Logistics Optimization for Food Delivery in Marion County

Final Progress Update

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Engineering Capstone Group

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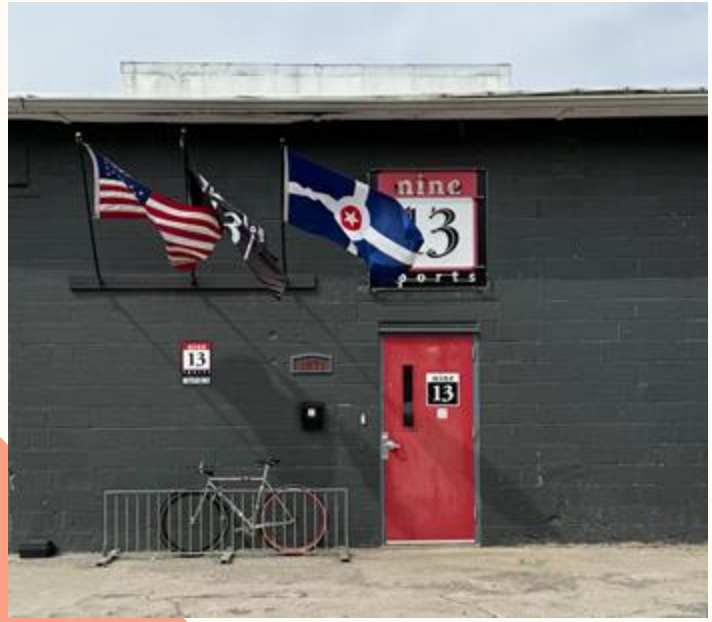
Nine13 Logistics

Nine13 is a non-profit organization founded by **Tom Hanley** in 2012 that emphasizes health and fitness for kids through bikes.



Since 2020, Nine13 Logistics supports the community by delivering food via **home** (box) and **pallet** delivery services.

Pallets

Boxes

Engineering Problem Statement

Nine13 Logistics will expand its operation. A **new warehouse** will be constructed, and new vehicles will be acquired. This project aims to:

1) Provide a robust analytical framework to model, simulate, and **optimize** both home and pallet delivery.

2) Enable informed decision-making for reallocating resources, minimizing **costs**, and maximizing operational **effectiveness**.

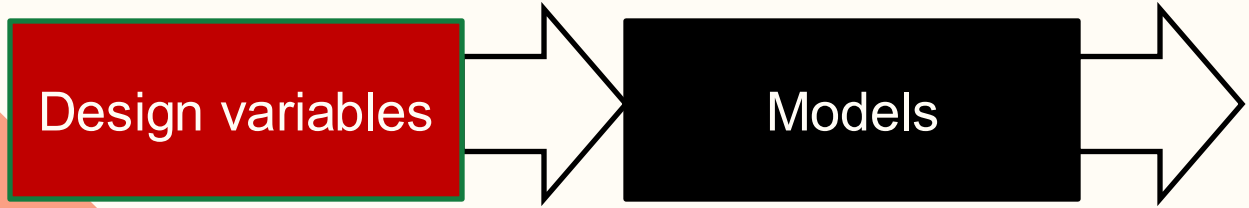
Design Approach

This methodology for this project is based on research from Alan Brown (V Tech, NAVSEA), aiming to optimize ship design by giving each design a rating of:

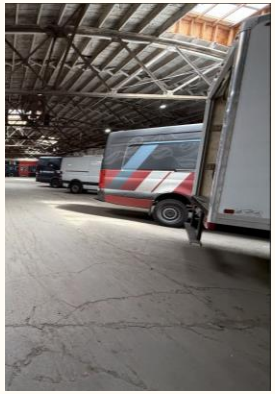
- Overall Measure of Effectiveness (OMOE)
- Overall Measure of Cost (OMOC)

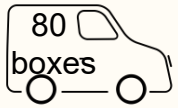
OMOE

OMOC



Design Variables





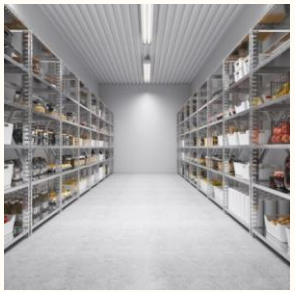
(x2)

(x1)

(x2)

Name	Range
Additional small vans	$0 \leq n_{\mathrm{sv}} \leq 3$
Additional large vans	$0 \leq n_{\mathrm{Lv}} \leq 3$
Additional box trucks	$0 \leq n_{\mathrm{trk}} \leq 3$
Frozen food containers	$0 \leq n_{\mathrm{frzn}} \leq 3$
Chilled food containers	$0 \leq n_{\mathrm{chill}} \leq 3$

