WHITE PAPER

VASFT022

Demand Driven Fulfillment – Identifying Potential Benefits

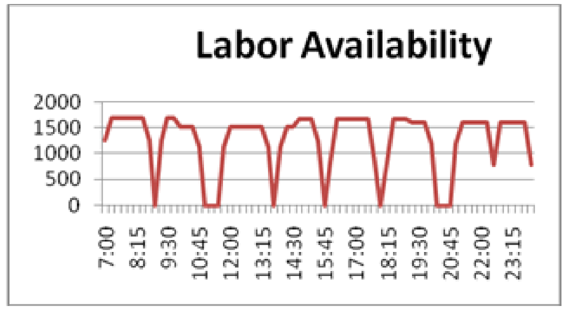
Demand Driven Fulfillment is a term describing the execution of the fulfillment process within the four walls of a distribution operation. The term was coined by AMR Research and describes the "how to" of lean processing in distribution whereas the more general term "Demand Driven Supply Chain (or Network)" is a term that describes the objective or nature of the operation.

The purpose of this paper is to communicate where the benefits of such a process lie and the opportunities available by incorporation of these techniques in distribution operations. In order to do this it is important to identify the opportunity and potential magnitude of possible improvement. Sometimes it is difficult to communicate the opportunity because many times the operation or process itself masks or hides the underlying inefficiencies. It takes closer inspection to identify the potential for improvement.

Normally the effectiveness of a distribution process is viewed through reports such as the one shown here:

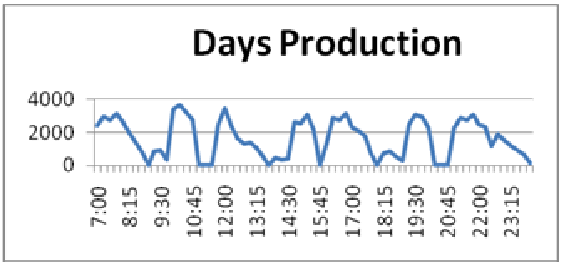
Weekly Production Report						**Week**	**26**
	Mon	Tue	Wed	Thu	Fri	Sat	Sun
Inventory							
Available Units (1,000s)	537	464	433	483	555	589	533
Received Units (1,000s)	34	63	137	145	93	0	0
Consumed Units (1,000's)	107	94	87	73	59	56	12
Shipmments							
Backlog Orders	1,235	1,801	2,659	3,242	3,627	3,828	4,077
Backlog Units	11,115	16,212	23,927	29,178	32,639	34,452	36,692
New Orders	12,451	11,240	10,167	8,441	6,670	6,383	1,389
New Units	112,055	101,161	91,501	75,970	60,032	57,443	12,504
Orders Shipped	11,884	10,383	9,583	8,057	6,469	6,134	1,326
Units Shipped	106,958	93,446	86,250	72,510	58,218	55,203	11,937
Production Labor (hours)							
Receiving	23	42	91	97	62	0	0
Replenishment	97	85	79	66	54	51	11
Picking	856	748	690	580	466	442	95
Packing	357	311	288	242	194	184	40
Shipping	89	78	72	60	49	46	10
Total Hours	1,421	1,264	1,220	1,045	824	723	156

If such an operation was observed and the process was well managed one would expect to see workers constantly busy and no noticeable inefficiencies would be detected. Distribution operations have "cyclic" production and the cycles are caused by multiple conditions, the most obvious being planned work cycles that include breaks and lunch periods. There are other conditions that also cause cycles in nearly all distribution processes. The only way to "see" these cycles is to look at production throughout the day. If the only cycles were related to work resource availability – shift changes, lunch periods and breaks, then the expected productivity would look like the following chart:

