

Management Outlook



Dynamic Routing

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Inventories move faster through the supply chain than ever before. Logistical companies focus on increasing the turnover rates of warehouse stock and reducing the order lead-times. Traditionally, the sales department could collect the customer orders throughout the entire day. The orders were sent to the warehouse management system (WMS) overnight for order-picking on the next day. In the evening of day two the trucks departed with the goods for customer delivery on day three. Nowadays these time scales have been squeezed together. We will demonstrate in this report how this fundamentally changes the control over the warehouse.

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Typically, a WMS releases the orders in waves. For each wave, the WMS computes which tasks must be performed to pick the orders and assigns a priority to each task. In most WMS packages the priority remains fixed. This had never been a problem in warehouses, since there was sufficient time to pick the orders. However in a time-critical supply chain, the merchandise must arrive at the dock strictly on time so that the various scheduled transports are not delayed. Consequently, the priority of an order should increase as the truck's departure time approaches. Clearly, wave planning will not solve this issue for us, since it only controls the release of the orders not their completion.

An alternative approach is *dynamic routing*. With dynamic routing, the WMS observes the progress in the warehouse in real-time via RF communication. Subsequently, the WMS decides each time which task an operator must carry out next by taking both urgency as well as efficiency into consideration. The following case study of TDG provides a good example of dynamic routing. The case also shows how an intelligent WMS further optimises the warehouse operation with *just in time replenishments* and *dynamic pick locations*.

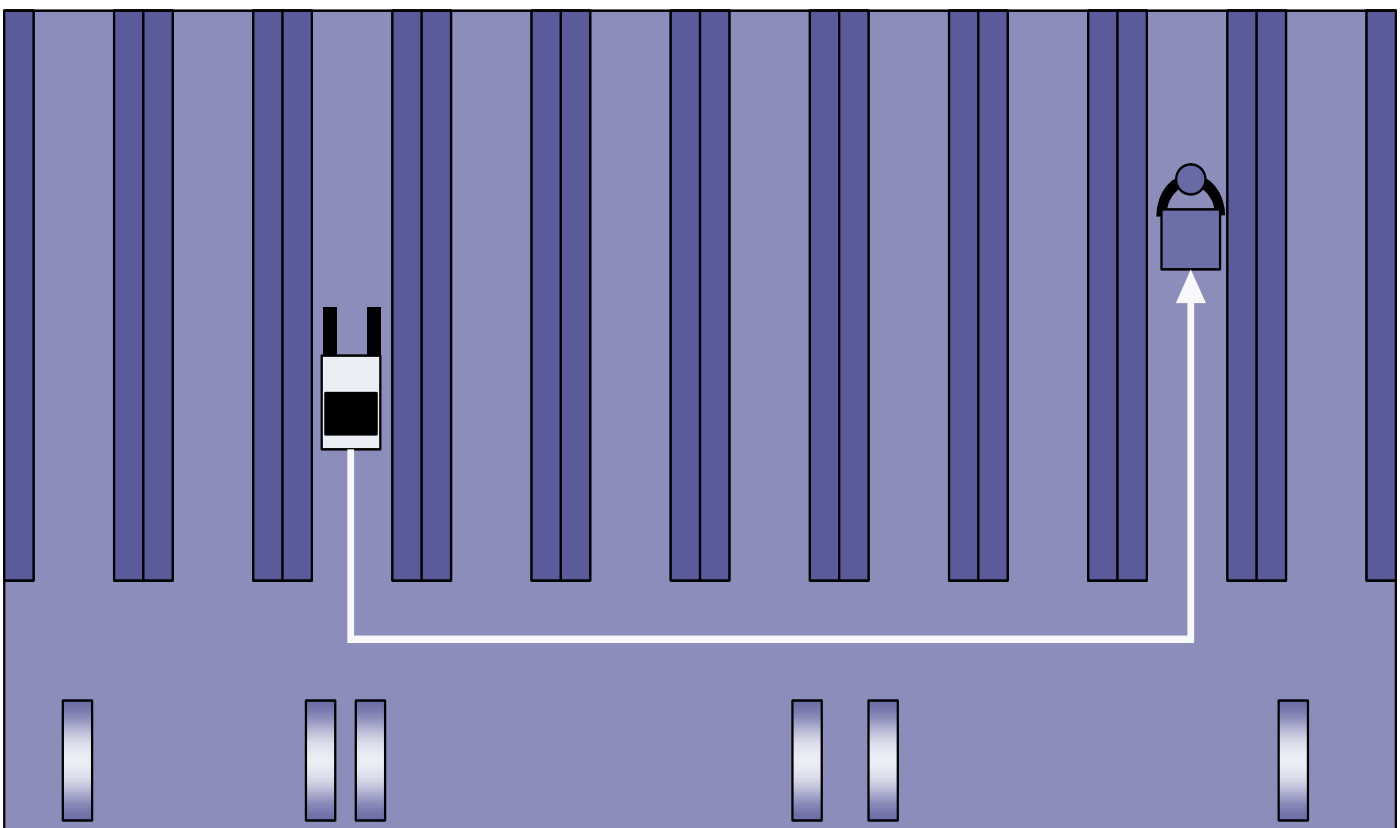
Figure 1. Long waiting times for the replenishment of a pick location.