(x1)



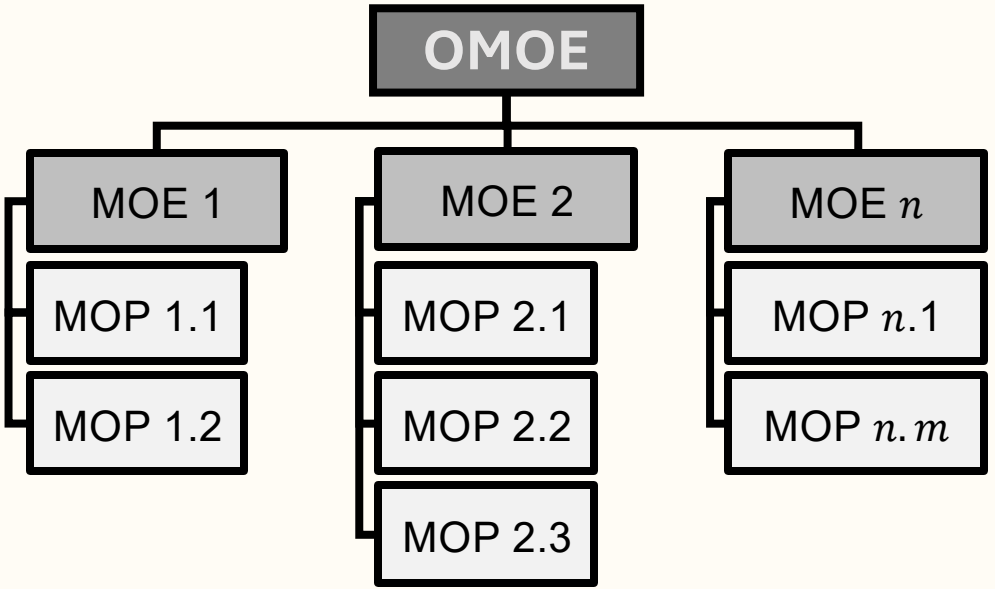
(x1)

Overall Measure of Effectiveness

$$\mathrm{OMOE} = \sum_{i=1}^{n} w_i \, \mathrm{MOE}_i$$

$$\mathrm{MOE}_i = \sum_{j=1}^{m} w_{ij} \mathrm{VOP}_i(\mathrm{MOP}_i)$$

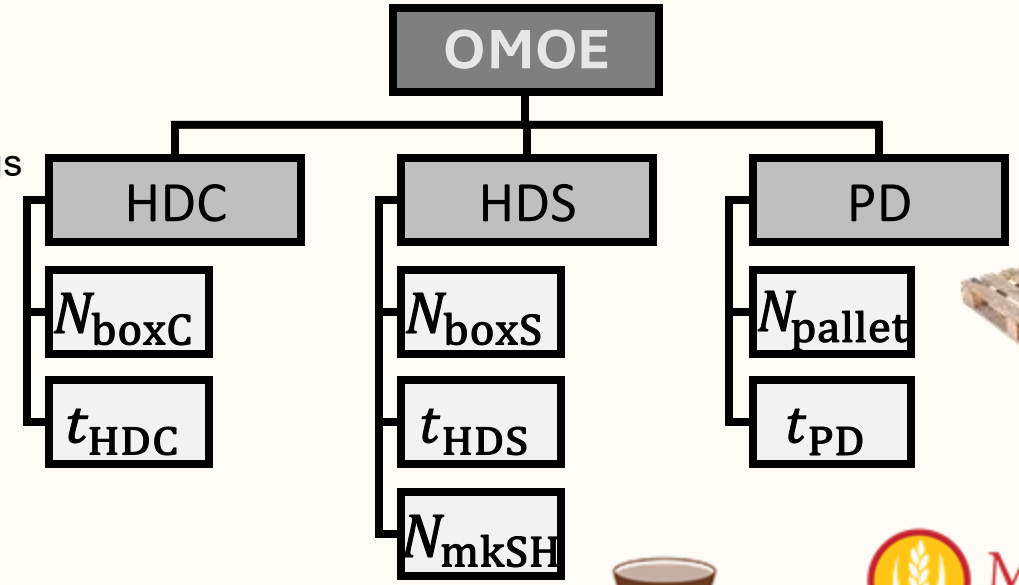
MOE: Measure of effectiveness
MOP: Measure of performance
VOP: Value of performance
w_i, w_{ij}: Weighting factors



