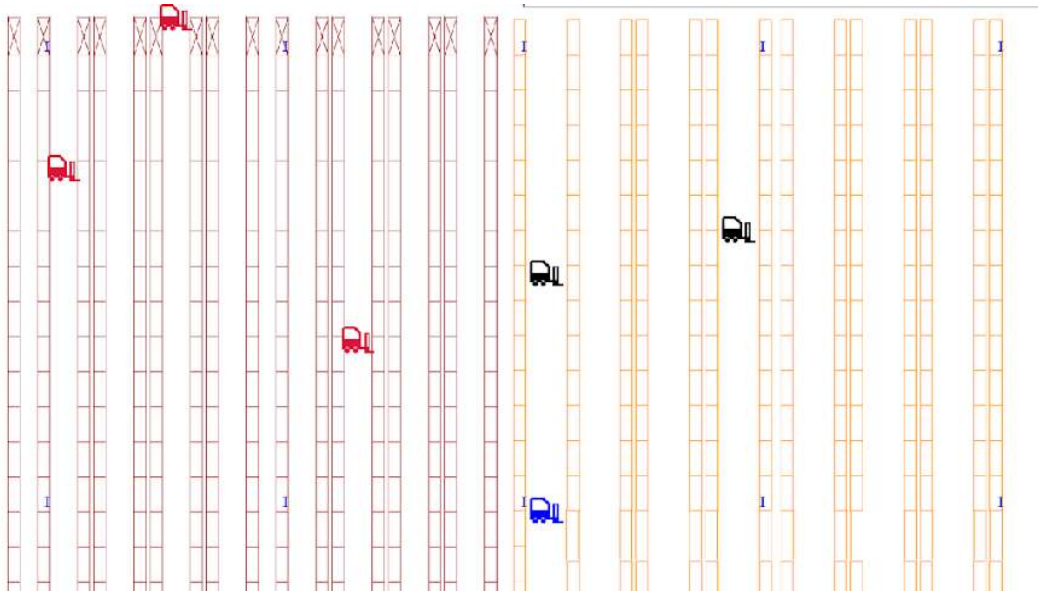

East-West Warehouse Highway Traffic

KPI: Traffic Congestion, throughput

Geography: United Kingdom

Project Time: 3 months

Customer: Undisclosed

A new warehouse needed to be built by the customer to cope with demand forecasted for the future years. The design was planned, but it was uncertain if any amount of material handling equipment would be able to handle the pallet movements in the facility. The reason was because the highway is narrow and some activities such as loading and unloading tuggers block traffic in both directions. If traffic is blocked for too long, delays on the pallet movement start occurring, which causes delays in trucks leaving the facility, putting pressure on the dock's utilization. This uncertainty also comes with the cost of planning. It is important to be able to generate a flow that is consistent and controlled enough to be able to understand the throughput that the facility can handle each day without too much variation. Variation leads to lack of control, and lack of control leads to delays and less added value to the final client.

The outline

The new warehouse (figure 1) plans the utilization of a variety of material handling equipment that is used for different purposes. They interact with each other, and they move around to different destinations during a 6am to 11pm shift.

The main issue is explained by the inbound flow, which considers movements using a counterbalance truck (CBT), onto a tugger and drop off at a designated zone using a different CBT that picks up the product and drops it at a transfer point. The product is then moved by a forklift to the warehouse. Other important

activities are waste collection and battery charging for electric vehicles. All these activities require the use of the main highway.

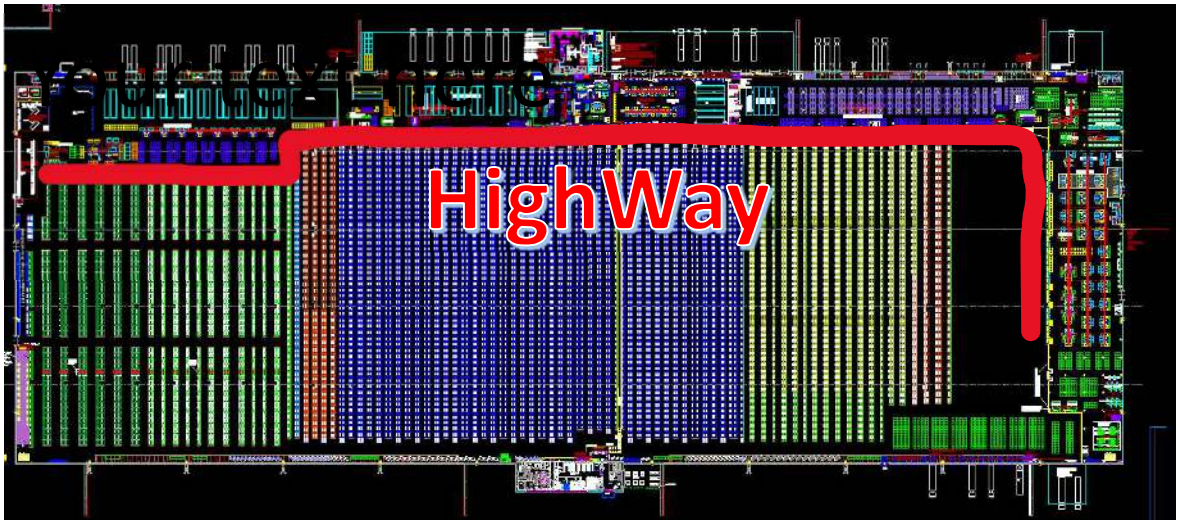

Figure 1. Warehouse Layout

Why Simulate?

