the expected impact on airport performance as a whole, the intensity of coordinated effort of all airport partners is expected to increase but is not further focused in this work.

What all triggers have in common is that the reason itself will be represented in technical data terms. In the case of a prediction of adverse weather conditions affecting the airport the capacity prediction of the runway system might suffer a reduction. The airport planning constraints stored within the AOP therefore suffer a variation and will be detected by e.g. the APOC’s support tools, especially the Total Airport Performance Assessment System TAPAS ([13] sketches its inclusion into the TAM APOC architecture).

3.3 When to Make the Decision

Not all scenarios require immediate reaction by the APOC agents, it is depending upon the severity of the anticipated effects. It is obvious that events that occurred on execution/ad-hoc level need an immediate reaction and thus a decision.

The APOC decision making is mainly focused on pre-tactical decision making (and beyond). Therefore, the immediate need to react to an upcoming event is not given per se, except in recovery management situations. It may be possible that the APOC agents will wait for an increase in reliability of the prediction that will cause the event. A second possibility is that the lead time until the occurrence of the event and the anticipated outcome leave enough lead time until a decision needs to be taken.

Considering the need of an inter-stakeholder coordination of varying complexity, the task until a decision finally can be jointly taken by the agents can vary in duration likewise. This is expected to be especially true for tasks where competing parties’ (possibly opposing) goals have to be incorporated into the final solution. In cases of conflict, a neutral entity (arbitrator) is proposed by TAM to be part of the APOC core team.

Comparing the decision making process and the time the agents may take until they come to a decision, this approach still offers more flexible than actually not taking any decisions and thus following the “do-nothing-scenario” where the anticipated outcome is believed to be worse.
3.4 TAM Technical Enabler: Preference and Possibility Windows Concept Element

Stated above is the requirement of detecting variations within the AOP as a potential trigger for CDM negotiation processes. It is obvious that it is infeasible to react to or initiate activity on each and every change in the AOP baseline data. It is as well obvious that not all variations are equally important. For example may the variation of the runway system’s capacity be more important than the update of a time stamp (e.g. estimated off-block time). Deriving from these assumptions it becomes evident that there is a need to introduce automatisms in variance impact assessment.

TAM proposes a technical key concept element as an enabler: preference and possibility windows.

The main concept idea behind the window system is that each event is represented by its corresponding data. For example is the touch down of an aircraft characterized by its corresponding actual landing time ALDT. In terms of planning, the airport partners use either the estimated LDT (ELDT) or target LDT (TLDT). Target describes the goal, estimate describes the most probable occurrence, in ideal conditions both times are the same.

3.4.1 Definition of Windows

Concerning the planning of the individual events, the corresponding owner may express his agreement to a (slight) variance of the event as follows: the event is initially planned to TLDT at 09:10h, but it is acceptable if the landing actually occurs between 09:05h and 09:30h. The process owner expressed his preference to accept the event to happen between 09:05h and 09:30h. He defined a preference window to this event; the window’s borders are 09:05h and 09:30h.

The defined preferences of the process owners may not always be accommodated. In order to achieve the overall optimum, it may be necessary to violate the preference of a stakeholder, e.g. to further delay a landing time. There are natural boundaries to this further adjustment, most often these are physical limitations (e.g. aircraft running out of fuel would be a very physical limitation to leave it in the air longer). These physical boundaries can be expressed by the term possibility window (color coded yellow). It defines the general possibility of the event happening within this window, including the range expressed by the preference window (color coded green, see Figure 2). Their borders can be identical, indicating that the process owner is flexible and accepts any solution he is presented with. For most events an even earlier or later event occurrence is physically not possible (indicated by the red bar) or indicating other hard constraints (e.g. physical capacity limitation).

Another example of the application of the window concept element is given in the following Figure 3 (a scientific approach to definitions is taken in [16]).

The KPIs defined in the AOP on performance level will have these windows defined during the Quality of Service Contract (QoSC) definition between the Airport and the Network. For example, the airport Punctuality Target is 90% and above (green), acceptable (preference) would be as low as 85% (yellow), below is possible but would indicate the necessity of interference by the APOC agents (red).

If variations now occur, these will be judged according to the defined windows around them as a first indicator of their severity.

4. Variances of Input Data

The variation of data at an airport is obviously evident. Every single process may vary slightly or sometimes severely from its mean execution pattern. Most often this is expressed in a variation of process start and end times, sometimes it is expressed by changing capacity figures, e.g. number of available security check counters, aircraft gate positions or allowed arrival or departure capacity of the runway system. The reasons for variations are manifold and their existence acknowledged but not further elaborated within this work.

Important to recognize nevertheless is the fact that variation in key resource elements at an airport will have significant influence on other directly and indirectly connected objects or events. Such an element is the capacity of the runway system. Variation of the capacity values often occurs more abrupt (e.g. closure or adverse
For APOC AOP deviation monitoring purposes, the incoming data is judged against their control windows. This allows for a certain flexibility before the process owner needs to react, e.g. if the event’s data jumps forth and back within the preference window’s horizon the agents probably would not react to it. Another issue is if the prediction precision for the process is not reliable enough and exceeds the control window size by definition. In this case, an exclusion of this process from the window approach could be reasonable.

