FEEDER NETWORK OPTIMIZATION

Company Background

UPS provides delivery and pickup services. After a rough sorting process at the airport hub, packages are transported back to the distribution centre (DC) for further sorting and delivery.

Objective

Achieve annual cost savings of 3%

Problem Statement

1. Current practice of moving logistics involves double handling of packages which translates to higher costs incurred.
2. Company requires a systematic framework for purchasing vehicles

Methodology

1. Revise operational plan and process flow to reduce double handling of packages which will in turn reduce costs incurred
2. Develop a framework for vehicle purchasing, that optimizes future vehicle configuration with respect to the forecasted demand and costs.

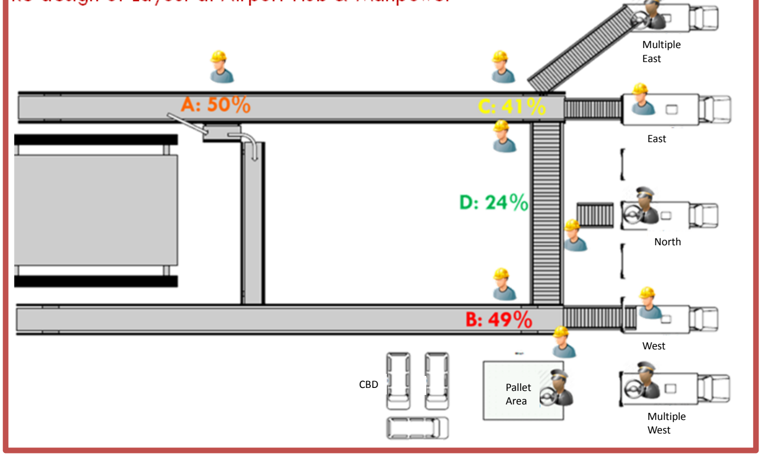
Operational Planning: Process Flow

Shift sorting process for 'multiples'[1] from the DC to the hub

1. Night shift workers drive 'multiple' trucks from the DC to the hub
2. 'Multiple' drivers report directly to the hub and pick up respective items
3. 'Multiple' drivers depart from, the hub directly for delivery
4. Redesign of layout at the hub to accommodate sorting process for 'multiples'

[1]'Multiples' refer to groups of packages which are delivered to the same address

Re-design of Layout at Airport Hub & Manpower



Feasibility Check

Equipment: Shift existing equipment from the DC to the hub
Operations: Manageable package flow & manpower reallocation

Improvements

By shifting the sorting of 'multiples' from the DC to the hub, double handling of packages is eliminated, which translates into 1.5 man hours savings for each driver of 'multiples' vehicle and the west 'multiples' helper daily.

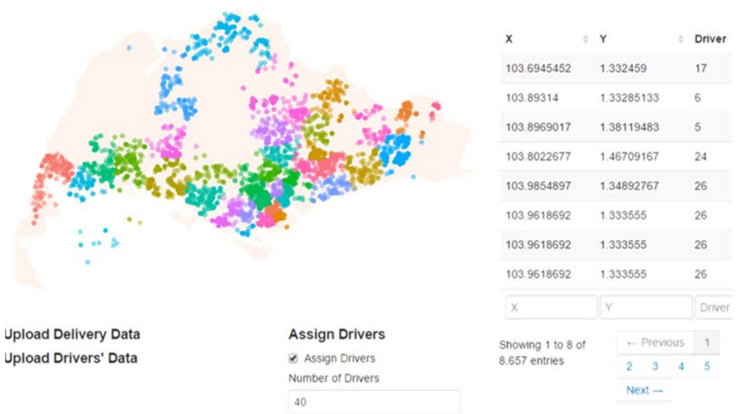
Total Savings: 24 man hours per week

Total reduction in manpower cost per week will be 24 times the hourly rate for a UPS driver.

