CASE STUDY

Decision Lab: Packing Equipment for Military-Grade Logistics

The LOGOS packing system is expected to increase the UK military's transport efficiency by 20%.

GUROBI OPTIMIZATION | DECISION LAB

Cutting-Edge Innovation, Real-World Application

The Defence Science and Technology Laboratory (Dstl), an executive agency of the United Kingdom's Ministry of Defence, focuses on maximizing the impact of science and technology for the defence and security of the UK. It is staffed by government scientists working at the cutting edge of innovation aimed at practical, real-world applications.

Inefficient transport of goods can waste an incredible amount of time, fuel, and money, in addition to its detrimental impact on the environment. This is especially true for the military, whose logisticians must deliver vital materials and equipment to the right places at the right time.

In highly challenging and stressful conditions, such as military zones, speed is critical. Having a solution to navigate materials packing can improve key logistical challenges under difficult circumstances.

The Challenge

UK-based consultant Decision Lab, which helps organizations solve complex challenges like these, supported Dstl through a Defence and Security Accelerator competition to develop a system that provides more rapid, effective material handling in Deployed Military Logistics Hubs.

The challenge was to enable military personnel to pack more items, more efficiently and effectively, thus reducing the number of pallets and transports needed in each operation. This could improve safety outcomes and conserve valuable resources such as personnel, transport vehicles, and fuel. It also had to be easy to deploy.

Dstl commissioned Decision Lab to show how mathematical optimization could help meet these requirements. The “knapsack” or “bin packing” problem is a classic optimization question. Decision Lab’s challenge was designing an optimization model that would be fast enough to meet military requirements. It needed to provide solutions in tens of seconds.

Solution Design with Gurobi

Decision Lab developed the modular Logistics Optimization System (“LOGOS”). At its heart is the optimization engine—a multi-stage approach that includes a stores-routing algorithm, a pallet packing algorithm, and a transport loading algorithm. LOGOS considers an item’s size, weight, fragility, required orientation, and destination for multi-drop loads.

Since a fast, highly capable solver was key to Decision Lab’s success, they chose Gurobi. When they linked LOGOS to the Gurobi Optimizer, it was able to provide solutions in tens of seconds or minutes, which was the performance Dstl needed.

LOGOS also includes a visual assistant, a dynamic floor-projection system that uses the optimization solution to give contextual instructions to packers, guiding them through their work. This is all delivered in the LOGOS application, which provides a user-friendly way of running the system.

A Race Between LOGOS and Human Packers

Decision Lab trialed the system at Dstl's Logistics Technology Showcase in October 2021 in front of major military and government stakeholders, during which they demonstrated the effectiveness and ease of use of the system.

> "We wanted to test our optimization solution versus human packers," shared the Decision Lab team. "We ran some simple experiments at a military base in the UK where we showed LOGOS could guide a human to pack more effectively—about 20% more items and faster.

If on-the-ground military logistics achieved this improvement, it would have a major impact on cost and efficiency.

Potential Future Applications

Dstl asked Decision Lab to pursue LOGOS further and they extended it to consider additional factors, including: item fragility and malleability; how to handle a military air transport full of items; and how to ensure effective supply runs during long-term operational deployment. Decision Lab demonstrated that LOGOS can scale to larger military transports and reduce the number of transports required (potentially up to 20%) and improve the on-time delivery of key items to military deployments.

LOGOS has demonstrated clear benefits against military challenges. While it was designed for a forward logistics hub, it could be tailored for a wide range of logistics centers—including air, sea, or rail—and civilian logistics. Decision Lab is also investigating an augmented reality-based visual assistant, which could provide powerful visual guidance from end-to-end.

> “But central to its success and future adoption is the optimization core,” explained the Decision Lab team. “And we are continuing to improve the formulation and work with Gurobi to push the solution.

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