Part 4.1 will explain variances on KPIs and their importance to decision making in the APOC. Part 4.2 will show with the focus on A-CDM’s variable taxi time calculation function various examples for the influence of variances on the different planning horizons and phases that ultimately will be important for the decision making process in a TAM APOC.

4.1 Variance on KPIs
The variation of KPIs results from variations of the underlying data that is required to compute or predict the KPIs. However, unlike the variation of individual flight data, the variation of the aggregated view of KPIs indicates a potential trigger for pro-active management.

Figure 4: Deviation Monitoring (example, [4])

The APOC agents agreed upon several KPIs (the airport performance targets) and their ranges (preference and possibility windows). This information is stored in the AOP. The TAPAS tool constantly (or frequently) monitors the variations in input data the connected systems submit into the central airport SWIM (system wide information management) database. By aggregating this information, TAPAS computes currently present performance levels and refines KPI predictions. Evaluating the recent KPI values against the self-defined performance targets, TAPAS is able to indicate occurring or predicted violations.

Although the reason for this flapping of data should be investigated if it occurs frequently.

4.2 Examples for variances on TAM planning levels and phases with A-CDM’s VTTC function
The aim of taxi time calculation (TTC) is to close the information gap between the inbound and outbound leg of an aircraft. For instance, better estimation of on-block times in dependence of runway allocation scenarios can contribute to the avoidance of stand occupancies in case of early inbound flights. This is achieved by using taxi time predictions to translate runway-related information (estimated landing time, ELDT) into stand-related information (estimated in-block time) as well as the other way round (target off-block time, TOBT into estimated take-off time). Additionally, taxi time calculation serves as an important link between arrival, departure and turnaround management systems (AMAN, DMAN, TMAN) in view of the sequence optimisation at the stands and the runway system.

The current improvement of taxi time prediction methods belongs to one key element of the A-CDM concept. In the area of A-CDM, traffic prediction using variable taxi time calculation (VTTC) is assumed to contribute to increased Air Traffic Control (ATC) slot adherence and airport operations efficiency. Especially the pre-departure sequencing process likely relies on precise predictions of outbound taxi times with regard to its objective to determine accurate Target Take Off Times (TTOT) and Target Start Up Approval Times (TSAT) under consideration of turnaround, surface movement and departure management requirements as well as airline/airport preferences.
Variable taxi times are calculated either by static look-up tables or recently also dynamically. According to [2] such dynamic approach is called “Advanced taxi time calculation”. Static taxi time calculation is based on statistical values, advanced taxi time calculation takes into account the planned and current surface movements and dynamically calculates holding times at intersections (and prospectively in the departure queue). Currently, TTCs at airports still revert to static data. In the worst case, but at several airports still applied, is the common use of default values for all ground movements. On the other hand, VTTC includes by definition a categorization based on individual relations between the parking stand and the runway or vice versa. Due to a mostly wide range of taxi distances at airports, this leads to a strong reduction of uncertainties. Nevertheless, in [19] was shown that the achieved accuracy of static look-up tables still does not comply with the requirements of [2]. Therein required accuracy is defined as +/- 2 minutes for flights with up to 30 minutes remaining time to off-block, +/- 5 minutes for flights between 30 minutes and 2 hours before off-block time and +/- 7 minutes for flights between 2 and 3 hours before off-block time.

![Figure 5: Comparison of Static and Advanced Taxi Time Calculation Uncertainties (Outbound at Frankfurt Airport), [19]](image)

Besides the prediction method, the accuracy of VTTC is limited by the input data, whichever is available for the used prediction horizon. For A-CDM the accuracy depends amongst others mainly on the airlines’ confirmed target off-block times (TOBT) and departure capacity predictions. Only in a very short prediction horizon, the input parameter is based on actual times with a insignificant inaccuracy of the input data.

Considering the quality of available input data different categories can be distinguished. For predicting the taxi out time (EXOT), the following five categories can be described (abbreviations adhering to [2]):

1. very short term: based on actual times
   - AOBT
2. short term: based on target times
   - TSAT
   - TOBT
3. medium term: based on estimated or actual times and estimated durations
   - EOBT
   - AIBT+EOTT
   - ALDT+EXIT+EOTT
4. long term: based on estimated durations and estimated times
   - ELDT+EXIT
   - ETOOT+EET+EXIT
5. very long term: based on scheduled times
   - SOBT

In this perspective, increasing the accuracy of VTTC is not only an issue of the taxi time prediction method and needs a wider approach. E.g. Increasing the accuracy of an estimated landing time by the use of an AMAN and increasing the accuracy of a target off block time by the use of a TMAN increase the accuracy of the taxi time prediction also in longer prediction horizons.

