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JIT, truck docks, and simulation

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ABSTRACT

Changes in manufacturing and distribution strategies have changed the shipping/receiving functions into an integral part of the production process. As a result of this change, the performance requirements and standards for truck docks have changed. To meet those standards, many shipping/receiving docks have automated. This automation affects the entire operation of the dock facilities and introduces complexities into a previously manual operation.

Simulation is a particularly appropriate tool to help develop these new, automated facilities. This presentation discusses several applications of simulation to truck dock facilities.

1. INTRODUCTION

This paper will briefly define what we mean by JIT and describe some of the effects of JIT on the shipping/receiving function. One of these is the apparent paradox that JIT promotes dock automation. We will present several examples of applications of simulation in designing truck docks which illustrate this effect.

2. JUST-IN-TIME (JIT)

JIT is an operating philosophy which has as its basic objective the elimination of waste. Anything other than having the right amount of the right material at the right place at the right time required to add value to the product is waste.

Four themes of JIT are:

1) Simplicity - elimination of sophisticated, overly complex solutions when a simple approach would do.
2) Visibility - the state of the system should be clear, "line of sight management"
3) Synchronization of effort - all parts of the system should work at the rate of product demand
4) Continuous improvement - improvement is an ongoing activity

A result of applying these principles is smaller lot sizes, not only for production, but also for shipping and receiving. Orders that used to be for truckloads are now for pallets or cartons. As a result of the reduced lot sizes, orders are more frequent. The smaller lot sizes reduce the planning cycle from one in terms of weeks to one in terms of hours. Eliminating large lot sizes also smooths out peaks and valleys in material flows.

The lower inventory levels require an improved quality level. Typically, safety stocks are substantially reduced or eliminated. With less inventory, the stock will tend to be from fewer lots - which have to be good. The improved quality level may eliminate incoming inspection entirely. This would eliminate the large, ambiguous inspection buffer between the docks and production.

3. JIT AND SHIPPING/RECEIVING AUTOMATION

A paradoxical result of JIT has been the promotion of automation in shipping/receiving. Although JIT promotes simplicity in production, in the truck dock area it has sometimes provided a justification for more complex systems.

Automatic identification of containers, part numbers, quantities and delivery zones eliminates copying errors. Real time tracking of inventories keeps the timely records required for JIT. Automated handling equipment facilitates the movement and tracking of the smaller, more numerous orders and batches.

4. SHIPPING/RECEIVING FACILITIES

The majority of truck dock operations have remained unchanged since the advent of motor freight operations. Lift trucks and pallet jacks are used to move palletized loads. Cartons are primarily loaded or unloaded by hand with occasional use of roller conveyors. Invoices are manually created and checked, usually several times.

In the past several years, this has begun to change. Automatic identification and handling of loads is commonplace. This automation has entirely changed the shipping/receiving departments. The familiar equipment of the past 60 years is being replaced by high speed tilt tray and slat sorters, bar code readers and computer screens.

Machine reliability is now critical. Instead of many lift trucks, there is one sortation system. If it breaks down, the system stops. A computer failure may cause the automatic sortation to lose track of everything in the system. Any new containers or packaging must work with the automation. The flexibility of manual handling and stacking loads has been lost.

Although the equipment is new, the same people are running the docks. The experience that allowed them to run an efficient dock before is no longer enough. Acquiring that experience with a few million-dollar failed automation systems is not acceptable. The dramatic (and occasionally, traumatic) transition to automated equipment requires a comparable transition in the tools used to manage the facility and staff.

5. SIMULATION APPLICATIONS

The simulation applications described in this presentation represent current projects in various stages of implementation. Each application demonstrates the use of simulation in the design of the facilities and controls for a shipping/receiving function. In each of the projects, communicating to management the operation of the system and its potential difficulties was as important as the technicalities of the simulation.

The applications include:

- an LTL receiving dock for daily deliveries to an assembly plant

- general warehouse shipping docks

6. LTL RECEIVING DOCK

A vehicle assembly plant was converting to JIT deliveries. The facility covered over 1,000,000 sq. ft. with 35 total dock doors, including point-of-use docks. The facility used about 5000 total stock keeping units (SKUs) for use in production, with a daily volume of about 3000 unit loads.

For this facility, JIT meant changing to parts receipts in daily-requirement quantities and fixed-route, fixed-driver pickup schedules. Each route had a fixed time window for truck unloading at the plant LTL dock. Incoming parts were to be taken directly to the assembly line with no quality control inspection.

