TL-OR Project Subjects 2.1 and 2.2: Fairness in Collaborative Transportation in Short Food Supply Chain

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2023-2024

Context: A Transportation Problem (1/2)

Data given

1. A set of **farmers** $\mathcal{F}$
2. A set of **clients** $\mathcal{C}$
3. A set of **locations** $\mathcal{L} = \mathcal{C} \cup \mathcal{F} \cup \{0\}$, with 0 being a **depot**
4. A cost matrix $(d_{i,j})_{i,j \in \mathcal{L}}$, with $d_{i,j}$ being an **estimated cost**, including **cost per km** of gas consumption, **cost per time** (including the salary of the driver), of going from location i and location j.
5. A set of **dates** $\mathcal{T}$ at which the transportation problem will have to be solved
6. For every date $t \in \mathcal{T}$, a weight matrix $(w^t_{i,j})_{i \in \mathcal{C}, j \in \mathcal{F}}$, such that $w^t_{i,j}$ is the total weight of food production that client i orders to farmer j at the date t
7. A vehicle with capacity Q.

Context: A Transportation Problem (2/2)

Problem description

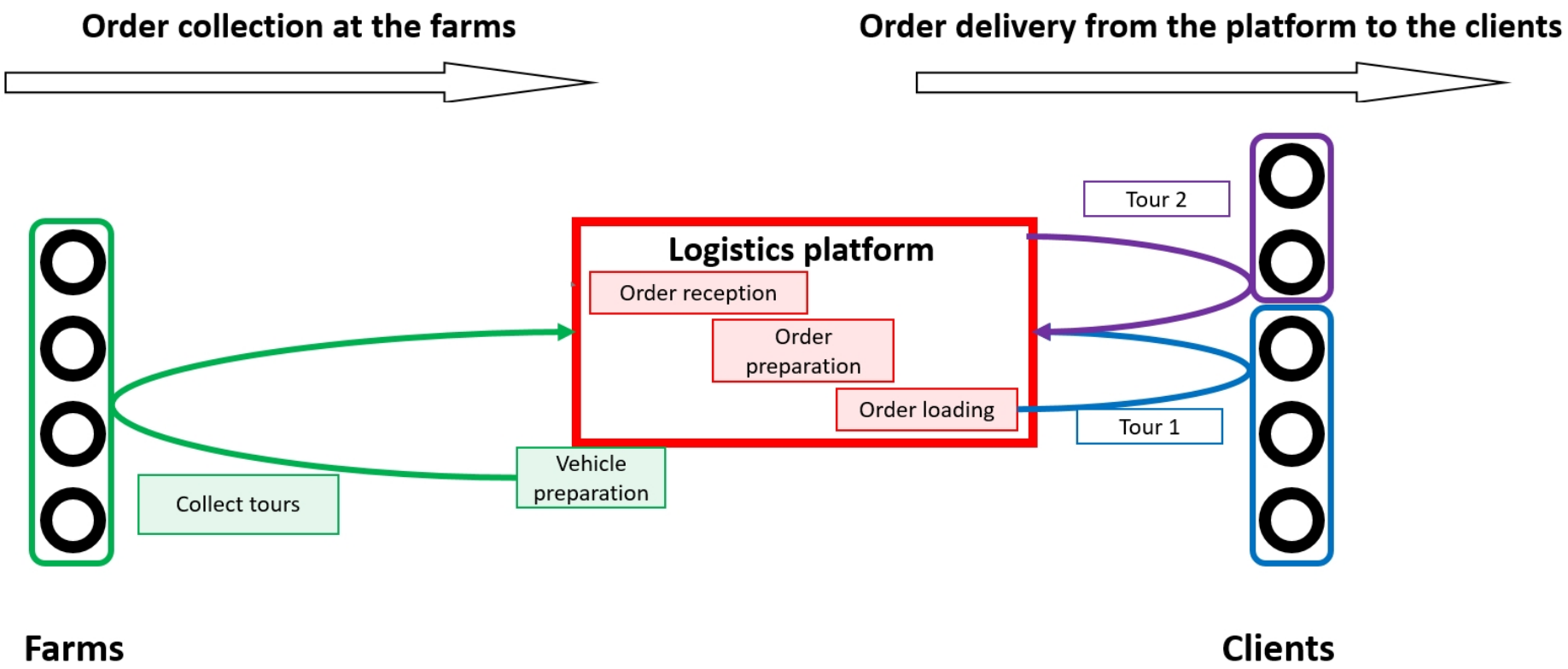
1. A group of farmers have multiple clients in common. They receive at **multiple dates**, some orders of food production. These orders must be **collected** at the farms then **delivered** to the clients.
2. One client can make **orders to multiple farmers**, and one farmer can receive **orders from multiple clients**.
3. At any given date, it is possible that a client does not order anything to any farm, or that a farm receives no order from any client.
4. The total cost of the pickup and delivery tours must be optimized.
5. The transportation cost of the problem must be divided among the farmers with **fairness**.

