SISTEM TRANSPORTASI DAN DISTRIBUSI BARANG

Integrasi Perutean Kendaraan dan Persediaan

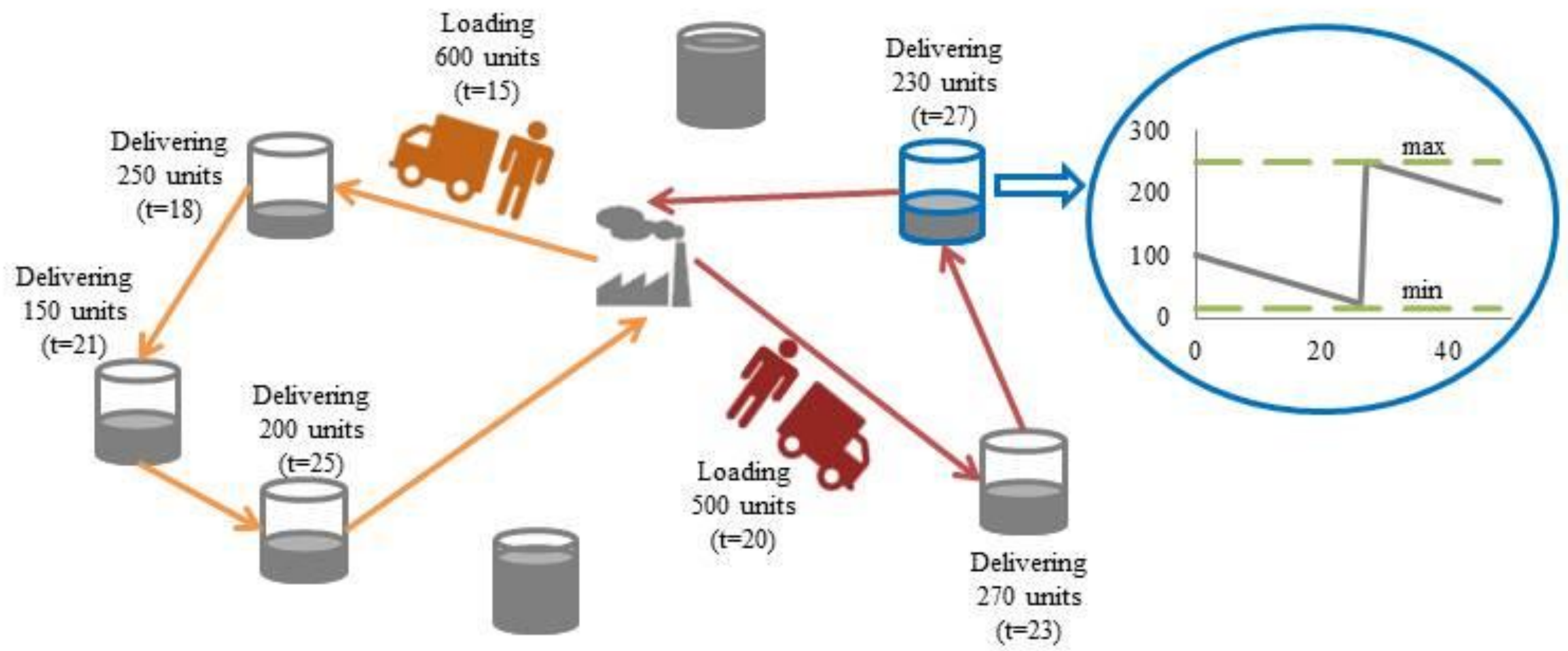

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Image Source: https://maravelias.che.wisc.edu/overview/supply-chain-management/inventory-routing-problem-in-the-chemical-industry/

