Introduction To

Dynamic Optimization

An Executive Overview

Usually you do not think of a distribution or fulfillment center as a place of "change and uncertainty"; however, consider the activities of the supervisors and managers. Consider yourself a supervisor as you arrive early to find the work that you are expected to accomplish during your shift. Upon your arrival you are immediately confronted with Jane calling in sick, and then Larry arrives with a sprained ankle and he will not be able to do h is normal job. You find out that one of the fork trucks is down in the maintenance shop waiting for a part. Ralph knocked over a pallet and you had to send Jim to go through the product to separate that, which was damaged. Lois in shipping called to tel l you that one of the drivers had an accident and will be 2-3 hours late. A belt broke on the replenishment conveyor and it will be down for another 20 minutes. And this all occurred within the first 15 minutes of your shift!

On top of all of these "unex pected events" you are faced with the "normal" unexpected events such as stock shortages, overages, order cancellations etc. At VAS we call all of these unexpected events "exceptions". What is an exception? It is an un -predicted event. If it were predictable, we could "**plan**" for it and there would be no exception.

"Plan" – this is a simple word with a complex meaning. In the context of a distribution or fulfillment center a "plan" is "the organization of work to most efficiently (optimally) accomplish an objective". A "plan" is created before the work is executed.

Planning work efficiently is "optimizing" work. Optimization can be accomplished in two distinct and much different manners – namely "Static or Pre Optimization" and "Dynamic or Continuous Optimization". If work is "planned" most efficiently it is "statically optimized". "Dynamic optimization" is a method of optimization where the optimization process is **continuously** occurring. Dynamic Optimization is the most efficient method of organizin g or controlling work activities in an environment where change and uncertainty exist.

In order to show the benefits that may be realized through dynamic optimization a simplified description of an actual case is presented. It should be noted that "dynami c optimization" might applied universally to most operations. Dynamic optimization is a universal concept applying to the execution of any effort.

The "dynamically optimized" system presented here is of particular interest because prior to the dynamic optimization project the system included an excellent "pre -optimization" (static optimization) method. It would be hard to find a system with as good of a work -planning module.

The fulfillment system described here is to deliver "waves" of goods simultaneous ly from multiple pick areas for loading onto shipping trailers. Many, but varied, numbers of workers work in each pick area. The workers used handheld RF terminals to receive pick instructions and to report job completion. The recent "productivity" of ea ch of the workers was stored by the system. The system also tracked the "average" productivity of each of the pick areas. Upon receiving new work (delivery orders), the statically optimized system created an "optimized work plan" that identified the over all effort required in each of the pick areas and then assigned the workers to areas based on their individual recent productivity. The system optimized the labor assignment so that each of the pick areas would complete their work at the same time thus allowing the next work to proceed without delay due to varying zone completion times. That was the plan!

