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EMPTY RUN OPTIMIZATION IN A DRIVERLESS TRANSPORT SYSTEM

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Technical task:
The aim of this invention is to optimise empty runs in a driverless transport system.

Initial situation:
In a driverless transport system, transported goods are picked up at one point and brought to a destination. If there are many such pick-up and destination points and many transport vehicles, as is the case in a modular assembly system, for example, there is a certain amount of coordination work involved, which can be solved both centrally and decentrally in terms of control technology. A vehicle that has completed such a transport order is available for a follow-up order or lends itself to it. For various reasons, it is advisable to select those vehicles for a follow-up order that reach this new destination with a short journey time. You can also include vehicles in the selection that are still executing an active order, but will soon (predictably) finish this order and are near the destination of the new order. It can be assumed that there are always several vehicles on an empty run to the pickup point of a new order.
Due to the delayed start of the orders and unforeseeable events, the situation shown in Figure 1 may arise. In a strictly deterministic system the situation would be predictable and could be planned differently.
FTF A is at a time t1 the optimal vehicle to drive to destination 1. At a later time t2, FTF B is the optimal vehicle to drive to destination 2. At time t1, FTF B may still be busy with another driving job.

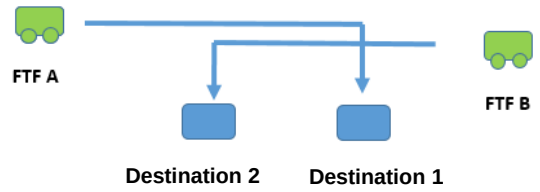

Figure 1

Both vehicles arrive at their destination at about the same time at a time t3. As can be seen in Figure 2, the driving behaviour at time t3 does not make much sense. It would be better if FTF B travels to destination 1 and FTF A travels to destination 2. Both journeys would be shorter and the arrival times earlier.

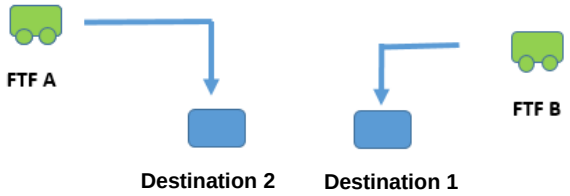

Figure 2

Solution:
After accepting a new driving job, the vehicles themselves or a higher-level system check whether there is another vehicle for the destination of the driving job, that can reach this destination faster and currently has no job or has a job where it is worth exchanging jobs, as shown in Figure 2.

For this purpose, a matrix of all destinations of all active driving jobs and the current prospective remaining driving time of each vehicle to this destination is created, see Figure 3.

	FTF A	FTF B	FTF C	FTF D	FTF E	FTF F	FTF G	FTF H	FTF I
Destination 1									
Destination 2									
Destination 3									
Destination 4									
Destination 5									
Destination 6									
Destination 7									

Figure 3

This matrix changes permanently due to the current positions of the vehicles and their remaining travel time to their destination and due to vehicles that have finished their current job and become free again. This means that this matrix is updated cyclically and checks whether there are pairs of vehicles where the times to their destinations are alternately shorter. Assuming FTF B would have a remaining driving time to destination 3 of 20 seconds and to destination 4 of 30 seconds and a driving job to destination 3 and FTF C would have a remaining driving time of 15 seconds to destination 3 and 40 seconds to destination 4 and a driving job to destination 4, then both vehicles would exchange their destinations: FTF C would be at destination 3 in 15 seconds and FTF B at destination 4 in 30 seconds.
The decisive factor here is that both times are shorter as a result. Otherwise, it could happen that the vehicles are optimized in such a way that long journeys are no longer served.

Advantages:
The vehicles reach the place where they are to take over their goods earlier. They thus compensate for any delays that may have occurred and consume less energy. This means that they are available for longer without having to be charged. If the goods to be transported are completely identical, which is rather unlikely in the case of modular assembly mentioned as an example, the procedure can also be applied to full loads.