

# White Paper

**TAV IT RMS** – RESOURCE MANAGEMENT SYSTEM

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## GENERAL OVERVIEW

While airport operators and authorities are trying to deliver the best service to all parties in the airport, the rapidly growing challenges and continuous growth entail those taking proactive actions both in business processes and technology. Given that optimization and automation needs in business processes are vital ever. As a result utilizing the resources to their highest degree becomes the key factor in order to cope with these challenges.

TAV IT takes over this responsibility with it's one of the newest and most important products in its portfolio, Resource Management System (RMS). TAV IT's Resource Management System is designed (or planned) to increase the quality of service levels dramatically by enabling airport operators and authorities to manage both mobile and immobile resources throughout the airport.

A long-lasting collaboration with academical environments and making use of extensive mathematical modeling facilities and optimization algorithms, a very highly anticipated product is about to be delivered to the market. Thus the buzzword "optimization of resources" will be achieved so highly, that it will not only increase the productivity of the usage of the resources for the airport operators but also makes possible to work in a collaborative environment with other parties in the airport.

## RESOURCE MANAGEMENT SYSTEM MAIN COMPONENTS

### Conceptual Infrastructure

In order to provide comprehensive capabilities and make easier management possible, the product is divided into modules with well defined functionalities. Given that, RMS is divided into 8 modules:

- User Management
- Reference Data Management
- Rule & Optimization Engine
- Management Console - Dashboard
- Integration Module
- Flight Management

### Technological Infrastructure

#### Modeling

- CSP Engine is developed to solve optimization problems.
- A Domain Specific Language (DSL) is developed for modeling and defining new constraints. The DSL allows operators to define functionalities in airport terminals easily and fast.
- Constraint editor a GUI tool that is developed to enter new constraints is also available.
- New resource and constraint definitions are handled through CSP & DSL without any low level programming.
- CSP Engine comprises state of the art search algorithms and approaches. It is possible to adapt these algorithms according to changing requirements. These algorithms have been developed in cooperation with academical environments. This corporation is an ongoing process, which ensures continuous improvement of CSP engine.
- Multiple objective optimization capability

## Simulation

- With its comprehensive features, RMS offers best simulation facilities while planning of resources.
- Another feature offered as a component, simulation scenarios can be prepared in order to foresee/estimate the needed resources according to historical and current data (i.e. construction of additional gates etc.) (This feature is offered optionally)

## User Interface

- Resource Management System (RMS) can be used as web based or desktop application. Thus variety of users with different devices throughout the airport can utilize the system in a collaborative manner.
- User interface called “Dashboard” includes touch screen capability to maximize the usability and control by all means.
- Dashboard is designed mainly according to the needs of control center staff and maximizing monitoring capabilities.

## RMS FUNCTIONAL MODULES

### 1. User Management

In order to meet the security and user right requirements, this module offers the following functionalities.

- Role definitions are created according to the existing job descriptions. So that a given user can carry out the operations consistent with his/her rights and responsibilities.
- Every function in the system is mapped with a single right. As a result an administrative user is capable to create roles consisting of multiple rights.
- Another feature this module offers is, utilizing the existing User Directory Systems such as MS Active Directory through LDAP.
- Every action performed by the users (CRUD operations) are stored and logged with timestamp for monitoring purposes.

## 2. Reference Data Management

This module can be considered as one of the most vital components in RMS. First it enables all the components within RMS to operate smoothly and correctly, in other words this module can be named as the vocabulary of the whole system. On the other hand, the data definitions created are playing a key role to ensure consistency of integration.

- Basic operations regarding the maintenance of resources (CRUD operations) are carried out in this module.
- This module enables the authorized personnel to define the following resources along with their attributes in detail.
  - Gate & Stands (Arrival & Departure Gates, Lounges , Terminal Stands, Remote Stands, Hangars etc.)
  - Check-in counters (Flight Check-in , Common check-in)
  - Baggage resources (Carousel, Chute)
  - Other resources
- Resources can be grouped according their profiles and capabilities which is called “logical grouping”. Eventually it enables the management and planning operations to be performed much easier. For instance during planning of a given flight the system picks and displays the resources having the needed capabilities.
- Also it enables to manage other referential data such as Airport,Airline etc.
- Since there are variety of devices with user interface both for management and operational purposes (control center, field operations, informative screens etc.) , pre-defined user interfaces are utilized to include and deliver the information the related entities.
- User screens for control center –that is dashboard- can be customized according to the hardware preferences. So that the dispatcher –that is the main user of the system- can utilize multiple screens with landscape or portrait format for better operation performance.
- Although this module provides flexible definition capabilities both for current and future definitions, it is also capable to send and receive the reference files as a bulk data through import/export functionality.

### 3. Rule & Optimization Engine

This is the core module of RMS and can be called as an integral part for meeting today's resource management requirements. This module has been developed mainly in cooperation between staff having academical background and academicians from renown universities because of its sophisticated capability requirements for managing the resources in an optimized and effectively manner.

Basically the rule engine enables the authorized personnel to model the constraints and relationships both for resources and tasks by their all possible attributes. In other words while defining constraints > the system is smart enough to present the required attribute-constraint mappings while defining new constraints for resources and tasks (or for them). Consequently the rule engine has the ability to deliver auto-scheduling of tasks based on the above claimed constraints.

