Cash+ Keeps ATMs Optimally Stocked

Arute Solutions helps banks deliver the right cash, at the right time, to the right ATMs, while minimizing costs.

Arute Solutions develops advanced enterprise software for Cash and Route Optimization via Machine Learning and Operations Research algorithms for financial Institutions and cash service providers. Their product and service portfolio helps clients to drive up process optimization and brings tangible cost reduction throughout the Cash Supply Chain with highly advanced forecasting and optimization algorithms.

Industry: Financial Services
Location: Americas
Use Cases: Cost Reduction, Forecasting, Inventory Optimization, Logistics, Operations, Supply Chain
Website: arutesolutions.com

Results

Arute Solution's Cash+, powered by Gurobi, enables customers to minimize total operational costs, while conforming to the constraints of each ATM or CMC—with 22% less cash and the same number of CITs.

Contrary to popular belief, the need for cash is on the rise for businesses and individuals alike. Despite recent technological and financial developments in cashless payments, cash is proving that it is indeed still king.

To keep up with demand, banks keep their ATMs stocked with massive amounts of cash. But the key is to stock the right amount of cash to meet demand, without letting cash sit idle—where it can rack up interest costs.

Plus, there are operating expenses to consider, such as the costs of carrying the cash between cash management centers (CMCs) and ATMs, preparing cassettes or cash bags, counting collected cash, maintaining ATMs, and paying Cash-in-Transit (CIT) staff.

This leaves the banks asking an important question: When should we visit an ATM, and how much cash do we need to replenish to its cassettes, subject to all the rules of the operation and the field?

When a bank can identify the optimal answer to that question, they can keep ATMs sufficiently stocked—which increases customer satisfaction—while keeping costs low.

Keeping ATMs Properly Stocked is Complex Business

ATM cash optimization—the process of delivering the right cash, at the right time, to the right ATM—is a highly complex operation, subject to many rules depending on a bank's operational structure. Some banks outsource their CIT operations, while others use their own resources to transfer cash. Because banks have such wide-ranging operation types, cash optimization techniques need to be robust, reliable, and flexible.

Cash optimization techniques also need to consider an ATM's cash accepting-and-dispensing algorithm to achieve the best results. Depending on its cassette-banknote configuration, each ATM has its own transaction rules, meaning that the ATM decides the cassette-banknote combination of each withdrawal request, which in part might be fulfilled by the recycle cassettes.

Furthermore, ATM replenishments depend on CIT operations. For instance, there might be non-visitable days for ATMs, consecutive day replenishments might be undesirable, or there might be a minimum replenishment amount per ATM. These conditions and constraints create an enormous problem space—requiring a robust mathematical model.

Solving such complexity is a challenge. But solving it quickly enough to generate optimal plans on time for each day's operations—that's the key.

Time is Money: Solving Cash Optimization Models, Fast

To address this challenge, Arute Solutions developed the Cash+ ATM and branch solution, which—using advanced machine learning and mathematical optimization algorithms—generates optimal replenishment and collection plans for the next N days for each ATM and branch (cashpoint).

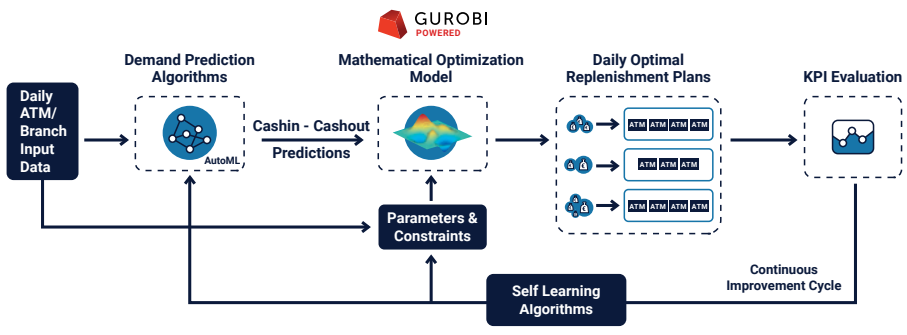

Figure 1: Arute's Cash+ Optimization Workflow

> “According to our empirical results, Gurobi is significantly faster than any other solver on MIP models. With Gurobi, we decreased the solution time by half, compared to another commercial solver that we were using previously.”

