

A Guide to Generator-Enhanced Optimization (GEO)

ZAPATA // AI

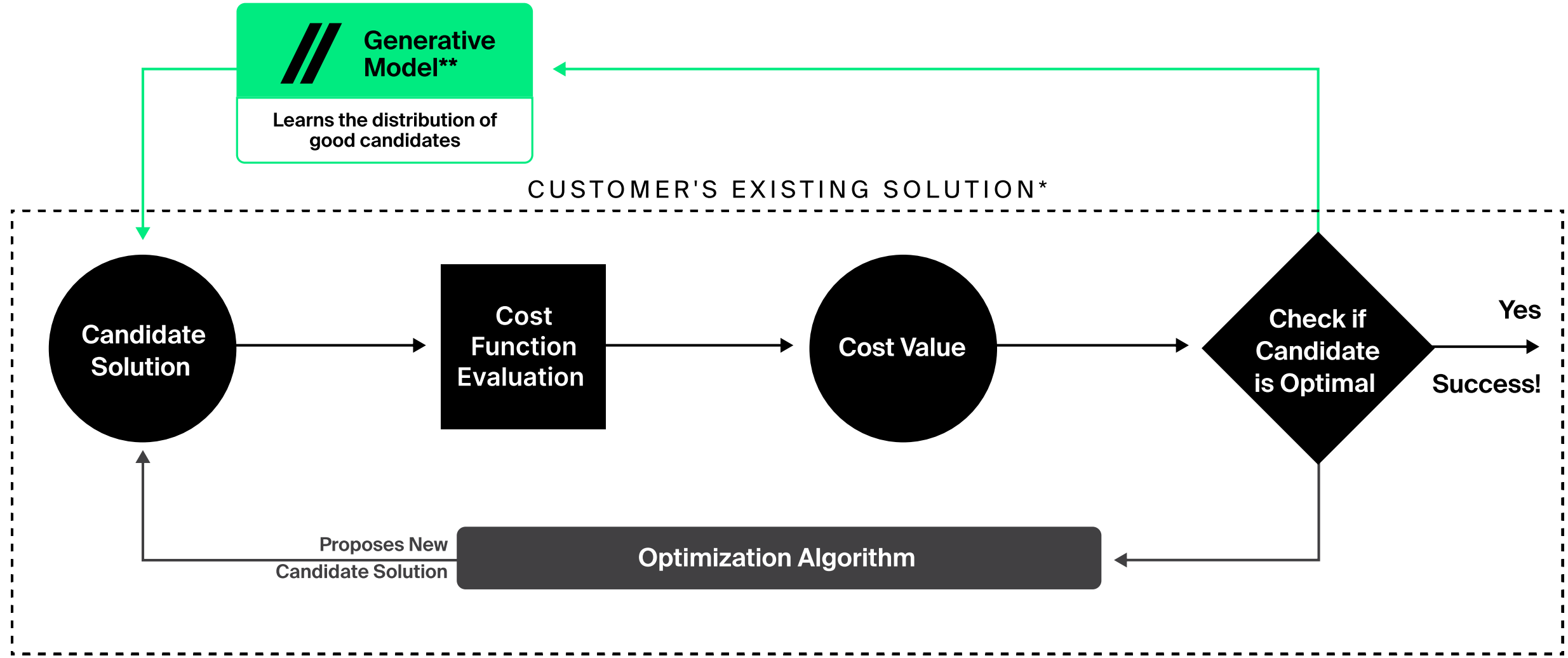
Generative AI for Enterprise Optimization Problems

Generative AI has shown impressive results in generating text, code, images, video, and more. Zapata AI's generator-enhanced optimization (GEO)¹ approach takes the concept further, using generative models to generate novel solutions to complex optimization problems. By training generative models on existing optimization solutions, we can generate new solutions that match or improve upon the solutions generated by leading classical optimization solvers. **We believe this could be the fastest path to practical quantum advantage over classical methods.**

1. Patent pending.

GEO Enhances Existing Optimization Solutions

Classical solvers can already deliver effective solutions for optimization problems across industries. GEO does not compete with these solvers – it enhances them. Quantum or quantum-inspired generative models can improve upon classical models' ability to generalize from the training data, which results in new solutions that were previously unconsidered.



