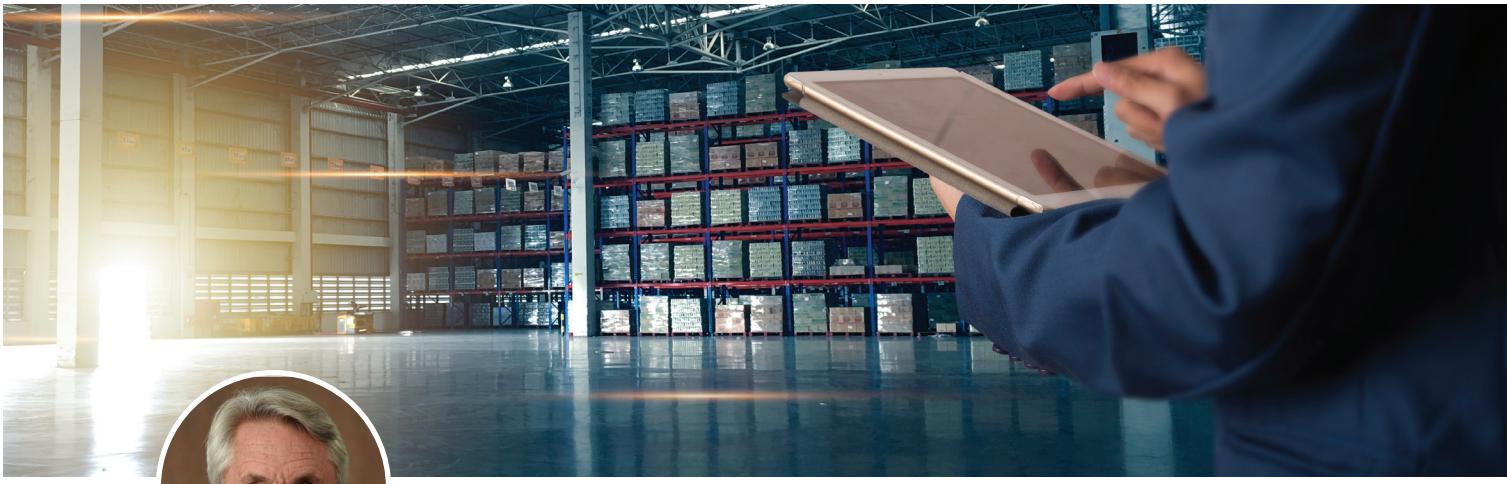
White Paper

[Simulating DDMRP Buffers]

DEMAND DRIVEN TECHNOLOGIES

Simulating DDMRP Buffers



Simulating a DDMRP buffer based on random demand from APICS 2014 attendees

Just how robust are Demand Driven Material Requirements Planning (DDMRP) Buffers? We used completely random data supplied by 57 different sources to test the resiliency of the DDMRP method in both long and short lead time environments. The results speak for themselves.

ERIK BUSH, CEO

Demand Driven Technologies was an exhibitor at the 2014 APICS Convention in New Orleans, Louisiana. As a demonstration of the resilience of Demand Driven MRP buffering, Demand Driven Technologies collected random demand values from visitors to its booth. The goal of the study was to illustrate how a DDMRP buffer could achieve very high customer service and strong inventory turnover without the use of a forecast.

Each participant in the study was handed a card and asked to provide 10 days of demand records which could be of any value from 0 to 500. There were no other restrictions placed on the input provided by the study participants. The completed cards were sequenced as they were submitted by the visitors and then inputted to DD Tech's DDMRP simulation tool. On the right is an example of a completed card.

Your Initials MPS

Demand Values Day	Value (0-500)
1	431
2	0
3	0
4	30
5	0
6	10
7	350
8	50
9	45
10	115

Details of the Simulations

With 57 participants in the study we were able to model Part 1 for a full year. We modeled Part 2 using the 200 days of demand not used in Part 1 and re-used the first 165 days of Part 2 demand to complete a full year analysis. Details of key parameters for each part were as follows:

Part 1 – "Widget"

1. Lead Time - 90 days
2. Minimum Order Quantity - 0
3. Assumed variability –High
4. Opening value for Average Daily Usage - 30
5. Safety % for Red Zone – 120%

Part 2 – "Gazoonk"