Mehmet Arıkkan
CEO of Arute Solutions

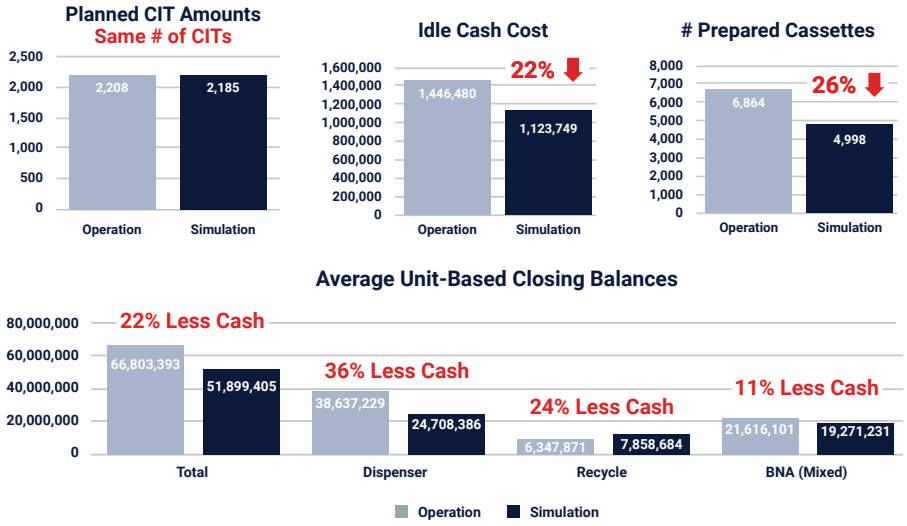

Figure 2: Arute’s Cash+ Simulation Results

“The objective is to minimize total operational costs—including CIT, idle cash, cassette preparation, and cash collecting costs—while conforming to the constraints of each ATM or CMC,” explained Mehmet Arıkkan, CEO of Arute Solutions. “Cash+ supports various replenishment and ATM types, as well as ATM-based or CMC-based system parameters that achieve ultimate flexibility for our customers.”

When running a simulation of Arute’s plans versus current operations, one customer found they could manage the whole operation—with the same number of CITs—with 22% less cash.

With Cash+, customers have been able to achieve the following outcomes with the same number of CITs:

- 26% decrease in the number of prepared cassettes
- 36% reduction in average dispenser unit closing
- 11% reduction in average BNA unit closing
- 24% more recycled cash at ATMs

Cash+ offers clients more recycled cash and fewer— yet enough—replenishments with a remarkably lower level of total cash, even with the same number of CITs. If the operation allows, even more benefit is possible with a greater number of CITs.

Cash+ was able to provide cost savings for all customers and PoCs. In one of the live PoCs for one month, Arute’s Cash+ plans yielded 19% less total cost than a control period.

Powerful Solutions Require a Powerful Engine

To power its Cash+ solution, Arute Solutions needed an advanced mathematical optimization solver, capable of solving real-time models extremely quickly. It would need to solve 5000+ MIP problems in less than 30 minutes, where each model has around 2500+ variables and 5000+ constraints—while ensuring a 0.01% optimality gap at most.

“To generate the best results, we need to have the latest balance information for each ATM just before the planning task starts. On the other hand, CMC staff needs to create the orders as early as possible to prevent any delays in the field. That’s why solving a model in a reasonable time is one of the key binding constraints in this business,” Arıkkan explained.

To find a solver that would be up for the task, the Arute team tested out nearly all commercial and non-commercial solvers that have a C# interface.

“According to our empirical results, Gurobi is significantly faster than any other solver on MIP models,” Arıkkan said. “With Gurobi, we decreased the solution time by half, compared to another commercial solver that we were using previously.”

“In addition, Gurobi supports nearly all advanced features such as callbacks and IIS,” he added. “Gurobi makes it easy to model an optimization solution.”

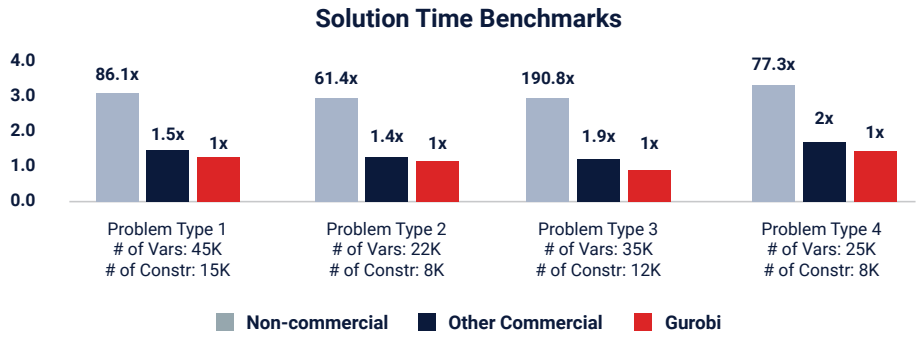

Figure 3: Solution Time Benchmarks on Different MIP Problem Types with Respect to Gurobi

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