Overall Measure of Effectiveness

HDC: Home delivery CICOA
HDS: Home delivery Second Helpings
PD: Pallet delivery

N_{boxC}, N_{boxS}: Boxes delivered
N_{pallet}: Pallets delivered
t_{HDC}, t_{HDS} , t_{PD}: Delivery time
N_{mkSH}: Number of meal kits for SH



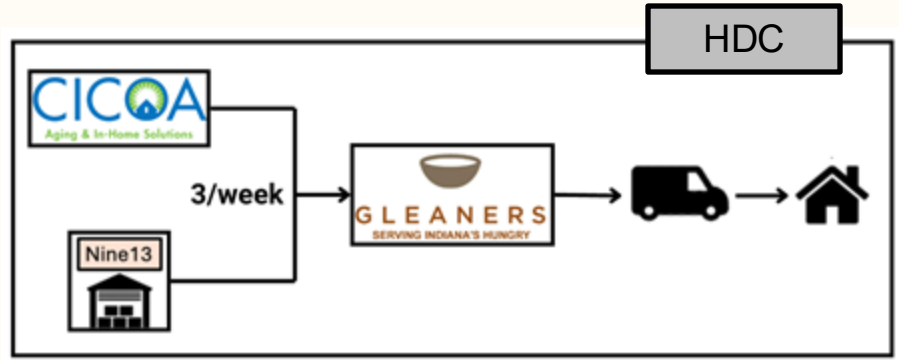
CICOA Aging & In-Home Solutions
A member of the IN connect Alliance.

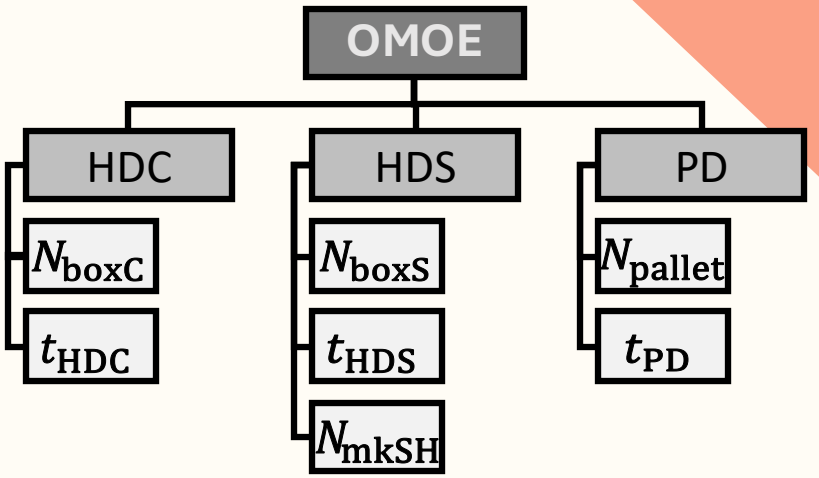
Second Helpings

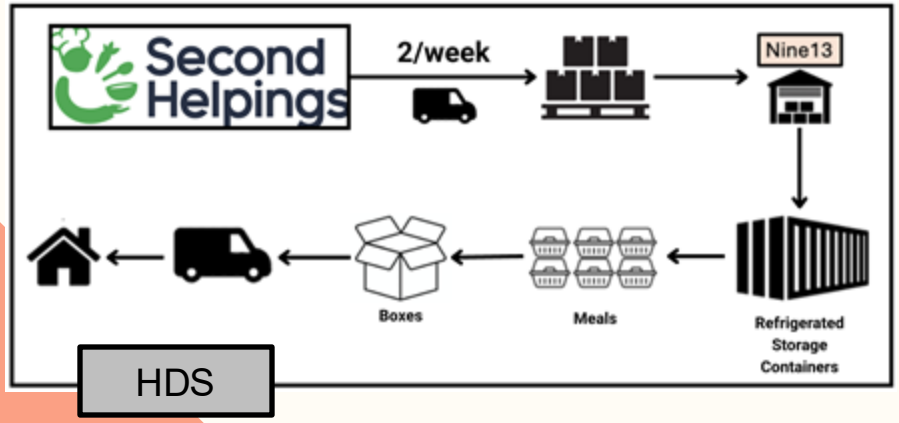
GLEANERS
a member of FEEDING AMERICA

Midwest FOOD BANK.