Model Matematis IRP

Penggunaan Solver untuk Penyelesaian Masalah IRP

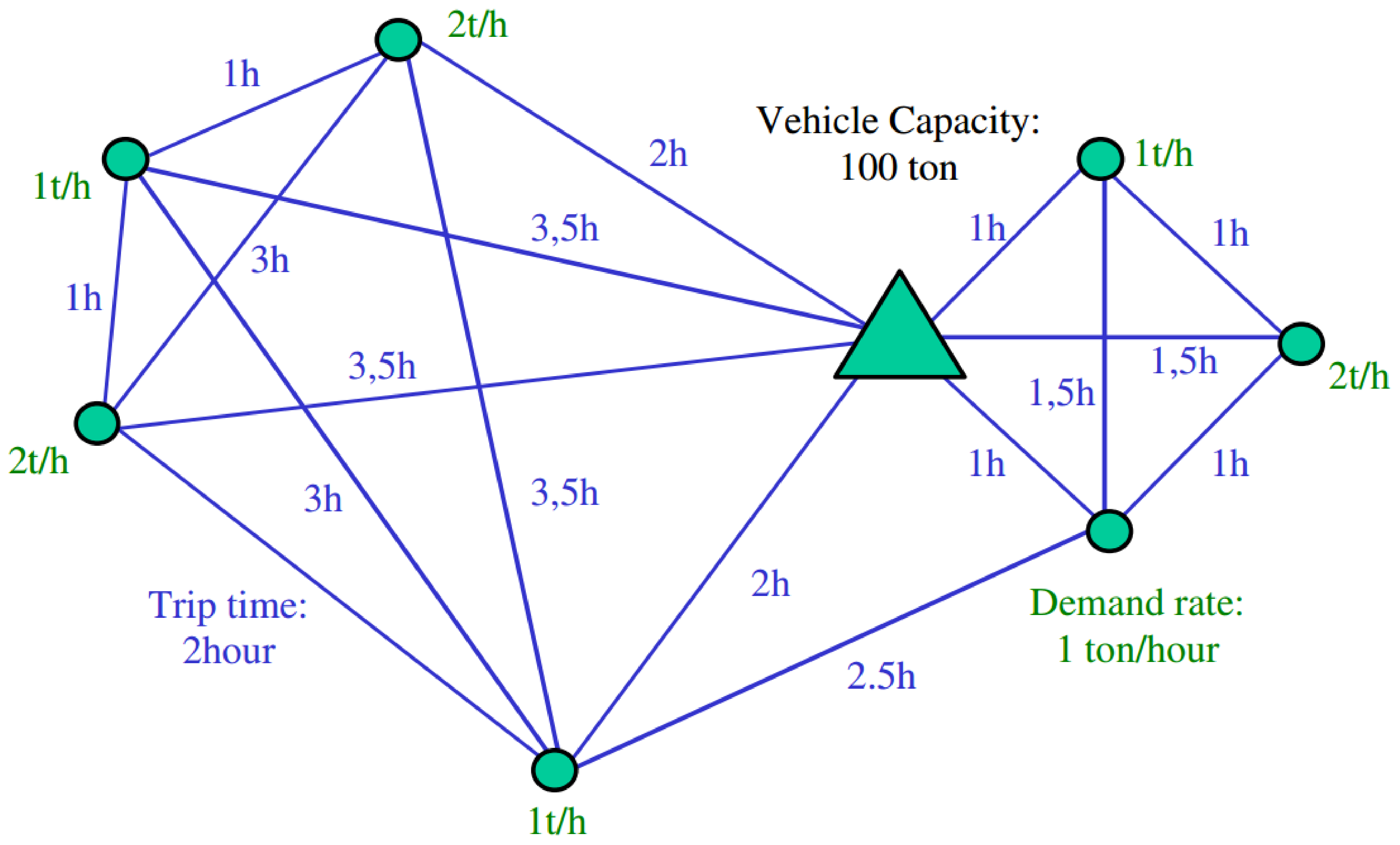
Source:

Aghezzaf, Raa, and van Landeghem (2006). Modeling inventory routing problems in supply chains of high consumption products. European Journal of Operational Research 169, p.1048-1063.