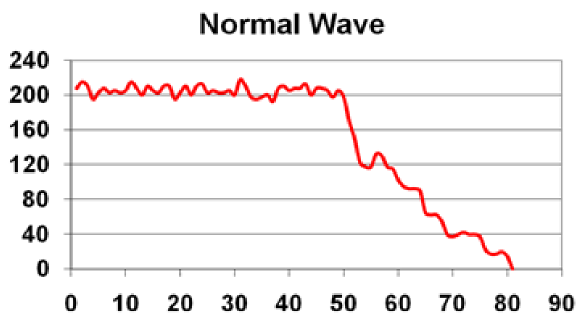


Most distribution systems operating today operate on "waves" of work and many operations are required to operate in waves. Waves add additional cyclic behavior. These wave cycles are not generally linked or synchronized with the labor availability cycles, and the combination of resource availability and wave cycles lead to a more complex production cycles. This paper is not intended to address the benefits of waveless operations, it is addressing the benefits of demand driven fulfillment, a methodology that yields great benefit in wave based operations. Demand driven fulfillment also happens to be the core of waveless operation.

A wave based operation's daily productivity would look something like the following chart. There may be many organizations that argue that their own daily production charts do not look like this but it has been the experience of VAS that most do, and the reason that most organizations do not believe that their operations look like this is because they have never analyzed the process to the degree necessary to detect the cycles.

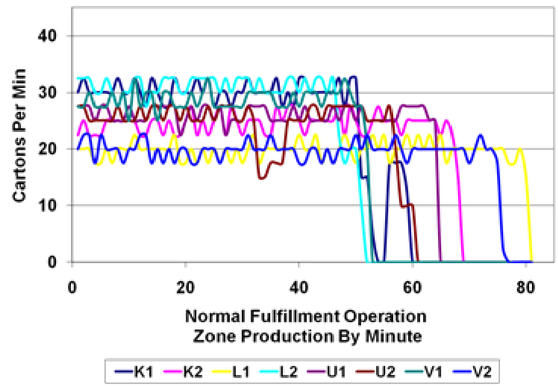


The chart below shows the production of an actual wave in a very well managed facility. Notice the "wave tail" as the production drops. These wave tails are caused by various conditions, but most think of exceptions as one of the prime factors. By definition, a wave represents the combined efforts of many resources to complete a given work requirement.



In such a process, if all resources completed their own assignments simultaneously the wave would complete abruptly with little or no wave tail. To do this (all resources complete their own assignments simultaneously), it would be necessary to have the resource efforts precisely balanced against the work required.

This next chart shows the actual degree of synchronization of work resources of a well-managed operation. This management process included the maintaining of individual worker productivity and matching individual work contributions to the required work, to minimize the time between the completion of work in various areas.



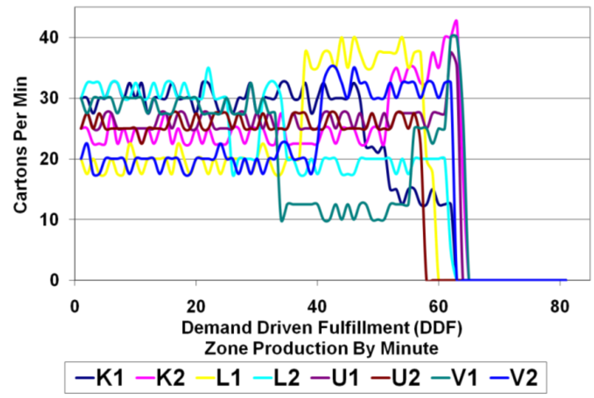
The completion efforts of resources shown in this chart to the left produced the wave chart shown above. The wave chart is the summation of all the efforts of all resources on the wave. The wave tail is created by workers finishing the work in one area before another. The L2 area had no "demand" once the work in that area was finished.

There are three common "attempted" methods to solve this particular problem. None achieves the desired outcome of maintaining constant work flow. One attempted method is to "better balance" the normal work expected from each work area. This is typically done through re-slotting or moving SKUs to maintain area-to-area workloads. The reasoning is, "if the work were better balanced, workers could finish more predictability". Trying to balance or normalize the work between work areas does not achieve the desired outcome, because the work required (the demand) is constantly changing day-to-day, wave-to-wave and changing the labor balancing process is near impossible for human beings. The effort (moving stock to attempt to maintain even work distribution) is endless. To validate this conclusion merely ask the parties responsible for the balancing in this manner "how often would you like to re-slot SKUs to maintain work balance?"

