Simulating DDMRP Results

Looking for a Best Practice in Food Distribution

A guest paper by Sebastián González

Demand Driven INSTITUTE™

www.demanddriveninstitute.com

The Demand Driven Institute (DDI) was founded by Carol Ptak and Chad Smith in 2011. With affiliates, compliant software alliances and instructors throughout the world we are changing the way businesses plan, operate, think and evolve. Every business has a choice; continue to operate with rules, metrics and tools developed more than fifty years ago or make a break from convention, recognize the complex supply chains we live in and make a fundamental change in the way it does Business.

For more information about our mission and how you might get involved, please contact us at: info@demanddriveninstitute.com

A simulation approach to define the more suitable inventory planning methodology for distribution environments

ABSTRACT

Given the opportunities that are in the field of distribution of Fast Moving Consumer Goods (FMCG) in Colombia in terms of service level, stock coverage, and results currently obtained in a reference company of the sector, there is a need for a better suited planning methodology for the sector. In order to search for this methodology, a simulation was carried out in a reference company of the sector. The goal of the simulation was to determine the best suitable inventory planning model analyzing several types of methodologies: (Q, R) Model - EOQ, (R, S) Model, TOC and DDMRP). The primary driver to choose one methodology over the others was the optimization of service level and stock coverage results. Other aspects presented in this study were also taken into account. After the simulation and the corresponding analysis, DDMRP was the chosen methodology because it suited the different demand patterns (smooth, erratic, intermittent, and Lumpy) and, including a potential of 4 percentage points in service level improvement and 27% average stock reduction. DDMRP methodology can be implemented on consumer product companies and in this document we detailed their advantages in terms of strategic, tactical and operational planning.

1. Opportunities in the sector:

Currently, distribution entities in FMCG have major challenges to face. First on the supply side, the devaluation of the exchange rate is affecting prices and margins of products (by the raw materials used); on the other hand, demand has been affected by inflation (Clavijo, 2016). This situation forces companies to define actions to be more efficient and to generate more with less.

Research found that while 89% of these companies reported that they often had enough stock on many of their products 67% also admitted that at the same time they had stock-outs of other SKU (Abdul Zuluaga Mazo, 2011). Sometimes This results in lost sales due to stock shortage while at the same time having high stock levels and This results in an inventory bimodal distribution (too little of the right, too much of the wrong).

Possible causes for this problem involve inventory planning methodologies. Many companies are taking decisions based on their own experience and management methods supported by quantitative techniques. There are also cases in which companies base their decisions on software information without knowing the procedures executed by this particular tools, contributing to the error margin increment. (Valentina Gutiérrez, 2008).

An investigation of different inventory planning approaches was undertaken; several different methodologies were found. But, which is the best one? This article aims to find the answer by performing a simulation of a real company and defining its scalability for its use in the sector. The decisive factors for this were diverse: from optimizing the service level and stock coverage, to improve management and contribution in making strategic decisions.

2. Methodologies analyzed:

During the simulation, a comparison was made between several inventory planning methodologies divided into two groups, “Push” methods versus “Pull” methods. The conventional approach in the industry is applying Push methodology, performing inventory replenishment and/or supply order generation based on forecast, typically through Distribution Requirements Planning (DRP).; It should be noted, however, in the reference company, an "Ad-hoc" Push model is followed. This means that the company conducts its inventory management quantitatively but it is not supported by any specific “brand” of push method. It continues to be supported by the experience of its team and customized tools. The results of the simulation compare the Push methodology applied in the reference company and the Pull methodologies research, which in this case will be the (Q, R) Model - EOQ, (R,S) Model (Ballod, 2004), TOC (Woeppel, 2001) and DDMRP (Ptak & Smith, 2016).