Another feature which is optionally offered in RMS is Optimization Engine. This submodule provides the optimization of daily tasks based on pre-defined business constraints and historical data. The main idea while building optimization engine is to serve to the priorities set by airport operators according to their management policy and preferences. Some of the common objective functions are given below:

- a. Revenue maximization by optimization of gate and stand assignments.
- b. Maximizing the utilization of gate capacity
- c. Maximizing the airport capacity
- d. Enhancing the overall service quality (punctual departures, cost competitiveness and reliability)
- e. Minimizing the walking distance for departing and arriving passengers to provide smooth passenger flow.

It should be noted that the above mentioned objectives can be evaluated together according to their priority levels. This approach can be called as Multi-Objective-Optimization.

On the other hand the system provides the definition of task constraints according to marketing considerations and airline/agent preferences. The task oriented rules can be based on the following groups that can be extended according to other classes and attributes:

- i. Airport based
- ii. Terminal based
- iii. Airline based
- iv. Registration number based
- v. Other (i.e. recurring assignment rules etc.)

Predictably because the planning staff would utilize so many constraints from above, it is inevitable that some of them would overlap. Although in some cases this can be considered as a preferred result in terms of operational workload, under normal circumstances some unexpected and undesired results may occur. The rule engine module resolves this issue with scoring mechanism. With the scoring functionality, overlapped constraints can be managed so easily that even adaptation of new users to the system becomes much easier. Despite scoring and constraints, there is another level utilized while modeling the constraints which are called Soft Constraints. These constraints refer to the rules which can be violated by Optimization Engine under some circumstances in order to meet the objective functions. In a given time during the operation (and also in planning) if there is a shortcoming in resources the system proactively generates automatic conflict messages with pre-defined solutions.

Consequently these functionalities brings variety of distinctive benefits such as,

- Intelligent rule based Conflict Management and error handling capabilities
- Immediate response to incoming changes in operation with “Real-time rescheduling”
- Robustness while creating master plan for the following day
- Maximizing stability and minimizing deviations
- Increasing productivity in operation planning and higher passenger and airlines satisfaction

## 4. Management Console (DASHBOARD)

The storefront for managing the resources in RMS is called Dashboard. This console offers extensive functionalities for easing the planning and the operation. It is basically designed on a Gant Chart, which became the common management user interface for monitoring and managing the resources.

Dashboard comprises two main views :

a. Dashboard (Planning-Mode)

Before going on operation, daily planning for following day is carried out in this module. While in planning mode, the system offers pre-defined master templates to the dispatcher for better planning performance. So the dispatcher is able to plan the resources (with rule engine) according to tasks' needs by utilizing resource-based view functionalities.

b. Dashboard (Operational-Mode)

In this module, the dispatcher can manage and monitor the active flights and resources in real-time and takes necessary actions in the occurrence of conflicts between resources. The system adapts any adjustments made by dispatcher and re-arranges the layout of resources and tasks.

The dispatcher also enters realized data for both the tasks and resources from this screen.

While in operation it is very important for the dispatcher to take necessary actions without any disruption, for this reason Dashboard is equipped with optional touch screen feature to enable the dispatcher working on-the-fly. Other offered features are given below :

- Dashboard can be split into sections in order to let multiple dispatchers work at the same time
- Simple / Advanced Filtering options for different resource and/or flight profiles.
- Multi-eye monitor configuration
- Kiosk UI (especially for Check-in Counters )

- Mobile-based user interface

In operational mode the user displays aforementioned planned resources on the screen in real time. The user can let the system handle conflicts to an extent level (which can be defined as a rule as well). However he/she is also able to bypass the automated mode and take the control of the tasks and resources with the help of suggestions made by the system for any given case.

## 5. Integration Module

As well as the other products in TAV IT portfolio, RMS is utilizing xml-based messaging for interaction with related subsystems in an airport. This ensures distribution of up-to-date information for all parties in real-time and making a healthy integration possible. RMS is currently capable to operate with the following systems.

- Gate Operating System (GOS)
- Airport Operational Database (AODB)
- Flight Information System (FIDS)
- Management Information System (MIS)
- Building Management System (BMS)
- Energy Management System (EMS)
- Baggage Handling System (BHS)
- Air Traffic Control (ATC)
- User Management System
- Other resource relevant subsystems

The messaging console that is bundled with Resource Management System (RMS) is intended to deliver easy management and monitoring of messages used in integration. It allows the administrative personnel to take necessary actions immediately both for incoming and outgoing messages.

## 6. Flight Management

RMS is capable to operate both in standalone and integrated mode. Given that for standalone case it is imperative to manage the flights in RMS. Another reason for the following modules developed is exceptional cases such as immediate flight attribute updates on the operational Dashboard.

### Seasonal Flight Management

The Seasonal Flight Management module enables users entering the scheduled flight data easily and conveniently. Once the seasonal flight schedule is entered, the system processes the scheduled data, creates active flight information and delivers the active flight data automatically to Active Flight Schedule according to a pre-defined interval periodically. The preview function is a very handy tool that allows users to see all the active flights that are generated out of a scheduled flight data prior to converting them into active flight information. Time-zone function (UTC – Local time) on the other hand is used to eliminate errors while entering seasonal flight data.

### Active Flight Management

Active Flight Management module is capable of managing daily flights that are automatically generated by seasonal flight data. The module enables authorized personnel to carry out all the flight related operations such as creating a new flight , updating , copying and existing flight etc. Additionally authorized users can display the incoming flights received by other subsystems such as AODB. If needed they can bypass the integration and take control of the flight data.