The second attempted method of solution is to allow early finishing workers to proceed with the next wave, buffering their work until it is needed. The reasoning here is "if the early finishing workers can continue to work while others are finishing up their own work there will be no productivity loss". This method often fails, because there is "much" new early work and "little" remaining work and there is an inherent work mismatch. These factors combined lead to the need for ever larger buffers. This conclusion can be validated by asking "how big of buffer would you like?" to the organization that is promoting the buffering solution.

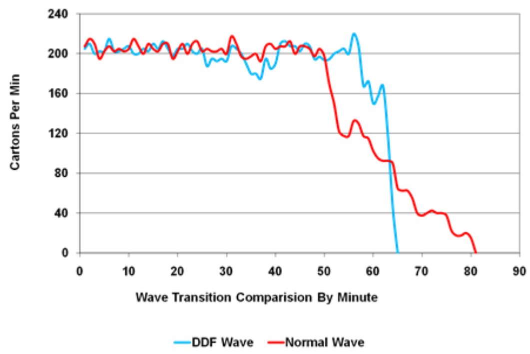
The third common attempted method of solution is to supervise the work effort more closely, having supervisors direct workers from completed work areas to the areas with remaining work. The method does not work because by the end of the wave, the movement of workers becomes somewhat futile. The movement should have taken place much earlier having the efforts of those workers available for a longer period of time. This solution would lead to a "fire drill" at the end of each wave. Additionally supervisors are only able to manage to the degree that they notice any imbalance in work and are able to ascertain the magnitude of the change in work assignments that need to be made to correct the imbalance.

The root cause of the major drop in productivity in end of wave is due to the lack of ability to synchronize the work effort with the work. The "work" represents the "demand". Demand driven systems use "demand" or "work" to drive the process. As demand in one area diminishes, compared to the demand in other areas, a demand driven operation senses that differential and redirects effort to meet the demand at hand. VAS has developed and installed systems for many years that take this approach. The demand driven processes have been called various things such as "dynamic optimization", "automatic labor balancing", and "adaptive software", but all of these solutions are demand driven.

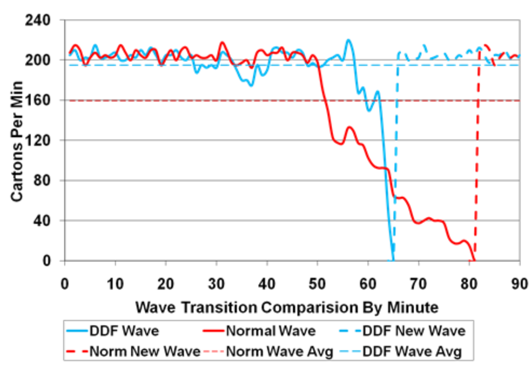


The chart above is derived from actual results of applying a demand driven fulfillment methodology to a wave based distribution operation. This chart is the result of applying that methodology to the same operation as was depicted in the chart above. Notice in the chart that as the remaining demand in one area diminished, work resources were driven (automatically) to other areas. This adjustment is made as the imbalance in demand and work resources is detected during the course of the wave. The net result was that the overall work was completed in less time. When the work from all the various areas is combined, the wave productivity is dramatically changed yielding a wave whose tails are significantly changed.

Now we compare the two waves; the normal wave where work in areas completes without intervention and the Demand Driven Fulfillment wave where work resources were driven to the remaining demand.