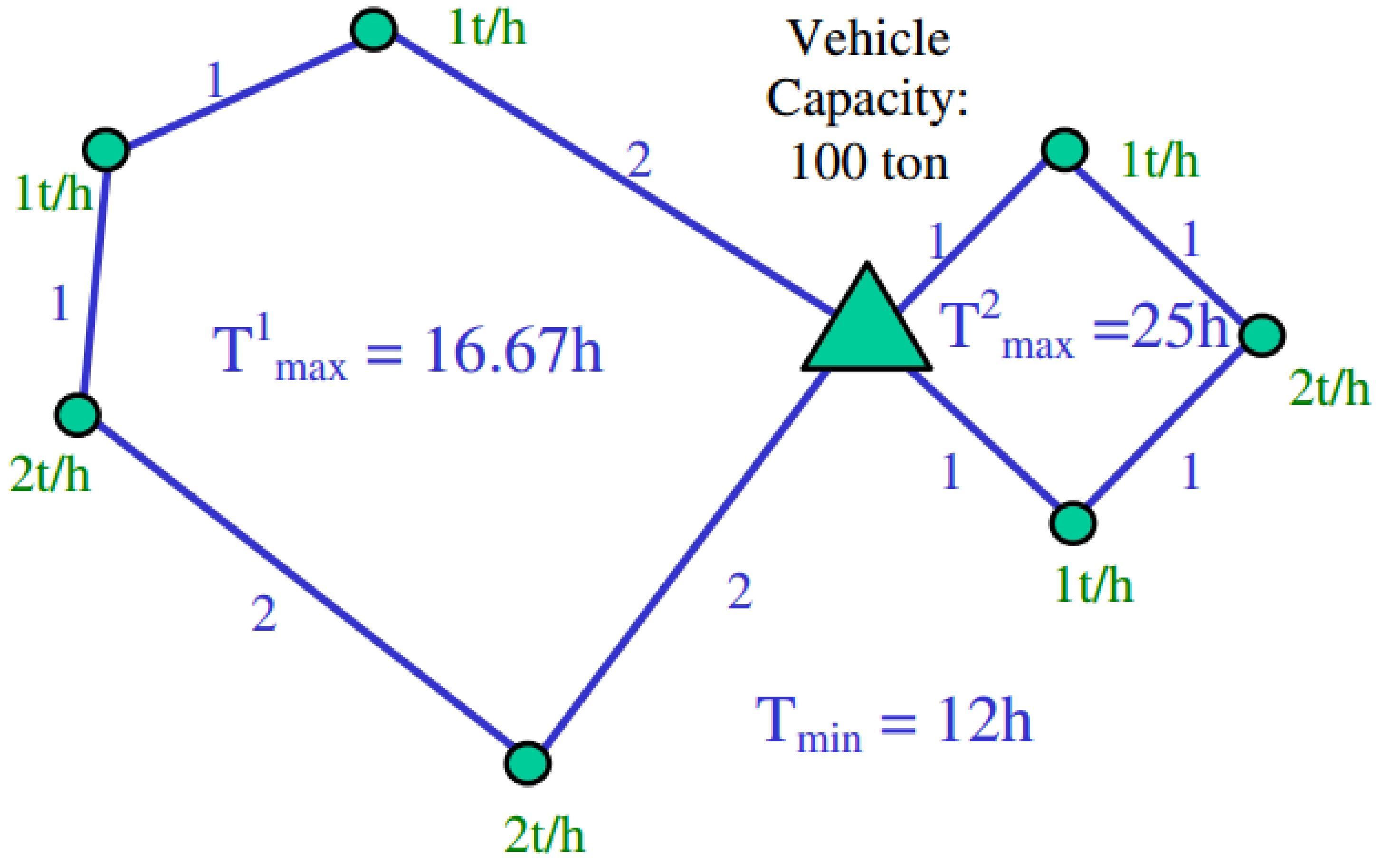
Kontek

- The problem is concerned with developing a cyclical distribution plan of a single product distributed from a single-distribution center r to a set of sales-point S.
- Sales-point $i \in S$ consume the product at a given demand rate of d_i per hour.
- A fleet of homogeneous vehicle V, each with capacity k
- The objective is to minimize the expected distribution and inventory costs during the planning horizon without causing stock-outs at any of the sales-points.
  - Decision to be made are frequency with which sales-point should be served
  - Determination of routes to be used

Ilustrasi Permasalahan



Problem



Feasible Solution:

Ilustrasi Permasalahan

Parameters:

ψ: fix operating cost per hour

δ: transportation cost per km

η: holding cost per unit hours

φ: handling and delivery cost

t_{ij}: duration trip

d_i: demand rate (ton/hour) in sales point i

$k(v)$: maximum capacity of vehicle v

Variable:

x_{ij}^{v}: A binary variable set to 1 if node j is served after i by vehicle v

y^{v}: A binary variable set to 1 if vehicle v is being used

z_{ij}^{v}: Sum of demand rates (in units per hour) of remaining node in a tour covered by vehicle v when it travels to sales-point j

T^{v}: The cycle time of the multi-tour made by vehicle v

IRP Mod… p

Holding cost

Fixed operating cost | Transportation cost | Delivery handling cost

Minimize
$$Z = \sum_{v \in V} \left[\psi^v y^v + \frac{1}{T^v} \left(\sum_{i \in S^+} \sum_{j \in S^+} \delta v t_{ij} x_{ij}^v \right) + \sum_{i \in S} \left(\varphi_i \frac{1}{T^v} + \frac{1}{2} \eta_i d_i T^v \right) \left(\sum_{j \in S^+} x_{ij}^v \right) \right],$$

Subject to:

$$\sum_{v \in V} \sum_{i \in S^+} x_{ij}^v = 1 \quad \text{for all } j \in S, \qquad (1)$$
Each node is served by a vehicle

$$\sum_{i \in S^+} x_{ij}^v - \sum_{k \in S^+} x_{jk}^v = 0 \quad \text{for all } v \in V, j \in S^+, \qquad (2)$$
Vehicle Flow conservation

$$\sum_{i \in S^+} \sum_{j \in S^+} t_{ij}^v x_{ij}^v - T^v \leqslant 0 \quad \text{for all } v \in V, \qquad (3)$$
Cycle time has to be greater than total traveling time

$$\sum_{v \in V} \sum_{i \in S^+} z_{ij}^v - \sum_{v \in V} \sum_{k \in S^+} z_{jk}^v = d_j \quad \text{for all } j \in S, \qquad (4)$$
Demand delivered by vehicle v is reduced by demand rate d_j

$$x_{rj}^v - y^v \leqslant 0 \quad \text{for all } v \in V, j \in S, \qquad (5)$$
Vehicle capacity constraint

$$T^v z_{rj}^v \leqslant \kappa(v) \quad \text{for all } v \in V, j \in S, \qquad (6)$$

$$z_{ij}^v - \left(\sum_{k \in S} d_k \right) x_{ij}^v \leqslant 0 \quad \text{for all } v \in V, i, j \in S^+, \qquad (7)$$
z Cannot carry any cumulated demand rates unless $x = 1$

$$x_{ij}^v \in \{0,1\}, z_{ij}^v \geqslant 0, y^v \in \{0,1\}, T^v \geqslant 0 \quad \text{for all } v \in V, i, j \in S^+.$$