1. Lead Time - 21 days
2. Minimum Order Quantity - 0
3. Assumed variability –High
4. Opening value for Average Daily Usage - 30
5. Safety % for Red Zone – 120%

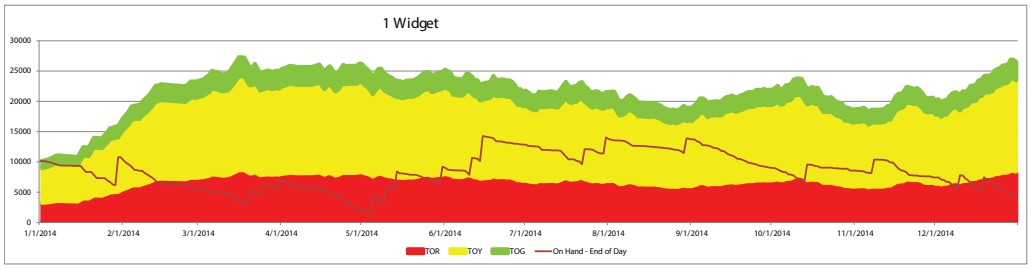
In addition, we set the buffers to have the ability to Qualify Order Spikes only 3 days in advance. This limited the benefit that Order Spike Qualification would have on the results achieved by the buffer. The Order Spike Threshold was set at 10% of the Red Zone.

Part 1 – Widget Simulation Results

The simulation of the demand for Part 1 – Widget resulted in 100% customer service and 6.43 inventory turns for a part with a 90 day lead time. The buffers rapidly increased in size during the first few months of the simulation as the demand provided by the participants was much higher than the starting assumption for ADU of 30 units per day.

Summary of key results for Part 1 – Widget

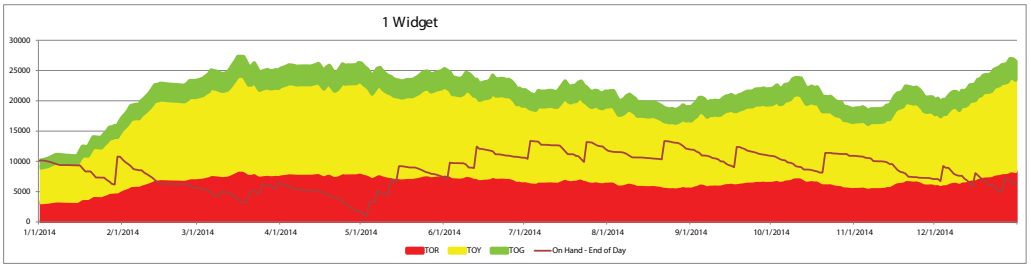
Simulation Results			
Avg on hand	8,551	**Minimum on hand**	1,369
Annual Turns	6.43	**Max on hand**	14,280
Total Demand	54,967	**Service Level**	100.0%
Average Daily Demand	151	**Days Stocked Out**	0
Peak Demand	500		
Supply orders	20		
Average Order Size	2,911		



The buffer trend graph demonstrates how it quickly adjusted to the greater rate of demand of 151 units per day versus the starting assumption. The actual ADU rate was 5 times the opening assumption and pressured on hand position which bottomed out at 1368 units. However, the incoming supply from orders generated early in the year put the buffer back into a strong position to maintain service the balance of the year.

We then turned off Order Spike Qualification with the following results:

Simulation Results			
Avg on hand	8,603	**Minimum on hand**	980
Annual Turns	6.39	**Max on hand**	13,376
Total Demand	54,967	**Service Level**	100.0%
Average Daily Demand	151	**Days Stocked Out**	0
Peak Demand	500		
Supply orders	20		
Average Order Size	2,936		



Without the benefit of 3 days forward visibility to sales order demand, the buffer still achieved 100% customer service for the year. Minimum on hand inventory decreased to 980 units – slightly less than 7 days of supply.