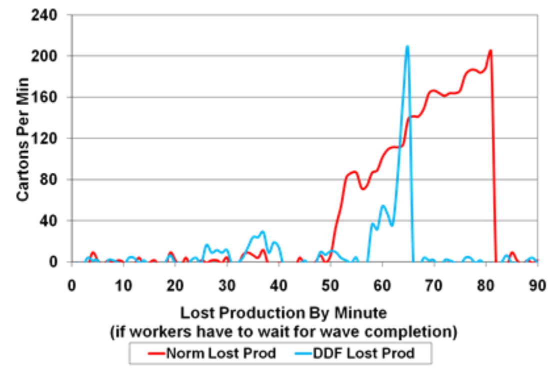


In identifying the benefits of Demand Driven Fulfillment it is easy to see that this methodology can yield significant improvement in productivity, by minimizing the imbalance in work (demand) and work resources. The benefit can be realized by reducing in-efficiencies created by having workers idle waiting for other workers to complete their work or by minimizing the amount of buffering that is necessary to allow early finishing workers to start on their next work assignments as other workers are finishing their old assignments.

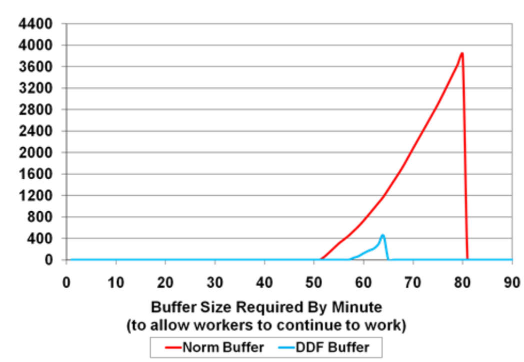


New waves can be started earlier because old waves complete sooner. The above chart shows this improvement.

As the result of starting new waves earlier, production gains are realized. The following chart shows the lost production that may be re-gained through the reduced wave tails yielded by Demand Driven Fulfillment when compared to a normal "push" based wave operation.

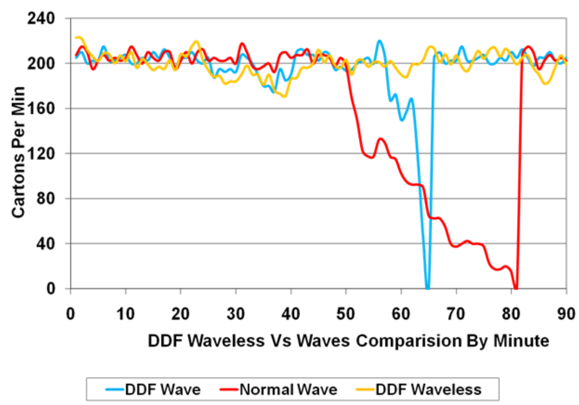


The alternative to losing production in a push wave based system, is to allow work resources finished with their current tasks to start new tasks while the work resources still working on the old work are actively working. Although this eliminates the perceived idleness, the new completed work must be buffered or held until it can be processed. The holding of the work can be either manual or automated. In a manual buffering system, new work is stacked until it is time for release. The stacking operation is not only less efficient, because of the extra steps, it is also subject to errors where completed work is not released when it is time and winds up making the next new wave more difficult to close. In comparing the amount of buffer required between a Demand Driven Fulfillment system and a normal wave system, is that the normal wave system requires a substantially larger buffer. This is due to the fact that eventually all the new wave work is being buffered waiting on the last old wave work resource. The longer this completion takes, the buffer is grows non-linearly or exponentially.



In summary Demand Driven Fulfillment systems perform much better than push driven systems regardless of whether the Demand Driven Fulfillment system is wave based or waveless. Demand driven systems can yield significant improvements in productivity more closely meeting productivity expectations. The final chart compares a waveless to a wave based system both using normal techniques and Demand Driven Fulfillment.

The demand driven fulfillment techniques presented here have been in operational practice for many years.



“The greatest opportunity for increasing personal productivity in distribution operations lies not in expecting people to work faster, harder, or even more accurately. The greatest opportunity for improvement lies in having people work constantly and independently at their own individual work rate.” John Fontanella, Vice President at AMR Research.