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Fraunhofer IAO, QUINTA Consulting

Optimized Parking Prices Thanks to Artificial Intelligence – A Look Behind the Scenes of an International Research Project

Few industries follow seasonal demand patterns as closely as airport parking. Vacation periods, public holidays, and major events are fixed several months or even years in advance. This is precisely when available parking space reaches its limits and requires operationally and economically efficient management. Until now, many airports have relied on static rate tables, seasonal differentiation, or manual adjustments. A research consortium consisting of Fraunhofer IAO, QUINTA Consulting, and an international airport is now demonstrating for the first time how artificial intelligence (AI) can accurately predict demand for parking spaces and optimally adjust parking prices—with tangible benefits for operators, the environment, and passengers alike.

Starting Point: Lots of Data, Little Transparency

A large amount of information converges at an international airport every day: passenger numbers, flight movements, reservation data, payment transactions. However, this data is rarely analyzed systematically in terms of how to efficiently manage available parking space. The existing data sources provide ideal conditions for using AI to generate an integrated view of future parking space utilization – the necessary basis for, among other things, optimally adjusting parking prices to demand in real time. The aim of the "AI-enabled parking space pricing" research project is therefore to develop a forecasting and pricing model that addresses the following three questions:

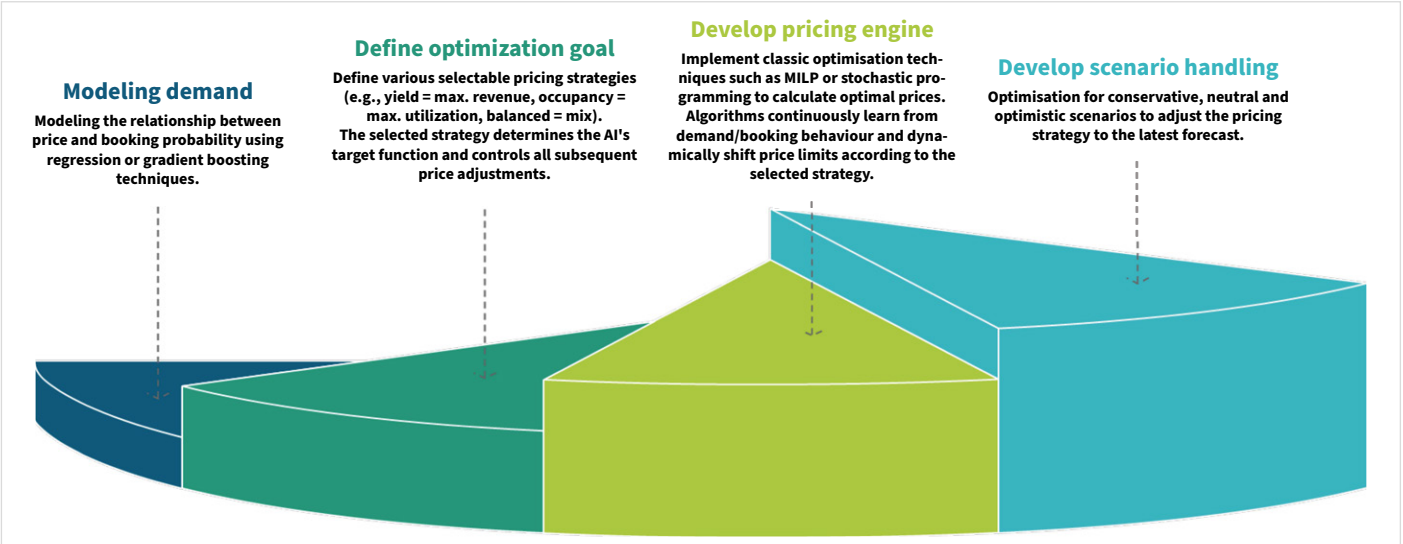
1. How high will parking space utilization be in the coming hours, days, and months?
2. How much are travelers willing to pay at different times for available parking spaces?
3. What price keeps utilization as stable as possible or optimizes revenue without compromising customer satisfaction?