Existing operations were traditional. The LTL dock consisted of 20+ dock doors with a large marshalling area for loading trailer trains for delivery throughout the plant. There were no systematic controls for deliveries to the assembly lines.

The proposed LTL dock automation included an automatic unloading facility (see Figure 1). This facility was to consist of automatic trailer unloading, automatic destacking of unit loads, automatic part number identification and determination of its destination within the plant, sortation into lanes by destination and transfer to an AGV tug system for delivery.

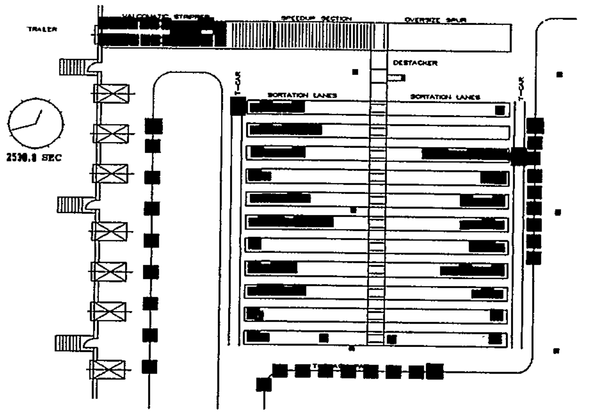

Figure 1: LTL Receiving Dock

The simulation model was written in Siman and animated in Cinema. The animation of the automatic unloading facility was essential in illustrating its complex operation. The unloading system had to be able to handle any arrangement of five different footprints.

The animation was also useful when using the simulation to determine the sensitivity of the automated dock to system parameters and the synchronization of the individual components. The animation suggested alternatives to test the system which might not have otherwise been considered. The simulation used as input the planned routes with anticipated delivery zones. The extremely skewed distribution of destinations demonstrated the critical role played by the distribution of deliveries to the drop zones.

Cost justification of the system was marginal from the comparison with the pre-JIT staffing levels. After partial implementation without the automation, the staffing had increased dramatically. The dock was filled with trailer trains with one or two unit loads. The plant is reconsidering the economics of the automation.

The lesson to be drawn from this simulation is that evaluating new systems must be compared to the correct alternatives. In this case the correct alternative was an undefined version of the current system. An effort comparable to the design of the new system may be required to obtain a definition of the "current" system as it will look in the future under JIT. Consequently, it may be difficult to obtain a consensus on the estimated cost increase due to JIT, when keeping the existing system.

7.AUTOMATED SHIPPING

A manufacturer and distributor of small consumer products distributes all of its product from a distribution center of over 1,000,000 sq. ft. There are over 3000 current SKUs, with a maximum daily shipping volume exceeding 100,000 cases. The shipping facility has 20 truck dock doors with limited staging area available.

The distribution center automated the facility to improve customer response time, increase inventory accuracy and improve worker productivity. Changing order patterns had increased the number of SKUs per order and decreased the number of cases per line item.

The automation was acquired under a design-and-build contract. The installation "fell through the cracks". The system had been designed with an inadequate functional description and very limited participation of the shipping staff. The system was not integrated with other dock operations. The equipment was functioning poorly in this application. The automation substantially decreased worker productivity.

The distribution center staff and SysteCon redesigned the system to integrate the automation with the rest of the dock operations. The automation was rearranged with minimal new equipment added. The proposed operations were worked out to achieve productivity improvements.

However, the shipping department was not committed to the revised system. The first attempt had been sold as perfect and had corporate-wide visibility. The failure also had high visibility. The automation required scheduling coordination where there had previously been no schedule.

An interactive scheduling simulation of the dock was developed in Siman and Fortran. The dock facilities were modeled after detailed discussions with the shipping department. Test cases were based on historical daily shipping records. The simulation ran in minutes and allowed alternatives to be easily tested.

The simulation model allowed testing alternative methods of assigning and transferring truck loading teams to different trailers. This analysis demonstrated the need for revised communications on the dock.

As a result of the simulation the shipping department supported the revised automation plan. The scheduling simulation is currently being modified to access system data bases to directly input daily shipping requirements. This will allow the model to be used as a daily scheduling aid without large data entry requirements.

AUTHOR BIOGRAPHY

WILLIAM H. MOLL is a supervising consultant with SysteCon, a Coopers & Lybrand Division. He has modeled a variety of material handling and production operations in conjunction with system design efforts. He has a M.A. in mathematics from Columbia University and an M.S.O.R. from Georgia Tech.

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