*GEO can augment customers' existing solutions, or Zapata AI can help build the classical optimizer in cases where it does not yet exist.
**Goal is to provide better candidate solutions with fewer cost function evaluations

GEO Works With Any Generative Model: Classical or Quantum

Most generators will be classical or quantum-inspired in the near-term, but as quantum hardware matures, users that have built GEO application workflows on Orquestra will be able to plug in more powerful quantum generators.

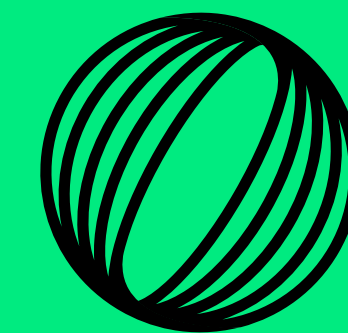


"GEO is an opportunity for business leaders to harness generative AI for complex optimization problems, potentially unlocking more efficient solutions than conventional algorithms."

Jhonathan Romero Fontalvo, Ph.D., Director of Professional Services & Co-Founder

GEO is Available on Orquestra®

At the heart of Orquestra's Quantum Machine Learning Suite are our proprietary Generative AI techniques, including a GEO library.

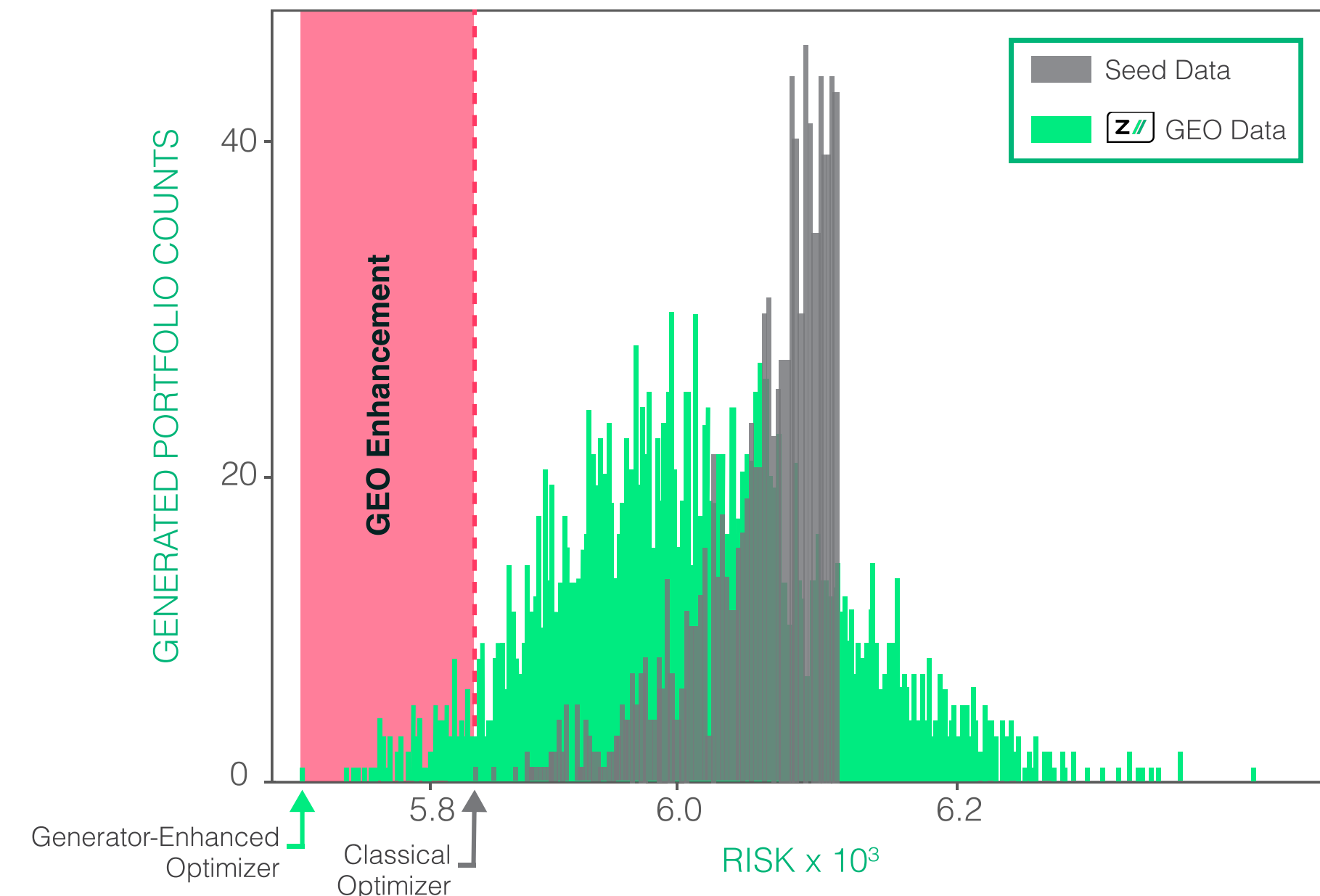


Orquestra®

Featured Use Case: Financial Portfolio Optimization