Case Study of TDG

We can find a good application of dynamic routing at the logistics service provider TDG. TDG has a site in Veenendaal, in the centre of The Netherlands, where the company picks products for delivery to retail DC's on behalf of various producers of fast moving consumer goods. The order pickers pick the products on pallets, often in layers. Reach truck drivers handle the pallet movements, such as put aways, replenishments and pallet picks. All operators work with RF scanners, which gives the WMS a real-time view on the progress in the warehouse.

Nevertheless, it happened regularly that an order picker arrived at a pick location with insufficient stock. At that moment, the WMS called up a reach truck via the RF for an immediate replenishment of the product (Figure 1). However, the waiting time for the order picker until the product had been replenished could be as long as 10-15 minutes in the large warehouse.

The cause for this long waiting time could be found in the control policy. The WMS incessantly assigned the task closest to the reach truck driver. We have illustrated this in Figure 2. This figure shows a reach truck in the midst of several locations where it can go to pick up the next pallet. Alongside each location, the time stipulating the



last possible time this location must be visited is indicated. With the control rules it designed, TDG expected to optimise the efficiency of the reach trucks since the empty interleaving travel times were minimised. However, with this policy it could

happen that certain tasks had to wait for a long time before they were assigned to a reach truck. This then could cause significant delays when the order picker arrived at the pick location prior to the replenishment of the product.

An alternative policy would be to always assign the most urgent task to the reach truck (Figure 3). This would mean, however, that the reach truck drivers would continually have to cover great distances to get to the next task. That would seriously hinder productivity.

Urgency vs. Efficiency

An effective control policy will therefore take into consideration efficiency on the one hand and urgency on the other hand. We call this *dynamic routing*. In Figure 4 we indicate how we worked out a balance between these two objectives at TDG. Instead of the closest or most urgent task, the WMS chooses the most urgent task within the zone in which the reach truck is found. A zone can be a section of an aisle, a complete aisle or even several aisles. At TDG the reach trucks continually drive around from one zone to the other. In this way, all zones are visited regularly so that all urgent tasks are taken care of and the empty interleaving distance of the reach trucks remains limited. In circumstances where reach trucks typically stay within one zone for some time, it may be necessary to force a reach truck out of its zone. This can be done using a threshold value. Only if the priority of a task reaches this threshold, a reach truck from another zone is directed into its zone.

