Parking space management with Qualicision® Photo: Stuttgarter Straßenbahn AG

Optimal processes in bus depots

Qualicision® technology in DMS

In 2007, PSI Transcom GmbH was commissioned by the Stuttgarter Straßenbahn (SSB) to supply a depot management system (DMS). Since the creation of a specification sheet and plant acceptance, the system has been rolled out to seven depots (bus and tram) with a total of 450 vehicles.

The DMS monitors and controls the entire company-internal operation, from monitoring entrances and exits to parking place management, right up to workshop information regarding impending repairs. Automatic parking place scheduling is an integral component of the depot management system. Vehicles must be parked in spaces and halls in such a manner that they can exit the following morning without manoeuvring activities. In addition to other criteria, fuelling optimisation as well as temporal restrictions on the availability of vehicles and parking spaces must be taken into consideration.

In the past few years, PSI Transcom has installed DMS at STAWA in Augsburg, at Meoline in Essen and at RSAG in Rostock. In so doing they have acquired the corresponding process know-how.

The last significant update of the PSI *traffic* framework to a new main version number included a conversion of BMS from an object-oriented database to a relational database. This required numerous adaptations to the software. In this connection, the module for parking place management was also tested. For

this purpose, PSI Transcom not only worked on the further development of its own software but also evaluated external solutions, among them that of F/L/S Fuzzy Logik Systeme GmbH in Dortmund.

PSI Transcom finally decided to run the project with F/L/S, mainly because of its numerous references from different sectors but also because of the convincing presentation of its implementation within the DMS project.

Parking space management comprises two stages. The first stage entails preplanning for the following and additional days, and regularly takes place every night. In Stuttgart, this preplanning extends over five days. Scheduling for the following day is calculated based on the route plan and fixed rules as to the use of vehicles on specific routes, as well as existing workshop orders for planned repairs.

In the second stage, the parking place management system compares the target plan with the current situation after the vehicles return from a round trip, performs a new calculation where necessary and allocates a parking place to the driver.
As it is rather the rule than the exception that vehicles return to the depot ourside the planned sequence, because they often depend on current traffic conditions, the optimization is generally carried out after the arrival of each vehicle.

To prevent drivers having to wait at the gate until the software finds a solution, the customer sets a limit value of ten seconds for each calculation, a value that has so far been adhered to in the tests that have been run with the F/L/S and PSI Transcom software.

Automatic parking space scheduling Photo: Jupiterimages

Qualicision® is used as an optimisation module for automatic parking place scheduling in depot management systems. A distinction is made between firm criteria to be adhered to and qualitative criteria to be achieved. Firm criteria represent requirements for the optimisation result, which can largely be directly or indirectly derived from actual spatial or physical situations (for example the current topology of a depot in terms of available parking places). The qualitative criteria to be achieved include qualitative requirements for Qualicision® optimisation. A qualitative requirement is a quality the user expects from the optimisation result. Examples for qualitative criteria are the requirement that all lanes in the depot should be equally occupied by vehicles where possible or the above-mentioned equalisation of the kilometres travelled by the vehicles. Qualitative criteria can either conflict or co-operate with each another or behave neutrally. The current relationship among qualitative criteria dependens on the current base data (actual situation of the depot and vehicles) and must be determined dynamically. By assigning relative priorities, schedulers can weight the qualitative criteria.

The Qualicision® optimisation recognises the conflicts resulting from the current base data and the

compatibility of the qualitative criteria, and calculates the best assignment of vehicles to parking spaces from a current point of view. Accoring to the call-up mode, the Qualicision® optimisation either generates a complete occupation plan or determines the next best parking space for a vehicle entering the depot.

In less formalised business processes, quantitative and qualitative data must often be merged for optimisation decisions. The more formalised the business processes are, the stronger the requirement for systematisation of decision making or optimisation. It is surprising that even then modelling is possible with the assistance of the Qualicision® technology.

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