

white paper

Simulation Modeling Optimizes Performance of the Factory, Warehouse, or Distribution Center

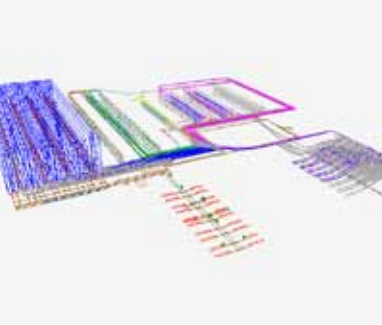
Dematic Corp.
507 Plymouth Ave. NE
Grand Rapids, MI 49505

Tel: (877) 725-7500
USInfo@dematic.com
www.dematic.com/modeling

Creating Logistics Results



DEMAC



Simulation Modeling Optimizes Performance of the Factory, Warehouse, or Distribution Center

Introduction

Would you buy a car without a test drive; so why implement a new logistics system without testing it? With computer simulation modeling software you can do just that: test drive your factory, warehouse or distribution center operation before finalizing the system design. When test driving a new car, you select the route you travel based on the features of the car that you want to exercise. Similarly when constructing a simulation model, the 'route' is selected depending upon the objectives of the study.

Figure 1 displays four different simulation categories (chevrons), the potential system components (boxes) and the component interface points (double-headed arrows). The Mechanical System component includes all material handling equipment. The scope of the different categories is depicted by the semi-transparent objects (ovals and triangle). Simulations can range from a simple Concept Animation to a highly complex Operational System Capability Study.

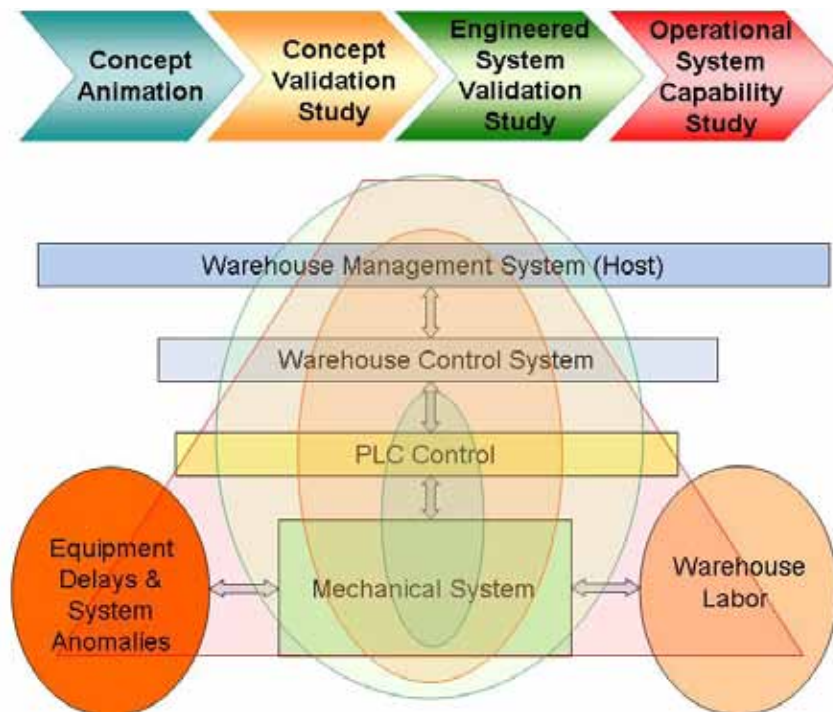


Figure 1 – Scope by Simulation Type





Simulation Modeling Optimizes Performance of the Factory, Warehouse, or Distribution Center

Concept Animation Models are created during the solution generation process. Color coding and labels are used to highlight the important aspects of a system. Conveyor speeds, material handling volumes and system controls in the model are defined without consideration for the system's required throughput. Consequently, system analysis cannot be conducted based on Concept Animation Model.

Benefits: Concept Animation Models demonstrate the functionality of material handling systems. When people visualize the functionality and product flow of a system they gain a better understanding of the system.