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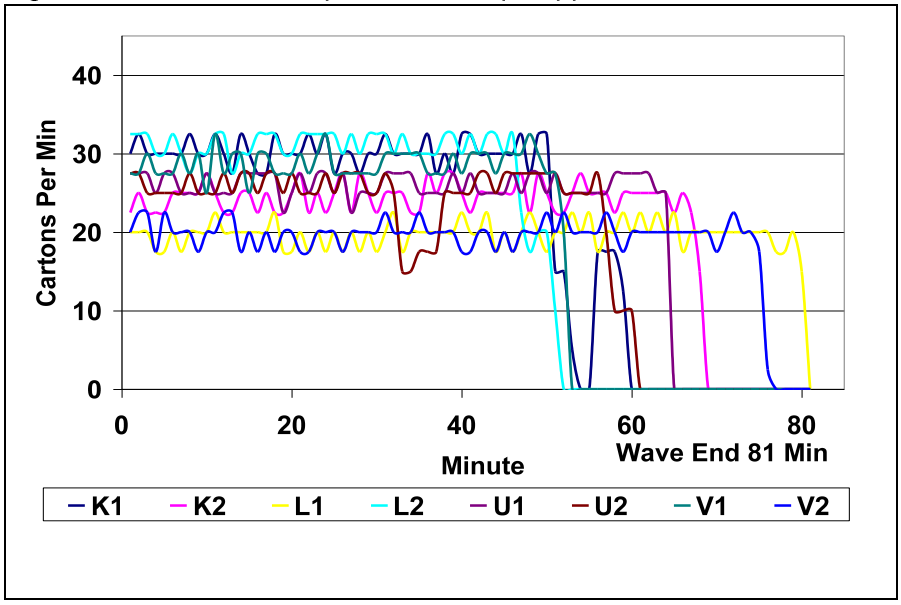
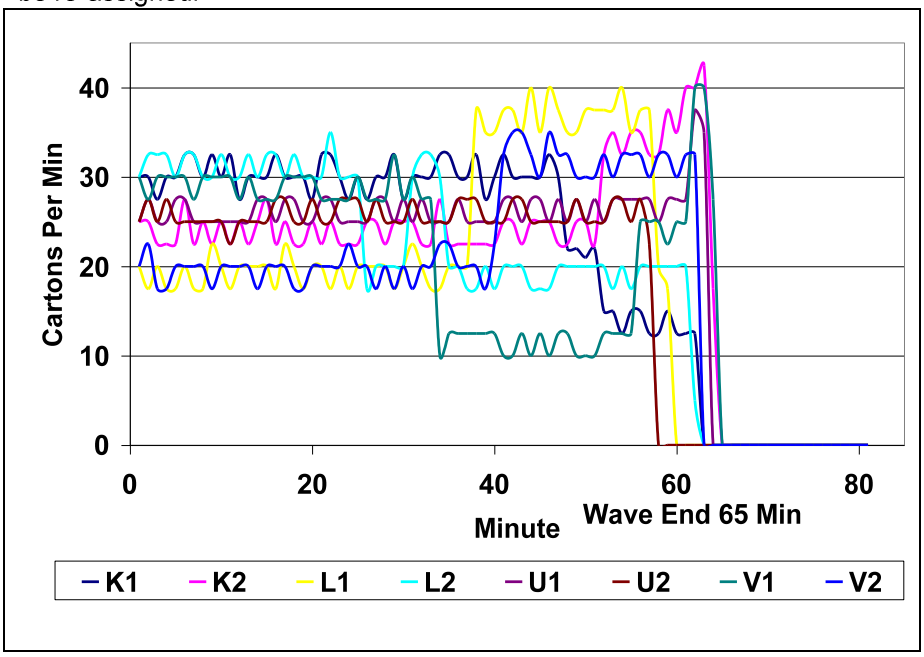
The statically optimized system was successfully installed and system productivity data was monitored and collected. As good as it was there were still a broad range of work completion times for each of the areas. Why? Exceptions! For example, just because Helen has historically (yesterday) worked at a particular rate, today she is not feeling well, Larry has a sprained ankle and Jim had to go over to sort out the pallet that Ralph tipped over.



After a year of operation, VAS suggested a "dynamic optimization" project and it was approved. The new project optimized the completion of zone work by dynamically making assignments to workers. Each time a worker completed an individual pick assignment; the system would determine the best thing to do next. The system "knew" the amount of time (lost production) that was necessary to re-assign a worker from one zone (area) to another. The dynamically optimized system evaluated the progress of each pick zone continually estimating the time that each area would complete. The dynamically optimized system evaluates the effects of transferring a worker from one area to another taking into account the travel penalty for making such a re-assignment. If the re-assignment would complete the total work earlier, the re-assignment would be made. Otherwise the worker would continue in their current area. With this arrangement if the area started falling behind, another worker from an area that was further ahead would be re-assigned.



The difference in the two charts is dramatic. The work in each of the areas finished within a much tighter range, and much earlier! The workers in all areas are better utilized, having less idle time. It should also be noted that the workers are not working any faster, they are just working constantly. Although there were several zone transfers (4 or 5) necessary, those transfers occurred early enough to allow their impact to yield the intended results. Dynamic optimization is clearly superior!

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