Investors seek the optimal allocation of capital to maximize returns and reduce risk – a complex undertaking given the sheer number of variables. Automated algorithms are often used to optimize the trading of assets within a portfolio, but current models can only account for so many variables before running up against the limits of classical computing.

Using real S&P 500 data, our proprietary quantum-inspired generative model proposed new combinations of portfolios with the same level of return but with lower levels of risk than the combinations generated by classical solvers.



Alcazar, J. F., Vakili, M. G., Kalayci, C. B., & Perdomo-Ortiz, A. (2022). GEO: Enhancing Combinatorial Optimization with Quantum Generative Models.

Select GEO Applications by Industry

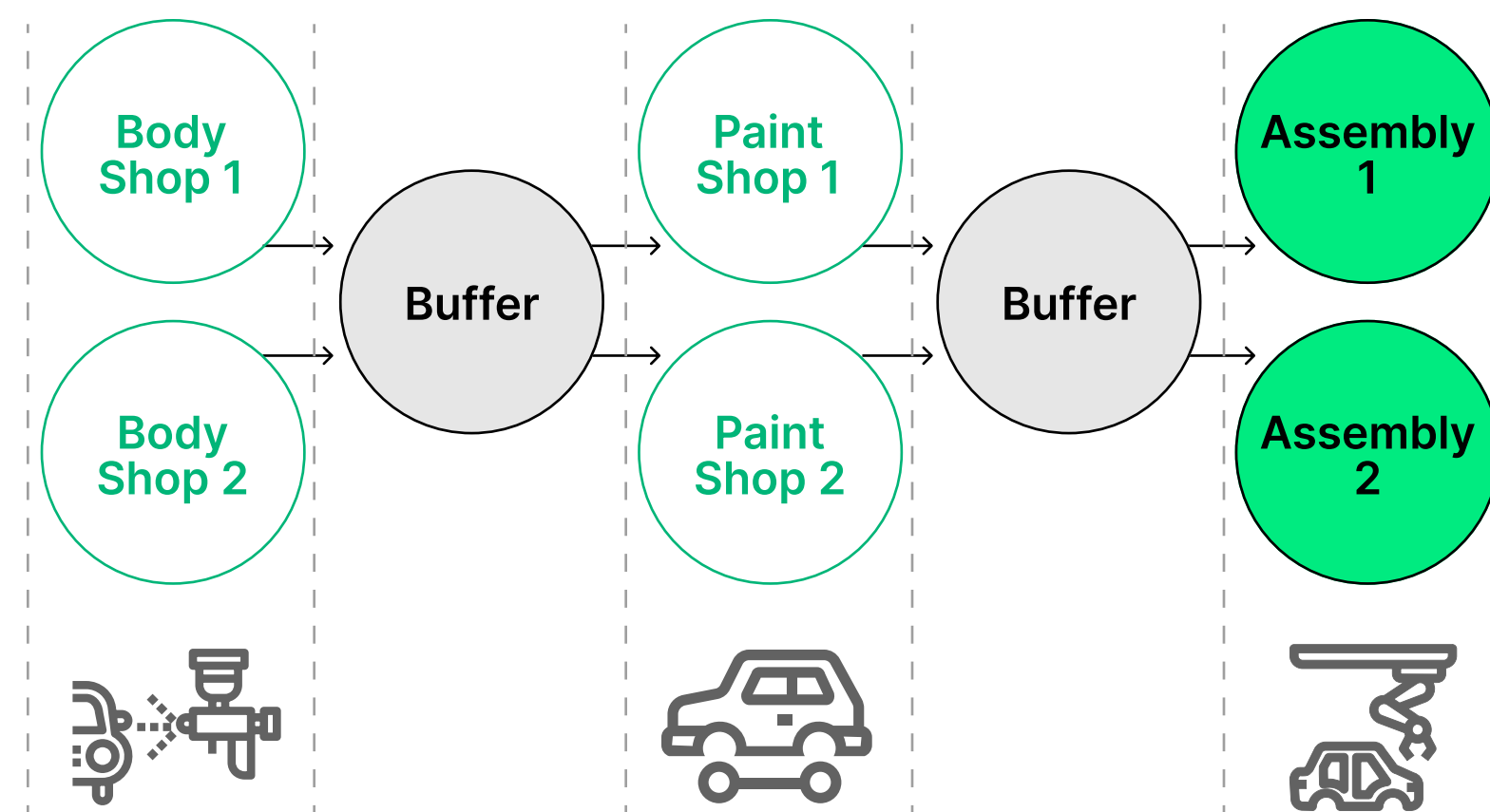
Energy & Chemistry	Manufacturing	Consumer Goods	Health & Pharma	Finance	Logistics & Transportation	Telecom & IT
Battery composition optimization	Manufacturing process optimization	Inventory optimization	Clinical trial patient selection	Capital allocation optimization	Delivery routing optimization	Network optimization

