

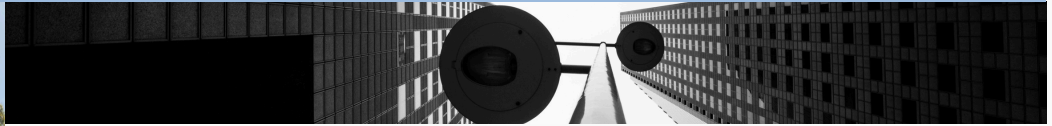
# NEWSLETTER



PHOTOGRAPHED BY MATRIXELLENT INC.

## INDUSTRIAL ENGINEER RESEARCH VOLUNTEER: HAODONG HU

- Conduct fundamental research on SCM, focusing on delivery system logistics.
- Engage in basic research of operational models for forming logistic relationships.
- Gain comprehensive knowledge and understanding of Graph Theory combined with delivery system theorem.
- Design analysis of exploring and contrasting pathfinding and search algorithms' unique features, efficiencies, and potential advancements.
- Focus on the pairwise comparison between Dijkstra and A\*, Breadth-First Search (BFS), and Depth-First Search (DFS).



## BASIC RESEARCH

At MATRIXELLENT INC., our primary basic research objective is to gain a more comprehensive understanding and knowledge of the subject under study without specific applications in mind. Our current research is about delivery system optimization, a crucial component within supply chain logistics. MATRIXELLENT INC.'s basic research topics include the general study of drone materials and dissecting and analyzing contemporary algorithms and methodologies that govern the efficiency and functionality of delivery systems. By integrating perspectives from mathematics, data analysis, industrial engineering, operations research, and computer science (machine learning), we uncover the intricate mechanics and underlying principles driving these systems. MATRIXELLENT INC.'s basic research emphasizes the commitment to acquiring comprehensive knowledge and understanding of delivery system optimization (supply chain system) topics. Haodong Hu's current research focuses on delivery system logistics, specifically comparing pathfinding algorithms and establishing logistic relationships.

### Legal Definition

MATRIXELLENT INC. is a Delaware charitable nonstock corporation that is primarily engaged in basic research. Basic research is general research to gain more comprehensive knowledge or understanding of the subject under study, without specific applications in mind. Basic research is also research that advances scientific knowledge, but does not have specific immediate commercial objectives although it may be in fields of present or potential commercial interest. It may include research and investigation in the sciences, social sciences, or humanities. (8 CFR 214.2(h)(19)(iii)(C)).

## COMPREHENSIVE UNDERSTANDING

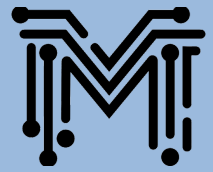
Supply Chain Management (SCM) encompasses a comprehensive framework designed to strategically oversee and synchronize the interconnected operations essential for the efficient flow of goods and services from suppliers to end consumers. At its core, SCM integrates six pivotal components (in MATRIXELLENT INC.'s basic research, MATRIXELLENT INC. conducts general research to gain more comprehensive knowledge or understanding of the subject (Supply Chain Management (SCM)) under study without specific applications in mind. Our research emphasizes on advancing scientific knowledge, but does not have specific immediate commercial objectives).

SCM encompasses the end-to-end management of the supply chain, from planning and sourcing to manufacturing and logistics.

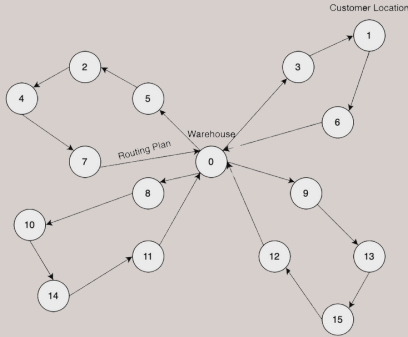
The delivery system is a critical part of this chain, focusing on the transportation, warehousing, order processing, and final delivery of products to customers.