Subject 2.1

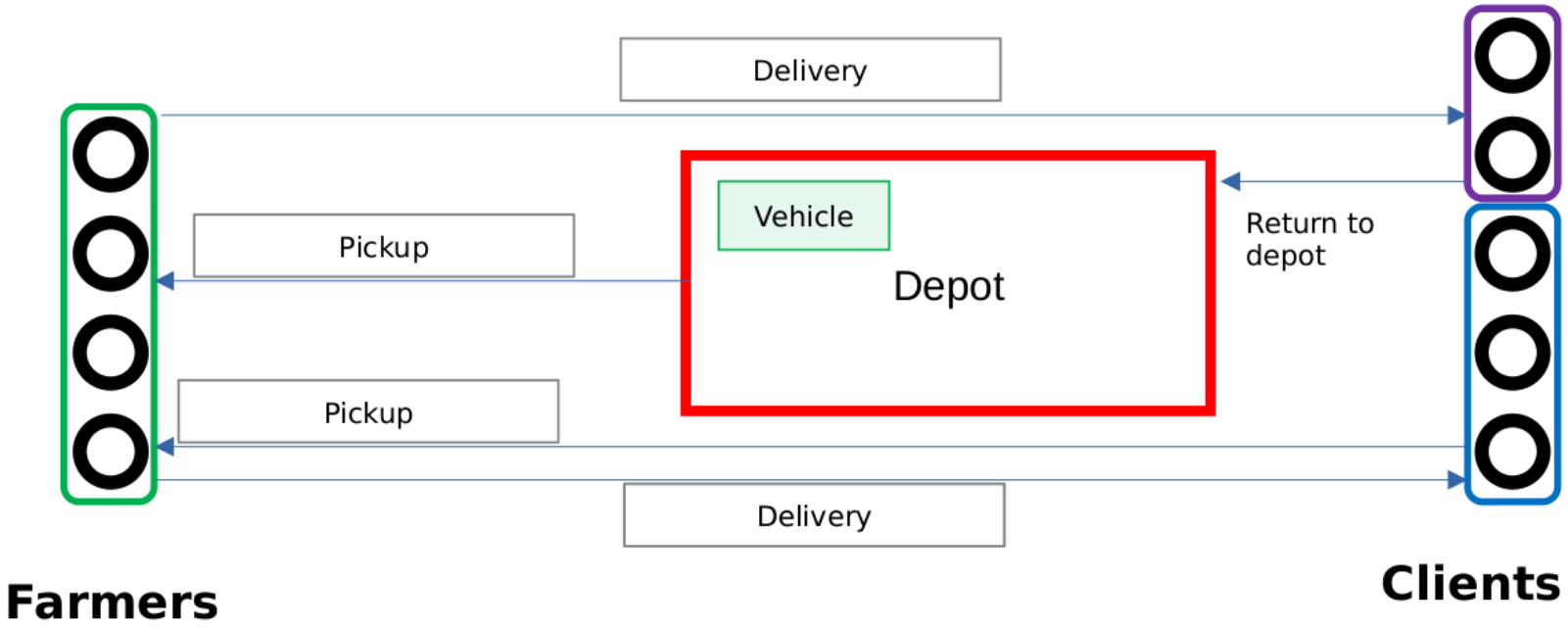
Two delivery methods are proposed

1. One with an **intermediary stop at the depot**, between the end of the collections at the farms and the beginning of the deliveries to the clients. In this case, **all orders must be brought to the depot before beginning the deliveries**.
2. One with **mixed pickups and deliveries**. In one single tour, the vehicle may collect and deliver the orders, as long as an order is not delivered before being picked up and the total capacity of the vehicle is not surpassed. **The vehicle must still start and finish at the depot.**
3. A method to allocate the costs to the farmers must be proposed. Cost must be allocated with **fairness**.

Subject 2.1, scenario 1: Intermediary Stop and Depot



Subject 2.1, scenario 2: Pickup-and-Delivery in One Tour



Subject 2.2: Facility Location with Pickup-and-Delivery

Description

1. The farmers now have the possibility to **locate a depot at the farms**. Locating a depot at a farm has a constant cost D, that only has to be payed once per depot located.
2. Now, a vehicle is available and come with each depot located. We assume that every vehicle has the same capacity.
3. Just like scenario 1 in subject 2.1, here we consider only the strategy that **all orders must be picked up before going through a depot and then delivered**.
4. One would want to **predict future orders** in order to find best location to place depots with better accuracy.
5. Cost must be divided among the farmers with **fairness**.