Example: The ergonomic de-palletization station needed to be demonstrated to a prospective user. A simple model was created; an existing three-dimensional electronic drawing was imported into the model as the starting point. The concept was brought to life in the simulation as pallets were introduced with color coded layers. The model demonstrated the flow of pallets to one of two lifts that presented a worker, on a platform, with the next layer. As the worker stripped a layer, cartons of the same color were shown traveling on the take-away conveyor. The worker then turned to the other pallet and stripped a layer while the first pallet was raised one layer. The model also demonstrated the flow of empty

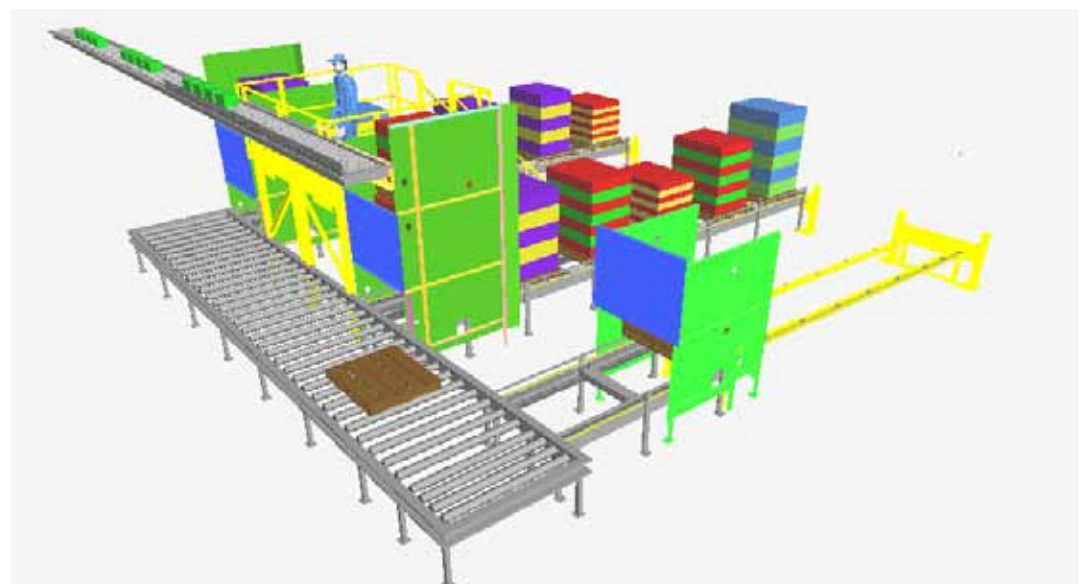


Figure 2 – De-palletization Station





Simulation Modeling Optimizes Performance of the Factory, Warehouse, or Distribution Center

Concept Validation Studies are conducted during or immediately after design conception. A high-level simulation model is developed from the conceptual equipment layout. Simplified PLC, WCS and/or WMS control schemes are simulated.

The material flow rates used in these models are derived from the rates used during concept development. Normally, the material flow rates used are in a From/To Matrix format. Data used to drive these models usually represents the average hourly sustained rate requirements for the various input sources of the system.

Benefits: This type of simulation determines the performance level of a system layout as controlled by the PLC, WCS and WMS. Unsatisfactory performance is avoided when infeasible concepts are ruled out before implementation. However the value of simulation goes beyond aiding “go vs. no-go” decisions; when properly constructed, simulation output (statistics, graphs, etc.) provide insights into what needs to change and why. Through an iterative process, bottlenecks are identified and alleviated.