|     | wh  | cust | load_tag | drone_id | prod_ | quant | cust_sort | weight |
|-----|-----|------|----------|----------|-------|-------|-----------|--------|
| 0   | 0   | 777  | 0        | 0        | 225   | 1     | 777       | 108    |
| 1   | 0   | 777  | 1        | 1        | 150   | 1     | 777       | 110    |
| 2   | 0   | 777  | 2        | 2        | 277   | 1     | 777       | 100    |
| 3   | 0   | 777  | 2        | 2        | 62    | 1     | 777       | 2      |
| 4   | 0   | 193  | 2        | 2        | 15    | 1     | 193       | 93     |
| ... | ... | ...  | ...      | ...      | ...   | ...   | ...       | ...    |

WORK PRODUCT BY HAODONG HU (INDUSTRIAL ENGINEERING VOLUNTEER) AT MATRIXELLENT INC.



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## GOOGLE OR TOOLS – ROUTING SOLVER

- The core idea: Given a starting location and a set of customers to serve, it produces a routing sequence that minimizes the longest distance traveled by any one vehicle.
- Engage in fundamental research on the Traveling Salesman Problem (TSP) to understand the use of the `pywrapcp.RoutingIndexManager` function.
- Develop a comprehensive knowledge of Google OR Tools, specifically focusing on variations of the Vehicle Routing Problem (VRP).
- Conduct in-depth research on the arc cost evaluator, `transit_callback_index`, which serves as the solver's internal reference to the distance callback from a theoretical perspective.
- Gain a thorough understanding of the first solution strategy using Python.



## FUNDAMENTAL RESEARCH

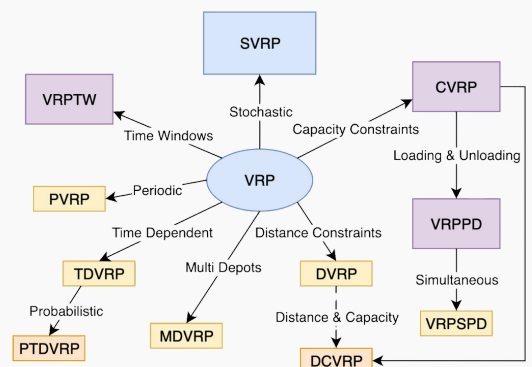
MATRIXELLENT INC. is primarily engaged in basic research to advance more comprehensive understanding and scientific knowledge about methodologies and algorithms for addressing the Vehicle Routing Problem (VRP) and its numerous variations (current research). These variations include the Capacitated Vehicle Routing Problem (CVRP), Vehicle Routing Problem with Time Windows (VRPTW), Vehicle Routing Problem with Pickup and Delivery (VRPPD), and particularly the Stochastic Vehicle Routing Problem (SVRP).

The primary objective in tackling these problems is to devise optimal routing strategies that minimize operational costs, such as total travel distance or time, while adhering to the constraints specific to each variant. We explore and compare current methods to understand their efficacy and limitations. This involves rigorous analysis and benchmarking of various algorithms, including classical approaches, heuristic methods, and modern machine learning-based solutions. This research is critical for improving efficiency and reducing costs in logistics and transportation, where routing optimization plays a pivotal role.

## SCIENTIFIC KNOWLEDGE

The VRP serves as a foundational model in logistics, aiming to determine the most efficient routes for a fleet of vehicles to service a set of customers. The goal is to minimize total travel distance or time while satisfying various constraints, such as vehicle capacity and customer service requirements. The CVRP extends the VRP by incorporating vehicle capacity constraints, ensuring that the sum of demands for each route does not exceed the vehicle's capacity. The VRPTW introduces another layer of complexity by adding time windows during which each customer must be serviced, necessitating careful scheduling and route planning to ensure compliance with these time constraints.

The VRPPD involves both pickup and delivery locations for each customer, adding a precedence constraint that requires the pickup location to be visited before the corresponding delivery location. These variations reflect real-world complexities that logistics and transportation companies must address to optimize their operations.



WORK PRODUCT BY YAN LI (INDUSTRIAL ENGINEERING VOLUNTEER) AT MATRIXELLENT INC.