Preference and possibility windows should be adjusted to the increasing variances of the prediction accuracy. The necessary prediction accuracy depends on the character of the decisions, which need taxi time duration as decision relevant information. For the five categories, the following decisions could be relevant with respect to the increasing variance of the taxi time prediction and its counterpart window margins:

1. very short term: situational awareness, ad hoc decisions
   - e.g. departure or runway sequencing
   - e.g. active routing and guidance with automatically conflict detection and resolving.
2. short term: event and resource level, tactical decisions
   - e.g. pre departure sequencing
3. medium term: traffic flow level, pre tactical decisions
   - e.g. planning the turnaround process,
   - e.g. potential impact of a TOBT
   - e.g. choosing different runway configurations
4. long term: performance level, strategic decisions
   - e.g. stand coordination
5. very long term: performance level
   - e.g. impact of new taxi ways
5. Applicability of Window Concept

In a multi-stakeholder multi-goal environment it quickly becomes obvious that it is important to find compromises and to accept trade-offs between the stakeholders’ own goals and the overall optimum (airport goal).

The control window concept is considered a facilitator. In the context of KPIs, every airport stakeholder is able to define his preferences and submit his acceptable boundaries into the system. This information will be utilized by the APOC planning systems to compute the overall boundaries that will, after agreement by all involved parties, become part of the performance targets. Additionally, the defined windows around the targets will be utilized for performance deviation assessment purposes (as described in 4.1).

Another essential area of employment of the window concept is for the definition of the airport working point that is key to AOP flow planning issues. The working point puts the key aspects punctuality/delay and throughput into direct relation. [20] teaches the fundamental correlations between capacity, demand (throughput) and delay. [21] derives empirically that there is a soft natural capacity (practical capacity) boundary limited by the maximum capacity (ultimate capacity, in terms of aircraft movements). An increase in delay was discovered when the number of movements approached this practical capacity that acted as a saturation value and delay dramatically increased in excess to it until the ultimate capacity had been reached and no further increase was possible. Additionally, it was noticed that this saturation value is dependent upon the weather condition.

The control windows now define sections on the axis of a x-y-chart as in Figure 6 with throughput on the x- and delay/punctuality on the y-axis. The slice plane over these sections includes a part of the curve that defines the working point range, defining the acceptable trade-off window between traffic flow and delay situation. This acceptable working point range will be subjected to the TAM optimization planning tools (e.g. TOP) and respected as an optimization variable.

In 4.2 it was shown that the application of the control window concept is feasible even on very detailed data and miscellaneous planning horizons like VTT predictions. It is, nevertheless, believed that the window concept may not be applicable to all detailed data items and the selection of appropriate window sizes (boundaries) is absolutely necessary to be thought through intensively. A too narrow selection of the boundaries for very volatile data is expected to yield false alerts and discourage the utilization of this concept element. A too wide selection may not be useful in the sense of deviation monitoring and situation assessment as it may not detect important changes of key parameters.

Equally, it may be necessary to adjust the window sizes depending on the association to the planning phase of the specific data being considered.

6. Summary and Outlook

6.1 Summary

The paper introduced to TAM and to the key concept element AOP and to one of its technological enabler counterpart elements, the control window. The correlation between the AOP, TAM planning, overall network aspects and the TAM APOC decision making process was given.

The importance of data variance monitoring was explained on an abstract KPI level view and with the example of A-CDM VTTC. The applicability of the control window concept to low level, highly detailed and partially volatile data was discussed. Mirrored against this approach was explained that the control window concept can be applied to the KPI based conformance monitoring as a trigger to pre-tactical APOC decision making between APOC agents and as an input into the optimization process of TAM planning support tools. On the level of performance planning the window concept enables deviation monitoring and a new degree of freedom in optimization approaches.

It was shown that the general approach is feasible over all AOP planning levels and applicable to all planning phases considered by TAM. Care needs to be taken on the exact definition of window boundaries in relation to the data considered.

6.2 Outlook

The theoretical research about the application of the control window concept element needs to be extended to uncover what items can be subjected to this approach.
Currently it has not been considered if a variation of the window borders over time is feasible although advantages for the optimization process are imaginable.

It has been identified that great care needs to be taken to select a sound width of the windows, most probably unique to each unique data type and depending on the individual airport configuration. It is conceivable that, e.g. for two competing airlines, the same type requires different window sizes, depending on the individual preferences or on the carriers’ operation strategy (low-cost vs. hub carrier).

It is unclear yet if an automated standard definition of window sizes should take place and whether this is feasible concerning the window sizes. Additionally, it needs to be answered when control windows should be existing around data items and how the above mentioned deviation monitoring functions behaves in cases of missing windows. The impact of volatile data to which control windows have been assigned need to be studied and correlated with recorded live data to assess the dimensions of variability of input data and to obtain an impression about the reliability of currently existing prediction processes. This then may lead to concepts of more precise and reliable prediction tools.

Once these theoretical assumptions have been taken, the implementation in novel prototype software systems and their integration into the APOC environment need to be pursued in order to gain first hands-on experience of the handling, potentially in simulations and eventually in shadow-mode trials.

It is possible that the TAMS project will be able to provide first solutions to the above questions and develop first industrial prototype applications supporting this concept element.

It is currently not known in detail to what extend and in what depth SESAR will be able to supplement the research into this direction, but currently existing impressions picture quite a dark scenario.

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8. REFERENCES


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