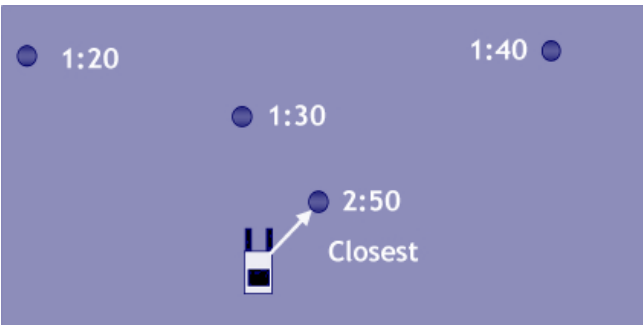


Figure 2. WMS assigns closest task to reach truck.

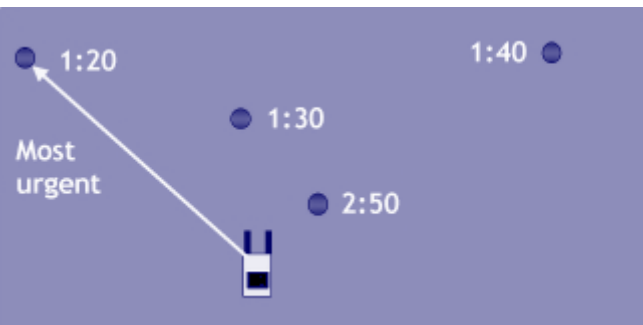


Figure 3. WMS assigns most urgent task to reach truck.



Figure 4. WMS assigns most urgent task within the zone.

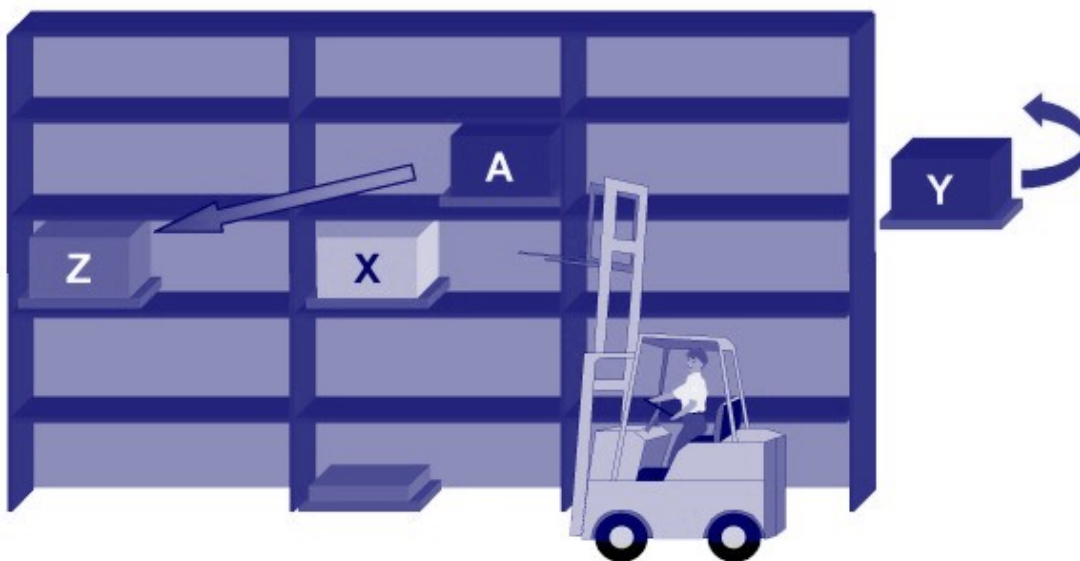


Figure 5. WMS assigns the most urgent task within the zone.

Figure 5 shows the same situation in a frontal view of the rack. The reach truck has just put away pallet A. Now there is a choice between the closest pallet X, the most urgent pallet Y (this one is outside the zone, however) and pallet Z, which is the most

urgent within the zone. According to the control policy, the WMS chooses pallet Z.