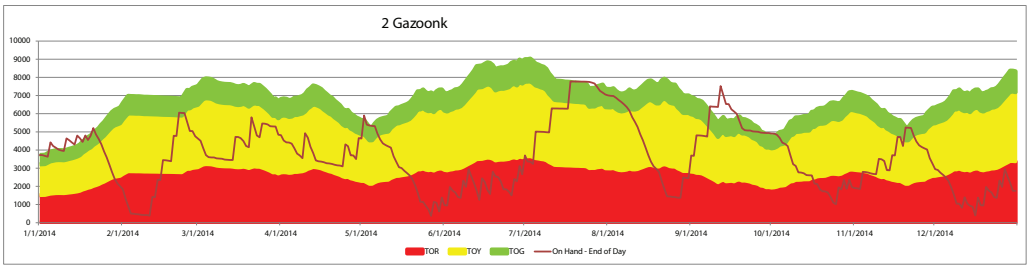
In both scenarios 20 supply orders were generated during the year with an average order size of just over 2900 units.

Part 2 – Gazoonk Simulation Results

The simulation for Part 2 resulted in 100% customer service and inventory turns of 15.56. The minimum on hand balance was 380 units and suggests that increased red zone safety coverage would be appropriate to further reduce the risk of stock outs.

Summary of key results for Part 2 – Gazoonk

Simulation Results			
Avg on hand	3,670	**Minimum on hand**	380
Annual Turns	15.56	**Max on hand**	7,776
Total Demand	57,105	**Service Level**	100.0%
Average Daily Demand	156	**Days Stocked Out**	0
Peak Demand	500		
Supply orders	48		
Average Order Size	1,187		

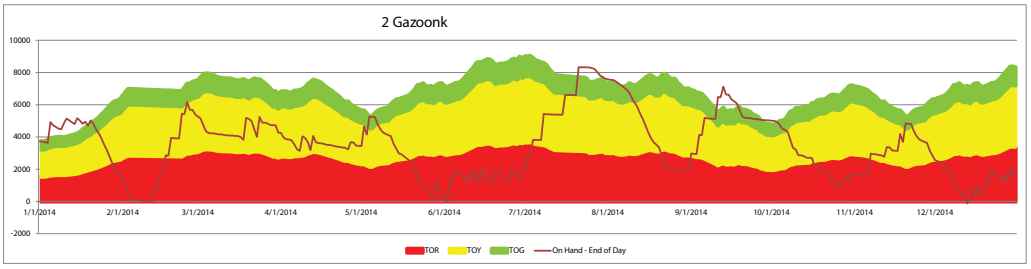


In the simulation for Part 2 the buffer size flexed to a greater degree as the average daily usage deviated from the mean in a more 'seasonal' type pattern than in Part 1. This further illustrates how DDMRP buffers are resilient to changing rates of demand providing high service while also driving very positive inventory turnover.

48 Supply Orders were generated during the year supporting the rapid turnover rate for the inventory.

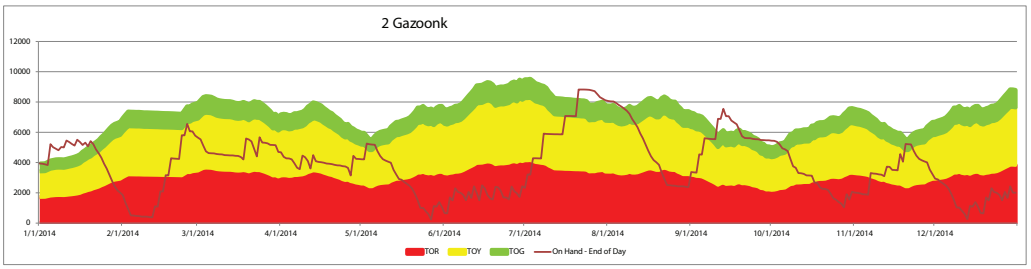
As in the Part 1 example we turned off Order Spike Qualification. In doing so, we experienced 2 days of stock out and a service level of 99.5%.

Simulation Results			
Avg on hand	3,509	**Minimum on hand**	(125)
Annual Turns	16.27	**Max on hand**	8,328
Total Demand	57,105	**Service Level**	99.5%
Average Daily Demand	156	**Days Stocked Out**	2
Peak Demand	500		
Supply orders	51		
Average Order Size	1,137		



While 99.5% customer service would be considered excellent in most clients we then addressed the stock out days by increasing the Safety Percentage for the Red Zone from 120% to 150% with the following results:

Simulation Results			
Avg on hand	3,865	**Minimum on hand**	235
Annual Turns	14.78	**Max on hand**	8,823
Total Demand	57,105	**Service Level**	100.0%
Average Daily Demand	156	**Days Stocked Out**	0
Peak Demand	500		
Supply orders	50		
Average Order Size	1,161		

