



Using Optimization to Navigate a Turbulent Planning Horizon



Carrying 34.1 million passengers and 621,000 tons of cargo each year, KLM offers direct services to key economic centers all over the world via a vast network of 92 European cities and 70 intercontinental destinations.

Industry: Aerospace
Location: Europe (Global)
Use Cases: Disruption Management, Workforce Scheduling, Resource Optimization
Website: www.klm.com



Boston Consulting Group (BCG), one of the world's leading management consulting firms, partners with leaders in business and society to tackle their most important challenges and capture their greatest opportunities.

Industry: Strategy & Management Consulting
Location: Global
Website: www.bcg.com

KLM | BCG Partnership

KLM and BCG combine the best expertise in airline operations management to provide best-in-class solutions for business transformation and offer front-line operations teams AI-based solutions that provide full transparency—in real time—about the impact of every business decision.

Website: www.airlineoperations.ai

Results

- With Gurobi powering KLM's optimization tool, the airline is now able to run 20-30 crew planning scenarios each week, compared to just one with older systems.
- Now that they can quickly develop long-term crew plans, KLM is better prepared to respond to market volatility and adapt to change.

With Gurobi, KLM is able to calculate projected crew needs 3-5 years into the future, within a fraction of the time legacy systems required.

For most airline passengers, not much thought is given to the complex logistics that make their journeys possible. But airline carriers are all too aware of the many challenges and variables that must be worked out before passengers even make it to their seats.

From ever-evolving regulations to changes in fleets, hiring needs, and training requirements, long-term crew planning can seem like an impossible task. But KLM Royal Dutch Airlines (KLM) saw an opportunity to improve their planning and operations by partnering with Boston Consulting Group (BCG).

Together, they developed a full, AI-based suite of tools to improve airline operations, including fleet optimization and disruption management. Among those tools is CrewVision, which creates optimal five-year crew plans by accounting for all of the aforementioned factors. With support from Gurobi's solver, these plans can now be generated within several hours, as opposed to an entire week—ultimately changing the way KLM makes critical decisions and adapts to market volatility.

Solving for the Most Critical Variables

In order to project long-term crew needs, airlines must first answer a lot of questions.

"What kinds of pilots, and how many, do you need to fulfill a given network demand and support a given company strategy? And at what moment in time? These are the things airlines have to consider," explains Irina Komissarova, KLM's Product Lead for the partnership with BCG "For instance, imagine an airline is looking to change the aircraft type for a specific fleet. This will of course have repercussions on the pilot population somewhere else."

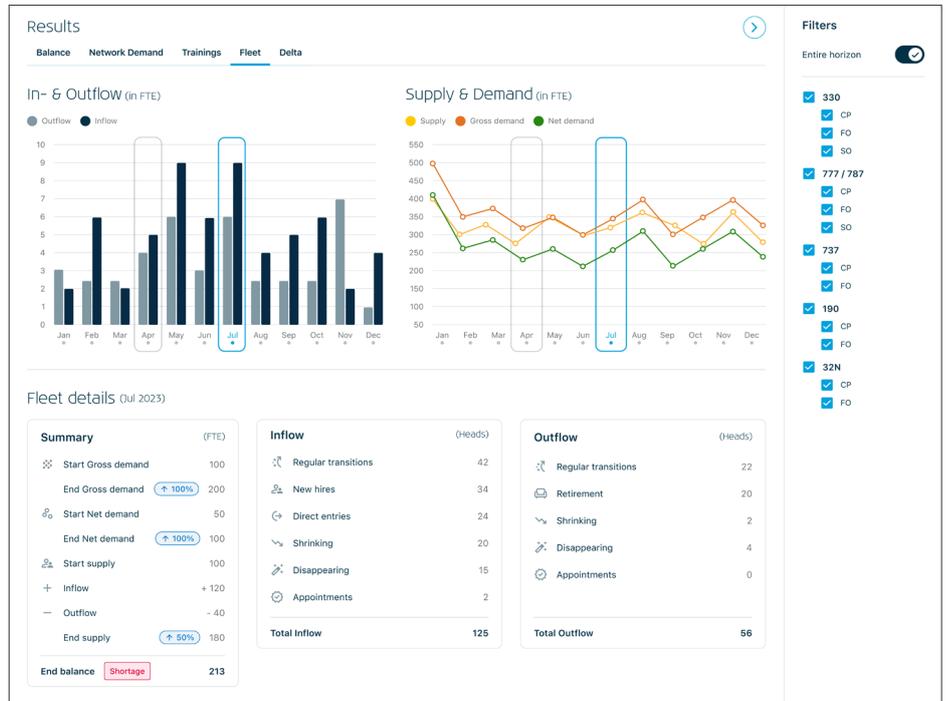
Because the career paths available to pilots are heavily regulated and vary by airline, long-term crew planning requires several years of lead time. That's why KLM and BCG developed CrewVision—to address these planning challenges, which have been further exacerbated by the growing demand for pilots and ongoing fleet renewal within airlines.



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Kunal Kumar, PhD

KLM's Lead Data Scientist for the Partnership with BCG



“People are the most important resources for an airline, which means you have to take into account employee satisfaction. We don’t want to over- or under-assign people,” says Lucile Witmans, KLM’s Director for the partnership with BCG.

Before developing CrewVision, KLM was using legacy systems to run analyses, with data spread across multiple sources. “The evaluation of each scenario could easily take two to three business days, and even then, there were no guarantees that the prepared plan was a good one, let alone optimal,” says Kunal Kumar, PhD, KLM’s Lead Data Scientist for the partnership with BCG.

Expanding the Planning Horizon with Gurobi

When it came to improving that system, KLM considered many different methods, but ultimately settled on the decision-making power of a mathematical solver.

“Gurobi has been the go-to mathematical solver for many optimization problems at KLM. It has unmatched performance, can handle multiple types of models, and provides exceptional support for engineers. It was an obvious choice for CrewVision,” adds Kumar.

Gurobi forms part of the larger CrewVision tech stack. The planning tool uses a neighborhood search algorithm with multiple stages, with Gurobi being one of those stages that can also be

repeated. This gives the team greater flexibility to expand on the run time, as well as the problem.

“The nice thing about Gurobi is that we can easily experiment with different parameters and thresholds. We can do a lot of different runs to see what is still acceptable. So even though we have expanded the problem a lot, we can still go in and quickly get results that are quite good,” shares Tim Lamballais Tessensohn, Data Scientist at KLM.

This allowed the KLM team to expand their planning forecast from nine months to two or three years. After further development, CrewVision is now able to develop five-year plans. “That’s a huge step,” Lamballais Tessensohn adds.

And now, the team can easily run four or five scenarios per day, compared to the several days it would take for a single run with their old system.

“This has significantly increased the speed of our decision-making,” says Komissarova.

A Dynamic Response to Market Volatility

With Gurobi’s solver supporting CrewVision, KLM is now able to calculate five years of crew plans in just four hours. Before using the solver, they would typically run one scenario per week; now, they’re up to 20-30 in that same period.

This allows the team to spend more time strategizing around their long-term vision. In addition to navigating the growing demand for pilots, they’d like to tackle other challenges next, including shortages of ground personnel, engineers, maintenance technicians, and other specialists.

“I think we now have a more dynamic response to volatility in the market,” says Witmans. “We can now plan for a range of scenarios, instead of balancing for a single scenario.”

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