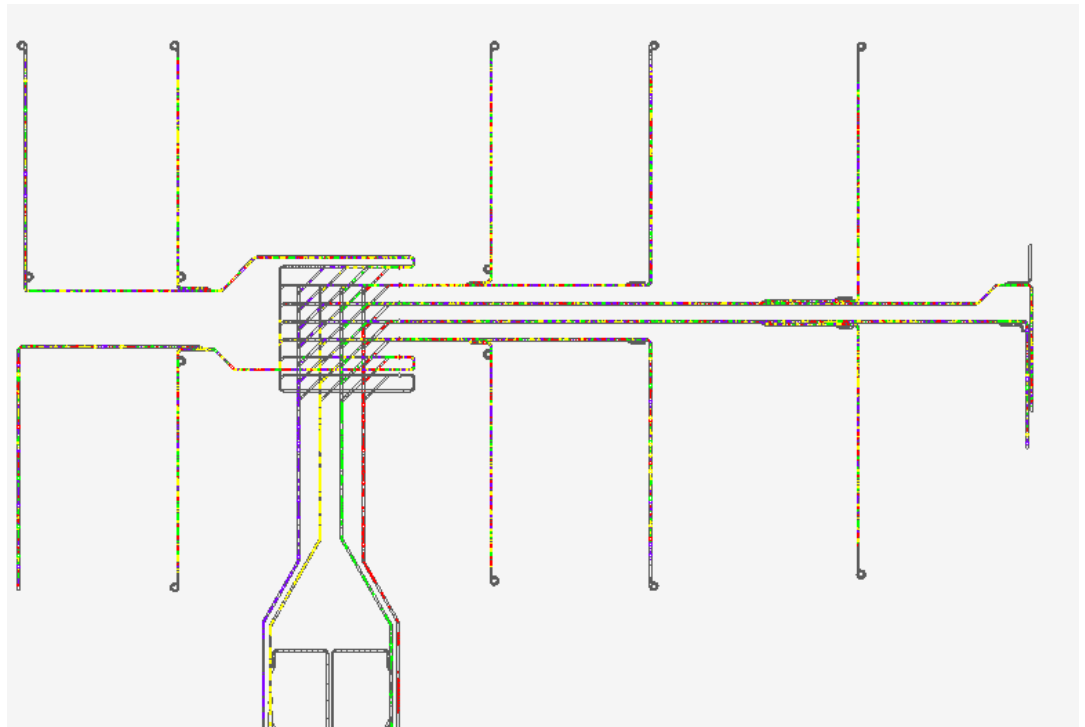
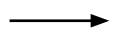
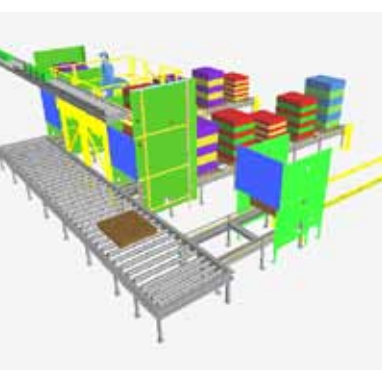


Figure 3 – New Distribution Center Concept





Simulation Modeling Optimizes Performance of the Factory, Warehouse, or Distribution Center

Example: A project's engineering team wanted to test a new concept for a large distribution center. It replaced the conventional merge and ship sorter with a matrix of smaller merges and pre-sorters. A model was built to determine if the concept's core conveyor could reach a sustained throughput of 36,000 cases per hour. A representative stream of cases was introduced to the model (without detailed modeling of picking labor or order profiles). Likewise, the scope did not encompass shipping lane details. Initially the base concept only attained a throughput of 30,000 cases per hour. The modeling effort subsequently focused on identifying and eliminating bottlenecks within the merge/sort matrix. By changing one control element at a time incremental improvements were realized until the required rate was achieved and surpassed.

Engineered System Validation Studies are conducted during final system engineering. A detailed simulation model is developed based on the engineered system design. PLC logic to be installed in the system is simulated along with pertinent WCS and WMS functionality. The material flow rates used in these models are derived from the rates used to engineer the system. Customer data reflecting order level detail from a peak operating day is frequently used.

Engineered System Validation Studies are used to determine the operating time required to process a peak day's orders when staffing is not a constraint. These models are used to refine the engineered system design, PLC controls, WCS controls and WMS functionality. If the simulation engineer discovers design flaws, then a team of experts develops alternative solutions and the potential improvements to the system are tested with the model. Conducting an Engineered System Validation Study helps ensure that the equipment and pertinent software controls will be capable of handling peak design day volumes.

Benefits: The benefits of Engineered System Validation Studies are similar to those of Concept Validation Studies. The difference between the two is rooted in the increased details of Engineered System Studies that capture more complex interactions. Since the scope of an Engineered System Study often encompasses order data, solutions involving wave planning and ship lane assignments can be evaluated.





Simulation Modeling Optimizes Performance of the Factory, Warehouse, or Distribution Center

Example: An automobile parts manufacturer starting up a new plant wanted to evaluate the capabilities of their new facility. The facility included nine automatic workstations serviced by AGVs. Product moves in a sequence between the workstations and is fed into machines by robots. The model was used to determine: the AGV fleet size, AGV work assignment algorithm, AGV battery charging rules, and the number of stands in front of each workstation. Several small layout changes were also tested as paths were changed and vehicle control points were relocated.