Data and methodology

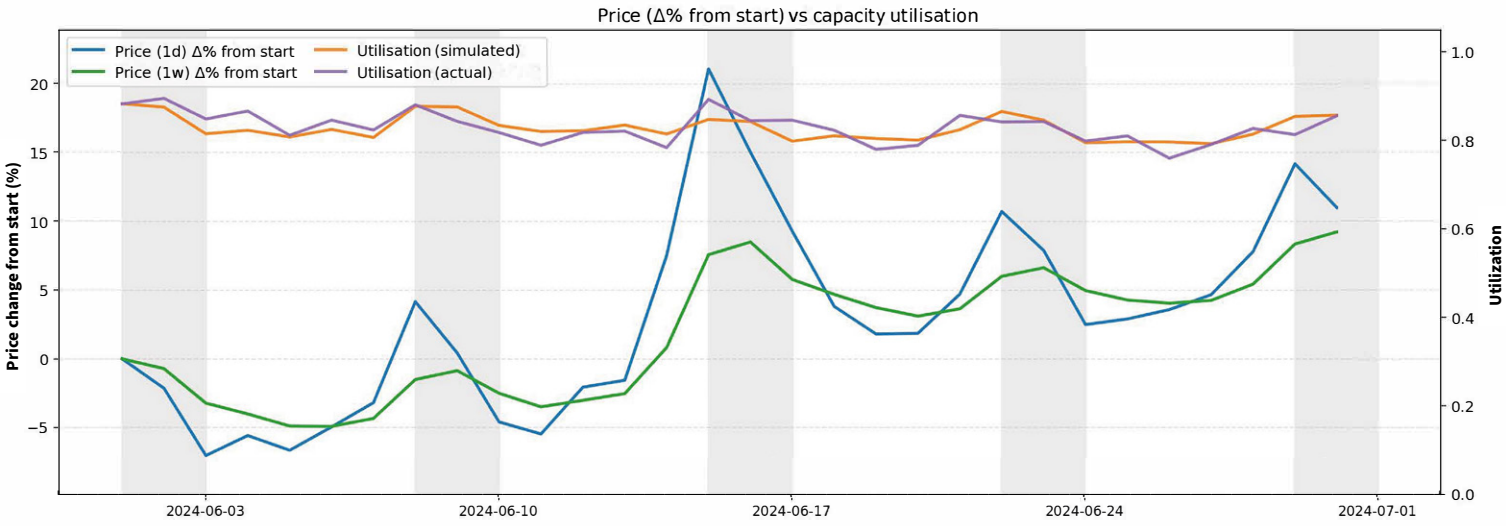
For the forecasting model, all available data sets were first harmonized: parking transactions (entries and exits, parking duration, fees paid), passenger numbers (arrivals/departures by destination and time), school vacations and public holidays, and infrastructure changes as well as temporary closures or capacity expansions.

An AI-based time series model learns from historical patterns and generates granular forecasts for parking space utilization over the next twelve months. The quality of the model is measured using "explained variance"[1]; values of over 92% were achieved in the test data set. This means that the AI forecasting model developed explains 92% of the variance in the test data, leaving only 8% of the variability unexplained. This indicates very good model performance.

In preparation for parking price modeling, an online customer survey was conducted among more than 1,000 passengers, using a price sensitivity meter (PSM) to determine their willingess-to-pay for different parking spaces. Three different elasticity



Process model for developing a dynamic pricing algorithm



Visualization of a pricing strategy based on the AI algorithm on synthetic data

scenarios were derived from the survey results: conservative, neutral, and optimistic.

From forecast to price recommendation

The AI model generates utilization forecasts for individually definable parking periods. Based on this, an optimization algorithm combines these forecasts with the determined price elasticity. The result is a price recommendation that stabilizes the utilization of each available parking space for each scenario.

For example, at the start of the vacation period from Friday to Sunday, there is high demand for parking spaces in important source markets. The AI algorithm suggests an increase in parking prices of up to +12% for parking spaces close to the terminal at the airport, while long-term parking spaces remain inexpensive. The final pricing decision is deliberately left to the revenue management team: price suggestions are visualized in a dashboard, including expected utilization, additional revenue, and risk indicators. This allows a decision to be made in just a few minutes as to whether the price suggested by the AI should be accepted or manually overridden.

Conclusion

1. Optimized utilization of parking spaces through intelligent price incentives: The AI-enabled pricing model creates targeted incentives for a more balanced utilization of available parking spaces. Price incentives motivate customers to use less popular parking areas: Long-term parking spaces see reduced turnover and longer parking times, while flexible pricing ensures that short-term parking spaces remain available at short lenghts of stay. For the car park management at an airport, this results in significantly improved space management with reduced bottlenecks and optimized capacity utilization.
2. Increased price transparency through digital booking channels: AI-optimized parking prices are initially implemented via the airport's online booking system, giving customers complete transparency about all parking prices available at the time of booking. Unlike opaque surge pricing models, travelers can better understand the pricing rationale and make well-informed purchasing decisions. Digital advance booking also allows price-conscious parkers to plan better and benefit from cheaper rates by booking early.
3. Data-driven operational optimization: The AI-enabled forecasting model continuously generates valuable insights into demand patterns, parking and usage behavior, and price elasticity. This information enables evidence-based development of the parking strategy, e.g., with regard to long-term investment decisions for capacity expansions or infrastructural adjustments.

Outlook

The AI-enabled pricing model will be tested in a pilot parking lot at the airport to measure effects, evaluate functionalities, and gain a deeper understanding of customer price elasticity. With this pilot project, an airport is introducing AI-enabled parking prices into operational use for the first time, proving that intelligent AI algorithms can not only increase revenue in parking, but also help to better smooth out traffic peaks and improve the parking experience – a win-win situation for operators, travelers, and the whole environment alike. ■

If you would like to know more, please contact Philipp Göbels or Mark Friesen. We would be happy to work with you to develop a dynamic pricing strategy for your parking spaces.
Fraunhofer IAO will also present at the EPA Conference 2025 – see p. 20, '3.6 AI in Parking and Mobility (Sponsored Workshop by Quinta Consulting)'.

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[1] Explained variance is a statistical measure that indicates how much of the variability in the dependent variables (target variables) is explained by the model.