An initial work was done internally in Excel. This work showed a healthy flow in the warehouse, even in peak hours. But considering that Excel in a case like this only works with averages and is not able to take into consideration accumulation of forklifts in the bottleneck, waiting time for material handling equipment moving to the same destination, and other factors, it didn't seem to be the right tool.

To account for these factors, a simulation is needed, since it doesn't only allow us to be significantly more specific with the traffic details, including speed, overtaking slower vehicles, traffic jams, vehicle sizes, etc., but also allows us to visualize in an animation what is really happening, making it easier to strategize and come up with better ideas that would lead to a re-engineering of the layout, or a redistribution of material handling equipment types (such as getting rid of tuggers).

MHE Movement

The movement of MHE equipment is complex and it doesn't follow classical protocols that are normally developed using basic discrete-events modeling, or typical A* algorithms for collision avoidance that are present in popular Software such as FlexSim and Simio. Additionally, there were some vehicles that require both AGV and free-space properties, which is a feature that is not present in any existent simulation Software.

For that reason, we decided to use AnyLogic as the simulation tool to develop the solution, since it allows the development of customized movement rules that can be built from scratch. AnyLogic is one of the most versatile simulation tools to achieve this.

Some of the complex characteristics were (figure 2):

- Forklifts entering on existing aisles are affected by other MHE depending on the radius of turning.
- Forklifts traveling at higher speed can overtake MHE at slower speed if it's safe to do so.

- Parked MHE affect traffic and require safely overtaking without risk of crushing with MHEs traveling in the opposite direction.

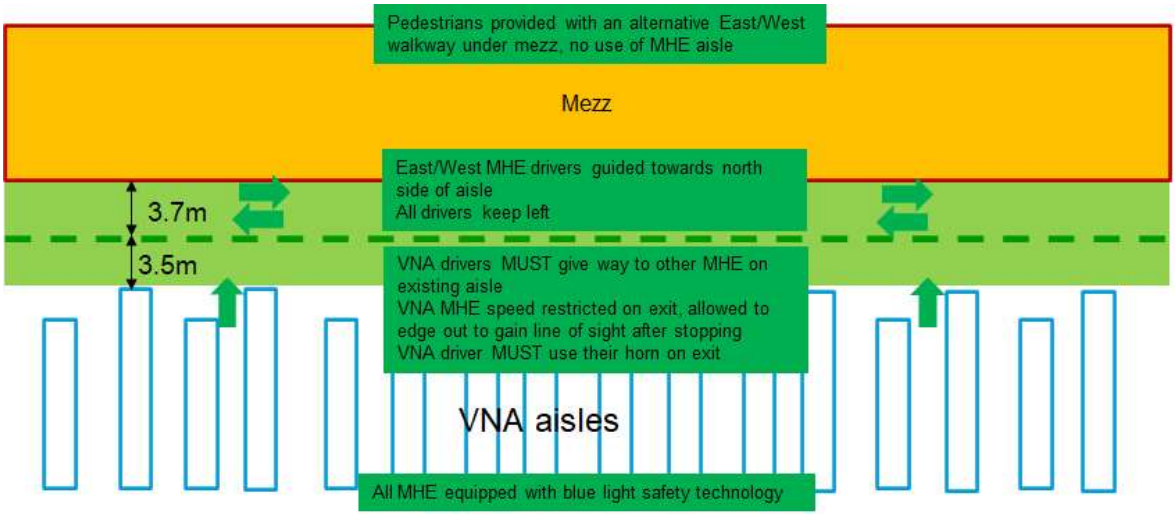

Figure 2. Some of the movement rules

Results

The first results were not promising and showed that the current implementation idea would make it impossible to complete the orders in time, and the simulation showed a great deal of accumulated orders that were not ready at the end of the day, based on the basic expected demand. Figure 3 shows how the orders accumulated during a particular day only because of extreme congestion.

Figure 3. Initial Results

For this reason, with additional tests, several solutions were considered for the final implementation.

1. Less use of tuggers

With the tuggers being parked up and loaded/unloaded on the highway being a major cause of congestion it was decided to use fewer tuggers and to use them only to pull the cages coming out of the warehouse area. All other movements are now to be carried out as a continuation of the pick/put away activity, eliminating the handover to different MHE and allowing better flow along the East-West highway. The simulation work was key to making the case for these changes and supporting the decision to alter the MHE mix.

The resulting change to the mix of MHE led to some in depth negotiations with the MHE provider, which ended up leading also to an undisclosed amount of money saved with the new mix.

2. Less parking on the East-West highway

To keep the East West highway as clear as possible any hitching/unhitching to tuggers that can take place off of it (under the mezzanine or similar) will be off the highway. Although it is not possible for every area along the highway the results showed low congestion. The view here is that there will still be congestion, but it will be at a manageable level. The simulation assisted in making it clear the importance of keeping the highway as clear as possible to allow traffic to move unimpeded.

Implementation

The warehouse is currently live, and operations are under way. No congestion or other problems relating to the East West highway have been experienced so far and with the changes made following the simulation the customer does not anticipate it being a major area of concern.