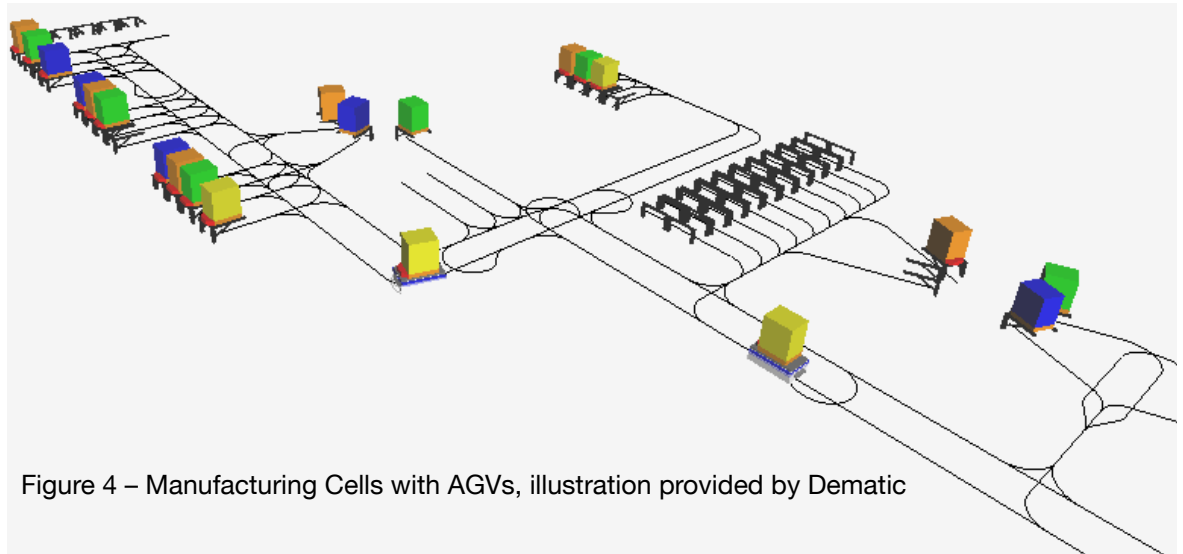


Figure 4 – Manufacturing Cells with AGVs, illustration provided by Dematic

Operational System Capability Studies are conducted during or after final system engineering has been completed. Like Engineered System Validation Studies, an Operational System Capability Study uses a model developed from the engineered equipment layout and includes the PLC control configuration to be installed in the real-world system and the pertinent WCS and WMS functionality of the real-world system.

Operational System Capability Models developed for these studies differ from Engineered System Validation Models in that these models include detailed modeling of pickers, packers, loaders and other relevant operating associates. Actual orders profiles are used to drive the model. Frequently, these models include the inventory management functionality of the WCS or WMS.





Simulation Modeling Optimizes Performance of the Factory, Warehouse, or Distribution Center

Operational System Capability Studies are used to determine the productive operating hours required to process a peak day's order volume when the system is constrained by the limitations of staffing and operating practices. Additionally, it is common to use these models to refine product slotting schemes and order sequencing algorithms.

Data describing Mean Time Between Failures (MTBF) and Mean Time to Repair (MTTR) for equipment failures and other anomalies can be included in the simulation and their impact on system performance can be evaluated.

Benefits: In addition to sharing benefits with the other simulation categories, Operational System Capability Studies have unique benefits rooted in the inclusion of detailed labor, breakdown and order data. Many clients require a crew size estimate. In these models staffing is a variable and performance as a function of crew size can be tested. Many clients provide actual order data. In these models the impact of the ebb and flow of product is assessed. Problems can be resolved before implementation. Solutions can be tested more easily and economically on the PC than in the DC.

Example: A fully integrated material handling system (AS/RS, AGVS, pick modules, large conveyor system, etc.) concept was developed for a national retailer embarking on a major expansion. Given the complexity and high risk of the project, simulation was employed from the start. The model acted as a focal point for understanding the material handling equipment and evaluating concept options. The simulation was used to determine the AGVS work rules, control schemes and fleet size. The final merge and sortation control logic evolved as a result of simulation testing. The labor needed in each functional area was determined along with the shift staggering pattern. Sensitivity analysis on the conveyor system revealed a potential staffing problem that would have to be managed on a wave-by-wave basis. The model was also used to determine that a second linear shipping sorter was not necessary.



Simulation Modeling Optimizes Performance of the Factory, Warehouse, or Distribution Center