Implication: Improvement in service level on top of cost savings

Additional Tool

Web application that assigns packages to drivers for more efficient routing:



X	Y	Driver
103.6945452	1.332459	17
103.89314	1.33285133	6
103.8969017	1.38119483	5
103.8022677	1.46709167	24
103.9854897	1.34892767	26
103.9618692	1.333555	26
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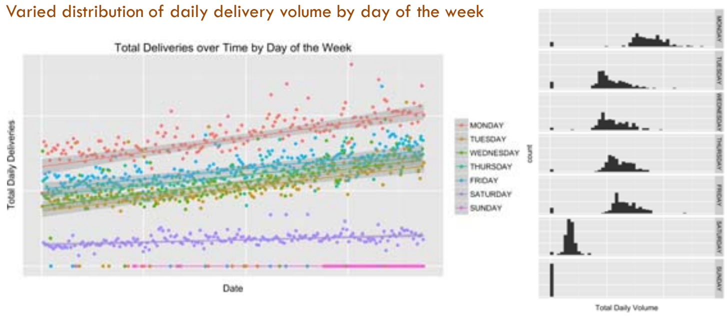
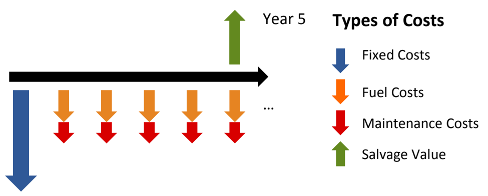
Tactical Planning: Vehicle Configuration

Varied distribution of daily delivery volume by day of the week



Implication: Demand should be segmented into two groups: Mon vs Tue-Fri

Vehicle Cost Estimation



Daily Vehicle Cost

Mathematical Model

Objective: Minimize total cost: manpower + vehicle

$$\min z = \sum_{y\in Y}\sum_{t\in T} x_{t,y}^{v}\cdot c_{t,y}^{v} + \sum_{t\in T}\sum_{y\in Y}\left(x_{t,y}^{mo}\cdot c_{y}^{0} + x_{t,y}^{mn}\cdot c_{y}^{n}\right) + 4\sum_{t\in T}\sum_{y\in Y}\left(x_{t,y}^{wo}\cdot c_{y}^{0} + x_{t,y}^{wn}\cdot c_{y}^{n}\right)$$

Constraint set #1: Ensure 100% demand satisfaction

$$\sum_{t\in T} x_{t,y}^{mo}\cdot d_{t,y}^{o} + \sum_{t\in T} x_{t,y}^{mn}\cdot d_{t,y}^{n} \geq i_{y}^{m} \quad \forall y\in Y$$

$$\sum_{t\in T} x_{t,y}^{wo}\cdot d_{t,y}^{o} + \sum_{t\in T} x_{t,y}^{wn}\cdot d_{t,y}^{n} \geq i_{y}^{w} \quad \forall y\in Y$$

Constraint set #2: OT regulation

$$\sum_{t\in T} x_{t,y}^{wo} \leq o\cdot\left(\sum_{t\in T} x_{t,y}^{wo} + \sum_{t\in T} x_{t,y}^{wn}\right) \quad \forall y\in Y$$

$$\sum_{t\in T} x_{t,y}^{mo} \leq o\cdot\left(\sum_{t\in T} x_{t,y}^{mo} + \sum_{t\in T} x_{t,y}^{mn}\right) \quad \forall y\in Y$$

Constraint set #3: Driver-Vehicle logic

$$\sum_{i=0}^{y} x_{t,i}^{v} \geq x_{t,y}^{wo} + x_{t,y}^{wn} \quad \forall t\in T, y\in Y$$

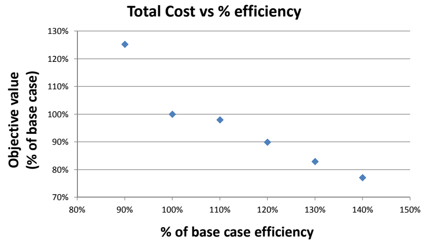
$$\sum_{i=0}^{y} x_{t,i}^{v} \geq x_{t,y}^{mo} + x_{t,y}^{mn} \quad \forall t\in T, y\in Y$$

Implication: Approximate cost savings: 3%

Sensitivity Analysis

We look at how does the objective function changes when the efficiency of drivers varies by a percentage. This efficiency refers to the number of items a driver can deliver in a day.

Base case: 80 w/o OT; 120 w OT



Result: A decreasing trend

Implication: The decrement in total cost may be able to justify any investment by the company to improve workers' efficiencies. An example of investment may include the installation of shelves in the delivery trucks.

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