Missions: HDC, HDS, PD



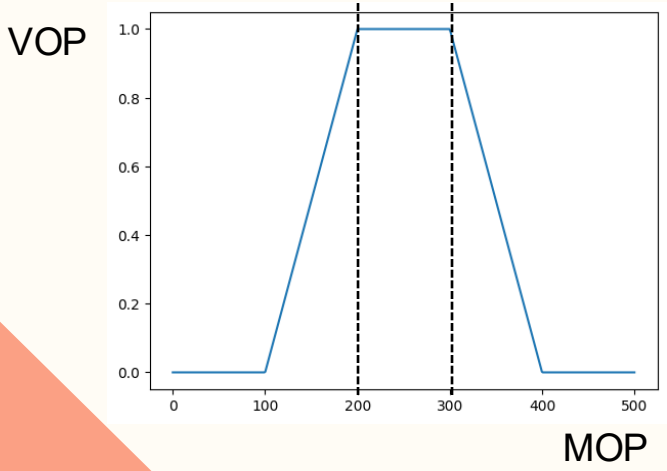


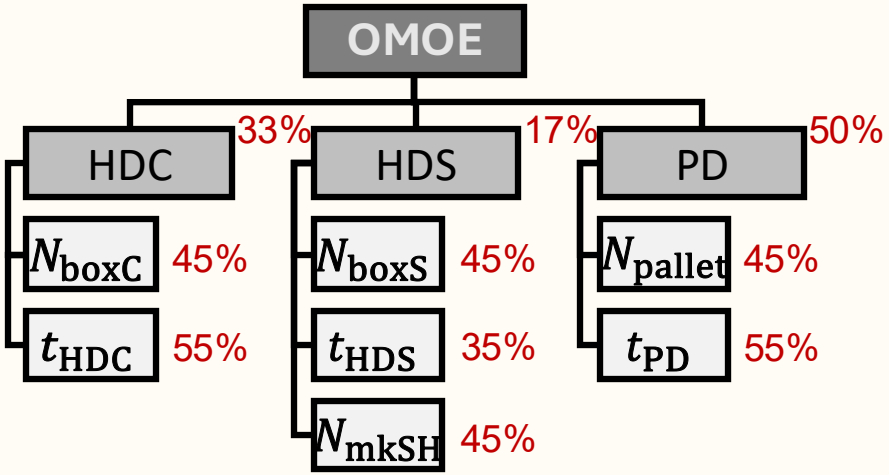


Measure of Perfomance (MOP)

$$\mathrm{OMOE} = w_1 \mathrm{VOP}_1(\mathrm{HDC}) + w_2 \mathrm{VOP}_2(\mathrm{HDS}) + w_3 \mathrm{VOP}_3(\mathrm{PD})$$

$$\mathrm{HDC} = w_{11} N_{\mathrm{box}} + w_{12} \mathrm{t}_{\mathrm{HD}}$$
$$\mathrm{HDS} = w_{21} N_{\mathrm{mkSH}} + w_{22} N_{\mathrm{box}} + w_{23} \mathrm{t}_{\mathrm{HD}}$$
$$\mathrm{PD} = w_{31} N_{\mathrm{pallet}} + w_{32} \mathrm{t}_{\mathrm{PD}}$$





Overall Measure of Cost

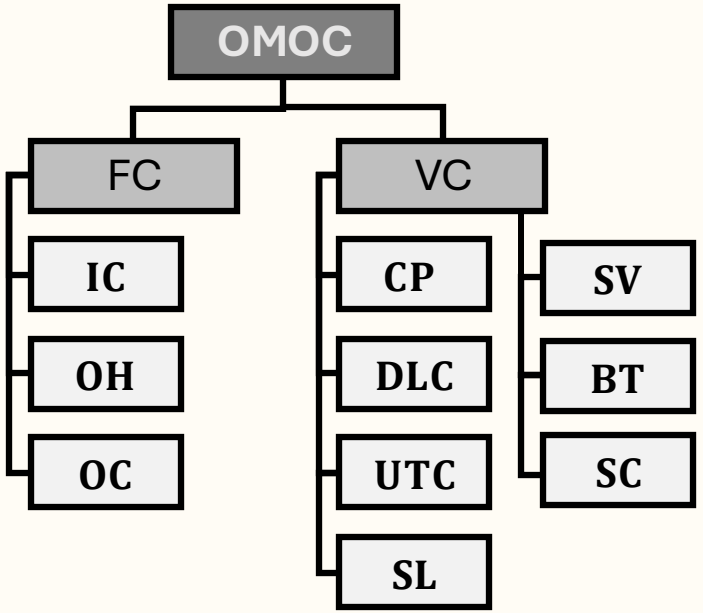
$$\mathrm{OMOC} = \mathrm{FC} + \mathrm{VC}$$

$$\mathrm{FC} = \mathrm{IC} + \mathrm{OH} + \mathrm{OC}$$
$$\mathrm{VC} = \mathrm{CP} + \mathrm{DLC} + \mathrm{UTC} + \mathrm{SL} + \mathrm{SV} + \mathrm{BT} + \mathrm{SC}$$