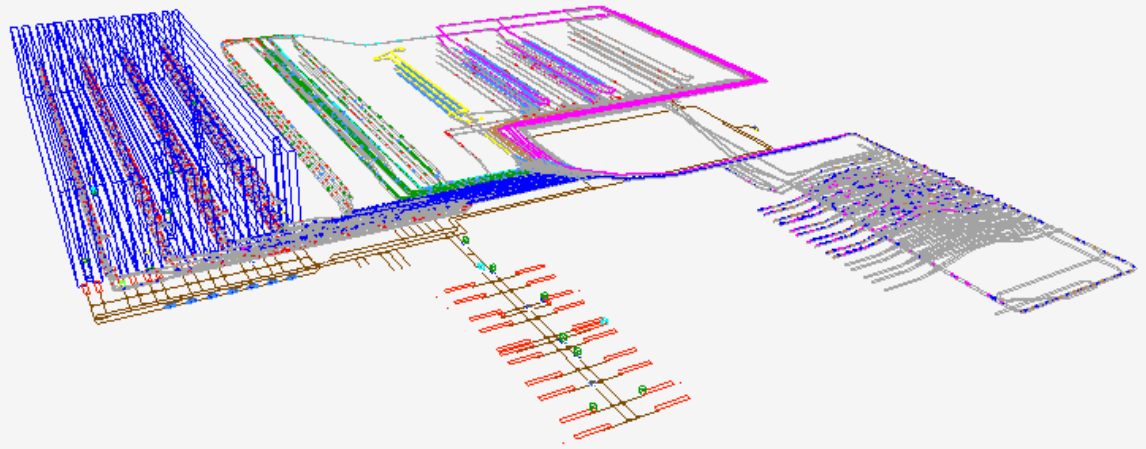
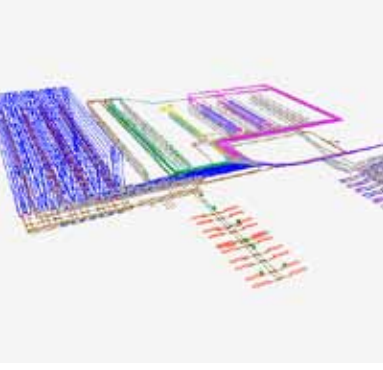


Figure 5 – Large Integrated Distribution Center

Staff Training Models are crafted for clients who want to supplement the training of system operators and supervisors with demonstrations of how to recognize operational issues and the effects that corrective actions have on the issues. This training is most valuable for “greenfield” facilities. Given their high level of detail required to accurately demonstrate the desired scenarios; these models are usually based on an Operational System Capability Model.

Example: An operator of an integrated DC wanted to train all of its engineers, supervisors and maintenance personnel before the first carton was shipped. After being shown an animation of how the receiving area’s AGVS should deliver pallets to the AS/RS, the students were presented with several anomalies. In one scenario two of the twelve receiving conveyors were filled up much faster than the others. Each of the conveyors were filled with loads for a single SKU, all headed to the same AS/RS aisle. A chain of events brought the receiving area down to a crawl. At key junctures the students were asked to describe what just happened and what would happen next. This simulated scenario taught three things: how the AGVS assigns work, how SKUs should be evenly spread among the AS/RS aisles, and why forklift drivers must be trained to unload trailers in a round robin pattern (i.e., “favoring a trailer leads to failure”).





Simulation Modeling Optimizes Performance of the Factory, Warehouse, or Distribution Center

Conclusion

Simulation is a powerful decision making tool. No matter the level of detail or breadth of scope, the use of simulation has benefited the decision makers. Simulation models are a powerful communication medium. They can range from basic simulation animations that illustrate the strategic differences between optional concepts to complex models that demonstrate details such as how alternative recirculation anti-gridlock schemes impact throughput or the impact of SKU slotting on the required pick staffing.

The simulation engineer must, during the course of building a simulation, interview a wide spectrum of disciplines (e.g., operators, vendors, IT specialists, controls engineers, mechanical engineers, customers, and sales personnel) in search of detailed answers to critical questions regarding equipment specifications and control and operating practices, this process is beneficial in and of itself. It inevitably results in a better understanding of the system and design and often highlights subtleties that were not previously considered.

It is “easier and more economical to change in the PC than in the DC.” Design issues and invalid assumptions discovered and rectified via simulation saves significant time and money compared to correcting them during the time-critical period of installation and commissioning or after facility start-up.

Dematic Corp is the world’s leading supplier of logistics automation solutions, systems and service. Dematic provides integrated material handling solutions that incorporate process improvements, material flow technologies, controls, and software to reduce operational costs, maximize productivity, and optimize supply chain performance.

For over 70 years, Dematic has proven to be a competent single source supplier that engineers, manufactures, implements and supports the core material handling technologies required to operate effective logistics solutions.

A global company with operations in 22 countries, Dematic’s North American engineering/manufacturing headquarters is in Grand Rapids, Michigan, with 18 customer sales/engineering/service offices. Prior to adopting the Dematic name, the company was known as Rapistan. For more Dematic information, visit www.dematic.us.

If you are interested in learning more about this topic and how we can help, please contact Dematic at (877) 725-7500 or visit www.dematic.com/modeling.

Continuing the *Rapistan* Tradition