Dynamic Pick Locations

The pallet selected is meant to replenish the pick location. In the past, each product had a fixed pick location at TDG. The cartons that were still situated at the pick location at the moment this location was being replenished had to be re-stacked on top of the new pallet by the reach truck driver. Or alternatively the order picker had already removed the present cartons at the pick location for his order line and waited for the replenishment in order to pick the remainder of the order line. Thus, we see that fixed pick locations always led to inefficiency during the replenishment of the pick locations.

We prevent this inefficiency by replenishing a product to a nearby empty pick location (Figure 6). The order picker then first picks the packages from the present pick location. This location is now empty and available for other products (dynamic pick locations). The order picker then takes the remainder of the order line from the new pick

location. In this way, we prevent products needing to be re-stacked or order pickers having to wait.

The WMS increases the priority of the replenishment task as the moment when the order picker will encounter a shortage approaches. The policy ensures that the replenishment of the pick location generally happens just in time, for example 15 to 30 minutes before the order picker arrives at the pick location. In this way, we prevent having two pick locations in use for a long time for just one product. This would increase the need for space in the picking area. Just in time replenishment is possible with approximately 10% open pick locations. We may create space in the picking area by picking slow-moving products from the rack's first beam with a man-up order picking vehicle.

The case study illustrates that a WMS can significantly improve the warehouse performance using intelligent control rules. Fujitsu, the new WMS vendor of TDG, was enthusiastic about the designed control rules and has now included these in its standard package.

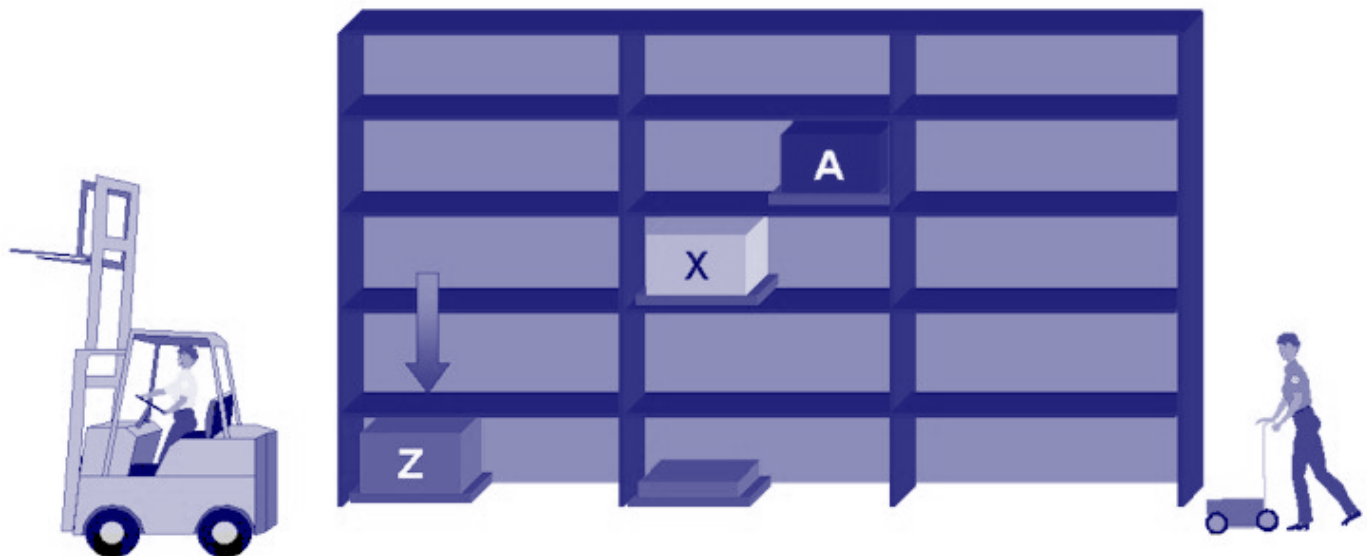


Figure 6. Just in time replenishment of a dynamic pick location.

Jeroen van den Berg Consulting is a research & consulting firm specialised in warehouse and supply chain management. For more information you can contact us at the underneath address or via our web site.

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