Proof-of-concept

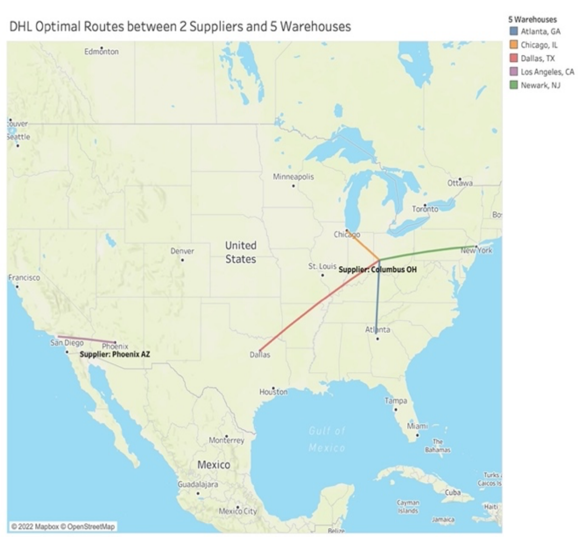
Success Criteria

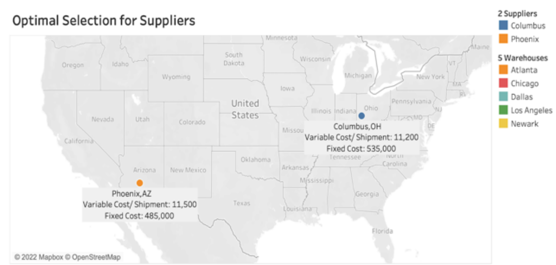
First, the linear programming optimization model (includes objective function and constraints) is designed in the hypothetical scenario and solved for the minimized total cost by selecting optimal routes among the given suppliers and warehouses with Python.

A. The objective function with six constraints is listed as below:

$$
\begin{aligned}
\text{Minimize}\quad & \textstyle\sum_{i=1}^{10}\sum_{j=1}^{11} x(i,j) * (VC(i) + R(i,j)) + \sum_{j=1}^{11}\sum_{k=1}^{988} y(j,k) * (VC(j) + R(j,k)) + \\
& \textstyle\sum_{i=1}^{10} FC(i) * s(i) + \sum_{j=1}^{11} FC(j) * w(j) \\
\text{Subject to}\quad & x(i,j), y(j,k) \in Z, && i \in 1,2,\dots,10,\ j \in 1,2,\dots,11,\ k \in 1,2,\dots,988 \\
& s(i), w(j) \in (0,1), && i \in 1,2,\dots,10,\ j \in 1,2,\dots,11 \\
& \textstyle\sum_{i=1}^{10} x(i,j) \geqq \sum_{k=1}^{988} y(j,k) * w(j)/1000, && j \in 1,2,\dots,11 \\
& \textstyle\sum_{j=1}^{11} y(j,k) \geqq D(k), && k \in 1,2,\dots,988 \\
& \textstyle\sum_{k=1}^{988} D(k) * s(i) \geqq \sum_{j=1}^{11} x(i,j), && i \in 1,2,\dots,10 \\
& \textstyle\sum_{k=1}^{988} D(k) * w(j) \geqq \sum_{k=1}^{988} y(j,k), && j \in 1,2,\dots,11
\end{aligned}
$$

B. The optimal routes for the hypothetical scenario with python are listed as below:





As shown in the figures above, the selection for suppliers is supplier 2 (Phoenix AZ) and supplier 5 (Columbus OH). The result for warehouse selection is warehouse 1 (Newark), warehouse 2 (Atlanta), warehouse 3 (Dallas), warehouse 5 (Los Angeles), and warehouse 6 (Chicago). There are five combinations of suppliers and warehouses, which are (2, 5), (5, 1), (5, 2), (5, 3), and (5, 6). There are 991 combinations of warehouse and customer shipment, which are (1, 1), (1, 6), (1, 9), (1, 10), (1, 19) … (6, 965), (6, 966), (6, 967), (6, 973), (6, 979). With the optimized solution of DHL network design, the total minimized price is $16,037,400.

Second, the calculated outcomes of the model must meet the success criteria for both the business functional assessment and the technical assessment, which are listed as follow:

A. Cost Minimization: Given the predefined model in a certain scenario (hypothetical scenario: 10 suppliers, 11 warehouses, and 988 customers, with specific partial costs), the optimal selection for the combinations of route paths (among suppliers, warehouses, and customers) must provide a minimized financial cost in total, so that the revenues and profits can be maximized for both DHL and the client Juice 2U. If there exists any solution that has a lower total price than the result of the model which is $16,037,400, then the model technically fails to meet such a requirement which implies that the model is not an optimal one.
B. Model Applicability: Considering about the complicated situations in the real world of supply chain management industry, the optimal model must be applicable in different scenarios, which means the model can function well not just limited to the hypothetical one as mentioned. By changing the number of suppliers, warehouses, and customers, as well as the partial costs (variable costs, fixed costs, and shipment costs), the model should work effectively to reach the optimization goal.
C. Efficiency in Running Time: The outcome with the optimal routes must provide the shortest delivery time to each customer, so that the products are as freshly new as possible when the customer receive them. If there exists any solution that can offer a shorter running time from any supplier to any customer, then the model technically fails to meet such a requirement to be the best solution for the project.
D. Practical Network: The suggested strategies offered by the model must be capable of being put into the real practice, which means the optimized solutions are clearly clarified and the recommended instructions are easy enough to be followed by a simple series of steps with practical actions. If not, the model fails to meet such a requirement for optimization.

Schedule

The schedule with proposed deliverables for the rest semester is listed as below:

- <u>Week 8:</u>
  a. The linear programming model (includes objective function and constraints) will be continuously developed and solved by python by utilizing multiple kinds of methods and algorithms with comparison, with efforts to meet the success criteria. The risk of investing too much time on seeking the most efficient methods will be considered.
  b. The model will be improved with remained advantages and will be revised with updates based on the feedback of clients.
- <u>Week 9:</u>
  a. [milestone] linear programming model (includes objective function and constraints) will be confirmed as updates. The risk of finding a better model later after this week will be considered to replace with the best one as our latest solution to the clients.
  b. The model will be tested in different scenarios with explanation and visualization through weekly presentation, as our initial result of sensitivity analysis.
- <u>Week 10:</u>

a. [milestone] Sensitivity analysis will be developed based on the confirmed model, to test for the optimal results in different scenarios for model applicability.

- Week 11:
    a. [milestone] After the sensitivity analysis, the results will be finally tested as the best solution and will be offered with recommended strategies for supply chain optimization to the clients.
    b. The latest results will be explained in detail with practical suggestions for operational improvement.

Deliverables

The deliverable of project will include following materials:

- Technical part:
    a. Python script (algorithm implementation)
    b. Excel spreadsheet (raw data)
- Non-technical part:
    a. Formalized slides containing full information
    b. Final reports containing detailed information of the entire project

Date: __________ Signature:_________