For more relevant applications to your business, see Zapata AI's solutions.

<https://zapata.ai/generative-ai-solutions/>

Case Study: BMW Plant Scheduling Optimization

Manufacturers often face a difficult optimization problem: how do they schedule their workers to meet production targets while minimizing idle time? There are many considerations and constraints, including varying production rates between shops, a discrete set of shift schedules, and the need to prevent overflows and shortages in the buffers between steps in the manufacturing process. As part of their membership in MIT's The Center for Quantum Engineering (CQE), Zapata AI optimized BMW's plant scheduling using GEO. We ran about one million optimization runs on Orquestra[®], cycling through dozens of problem configurations and optimizer solutions to benchmark their performance against each other. Zapata AI identified the best algorithm to solve each problem

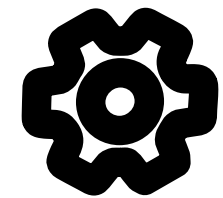


configuration, whether it was quantum or classical. **For 71% of configurations, GEO could either match or outperform existing state-of-the-art solvers.** Critically, GEO was the best solver for configurations with the largest space of possible solutions.

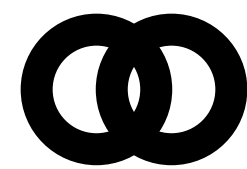
See *BMW Case Study*.

<https://zapata.ai/bmw-ai-in-automotive-case-study/>

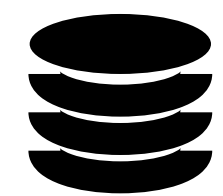
Advantages of Generator-Enhanced Optimization



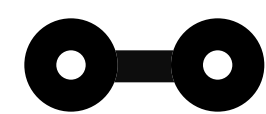
Universal Solver: GEO is flexible enough to adapt to any optimization problem.



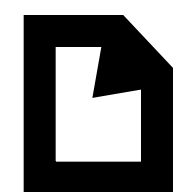
Works as a Booster: GEO doesn't compete with your existing solvers, it works with them to enhance the results. GEO can also work as a stand-alone solver.



Independent of Cost Function: GEO works with any cost function, no matter how difficult it is to compute.



Forward Compatible: GEO will continue to improve as generative models, traditional optimizers, and quantum hardware improve.



Data Driven: More data leads to better results. GEO uses the entire history of past candidate solutions, not just the most recent.

Get in touch for a demo.

Schedule a briefing to learn more about GEO and other Generative AI methods and how they can deliver better solutions for use cases in your enterprise.

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