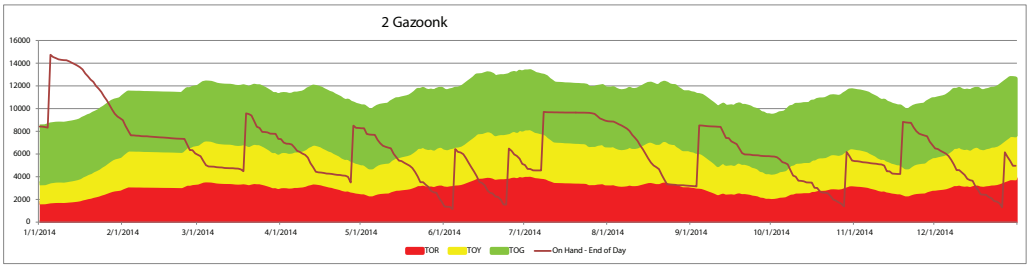


Service improved to 100%. Minimum on hand increased to 235 units while inventory turnover rate declined slightly to 14.78 annual turns. Again, this result was achieved without any forward visibility to sales order demand.

How Minimum Order Quantities Impact Inventory Turns and Flow

Building on the Part 2 simulation we then tested the impact of a large Minimum Order Quantity (MOQ) on buffer performance. We simulated a MOQ of 5000 for Part 2. This represented roughly 33 days consumption for a part with a 21 day lead time with the following results.

Simulation Results			
Avg on hand	6,298	**Minimum on hand**	1,141
Annual Turns	9.07	**Max on hand**	14,740
Total Demand	57,105	**Service Level**	100.0%
Average Daily Demand	156	**Days Stocked Out**	0
Peak Demand	500		
Supply orders	10		
Average Order Size	5,244		



Inventory turnover declined roughly 50% to 9.07. Supply orders declined to 10 from 50. Average on hand became 6298 which is roughly 42 days of supply. Minimum on hand increased to 1141 as a result of the larger and less frequent order size.

In our work with clients we consistently find items with Minimum Order Quantities representing substantial multiples of usage over the part's lead time. For purchased items, this often represents an ineffective trade off as the resulting discount rarely justifies the impact the MOQ has on the flow of materials. The same can be said for minimum batch sizes in production where efficiency metrics cause large 'artificial batches' which impede flow.

Summary

The simulation of buffer performance using random demand values provided by visitors to our booth was a very real and interesting test of the Demand Driven MRP methodology. Other than the upper limit of 500 we had no idea what demand input we'd be getting from the study participants.

Both parts that were modelled in the simulation achieved service levels of 100% while also driving very solid inventory turn-over rates. It's critically important to understand that this performance was achieved with at most three days of forward visibility to demand.

We applied a high variability safety threshold due to the unknown rate of demand which drove the perfect service levels achieved in the simulation. We also used the simulation to demonstrate how adjusting buffer parameters such as minimum order quantity affects buffer performance.

The core concept of Demand Driven MRP buffers is that they are designed to achieve constant material availability. The resilience of the buffers was proven in the examples above. Supply orders were triggered based on actual sales and the penetration of the buffers. High inventory turn rates were achieved without the prevalent inventory distortions seen in forecast driven methodologies.

DDMRP also provides users with a very easy to follow signaling system for planning and supply chain execution.

Simulate your own materials!

Demand Driven Technologies provides free simulation analysis to companies interested in gaining a better understanding of the impact that DDMRP tactics and technology can have on their supply chain performance.

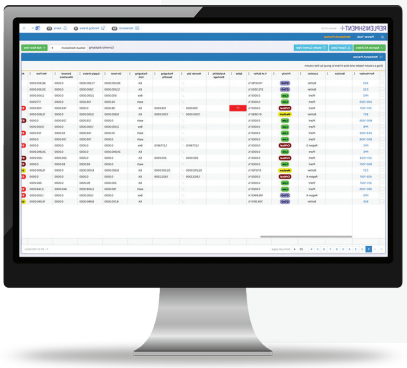
Thanks!

We'd like to thank the large group of APICS attendees who visited us in the Expo and participated in the simulation. We greatly appreciate their time and interest without which this study would have been impossible.

We look forward to working with you on your demand driven journey!

Erik Bush

CHIEF EXECUTIVE OFFICER



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