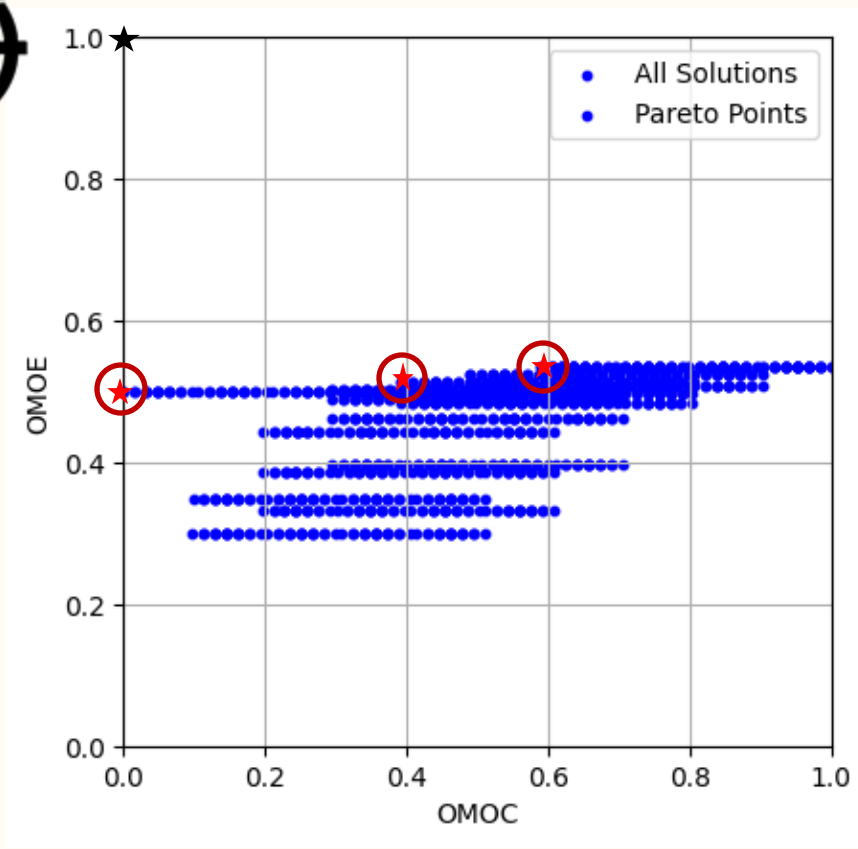
FC: Fixed costs
VC: Variable costs

VOP:

$$\mathrm{VOP(OMOC)} = \frac{\mathrm{C}_i - \mathrm{C}_{min}}{C_{max} - C_{min}}$$



Results

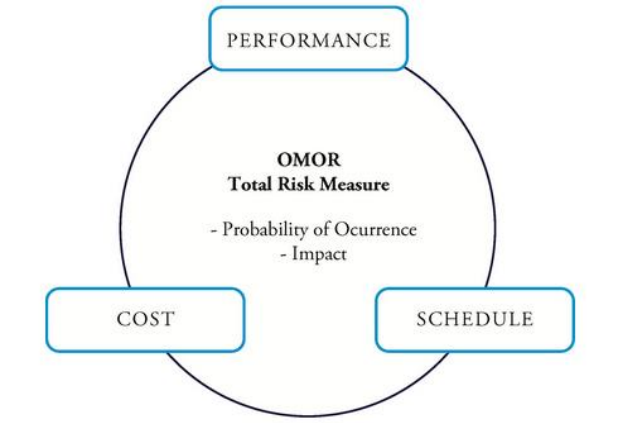


Results

Name	Lowest Cost	Highest Effectiveness	Best Compromise
Additional small vans	0	3	0
Additional large vans	0	3	0
Additional box trucks	0	0	1
Frozen food containers	0	0	0
Chilled food containers	0	0	0

Next Steps

- Add a risk component to the model to present **Overall Measure of Risk** (OMOR) simultaneously with OMOE and OMOC



- Develop mathematical models **specific to the different programs Nine13** has throughout the year to provide OMOE and OMOC modeling for specific opportunities

Questions?