Taking into account the research, the results of the sector, and the current landscape of the reference company, it was possible to arrive at several reflections before starting the simulation. As a first reflection, it is emphasized that the inventory replenishment model by forecast will always have a percentage of error associated with the forecast. In addition, it must be taken into account that the greater the forecast horizon and the more disaggregated forecast the greater this error will be. As a second reflection, for some Pull methodologies there are also disadvantages, specifically for the (Q, R) Model - EOQ and for the (R,S) Model. For these two models its conception is based on several pillars, including the demand is continuous and normally distributed (Ballod, 2004). Unfortunately, this is not the typical case. On the contrary, it is increasingly observed that as companies innovate more, they have more products and each product has its own independent statistical distribution, and in most cases the statistical distribution will not necessarily describe their future demand behavior.

3. Considerations of the reference company:

The food distribution reference company has a warehouse located in Medellín (Antioquia), which supplies products made in Cali (Valle del Cauca). The delivery promise from the distribution center to the customer is forty-eight hours from order receipt. Channels that are served from the distribution center are supermarkets, large chain stores, and smaller volume shops. The demand for each reference is independent, the frequency of orders can be daily or variable in its frequency for a period of time, and the quantity of the order depends on the type of customer ordering.

The company's current inventory planning methodology is based on replenishing the inventory regarding the regional sales forecast. The sales forecast has an average accuracy of 70%; the service level is 95.4% and stock coverage averages 10 days.

Initially an analysis of demand patterns was performed using the demand categorization method developed by Syntetos et al. (2005). The objective of this categorization was to define the pattern of demand given the variability of frequency (ADI Factor) and quantity (CV2 Factor). Figure 1 charts thrity SKU against that criteria.

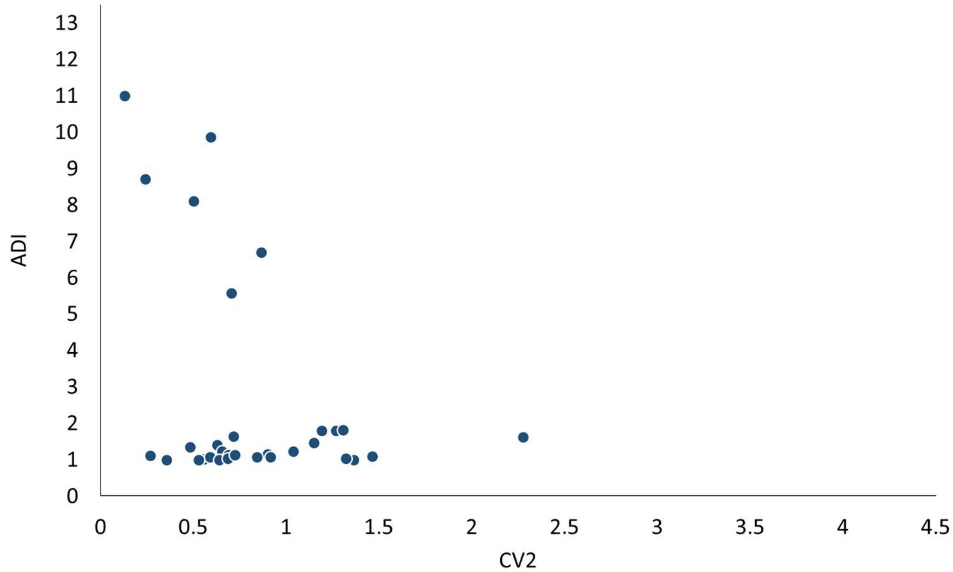

Figure 1. Demand behavior categorization

Figure 2 illustrates four categories of demand behavior: Smooth (occurrence of orders are continuous period to period with little variable quantity demanded), Intermitent (occurrence of orders does not continue period to period with variable quantity demanded), Erratic (occurrence of orders are continuous period to period with variable quantity demanded), and Lumpy (occurrence of orders does not continue period to period with variable quantity demanded). The objective of this categorization was to validate that the selected methodology would adapt to each of these quadrants.

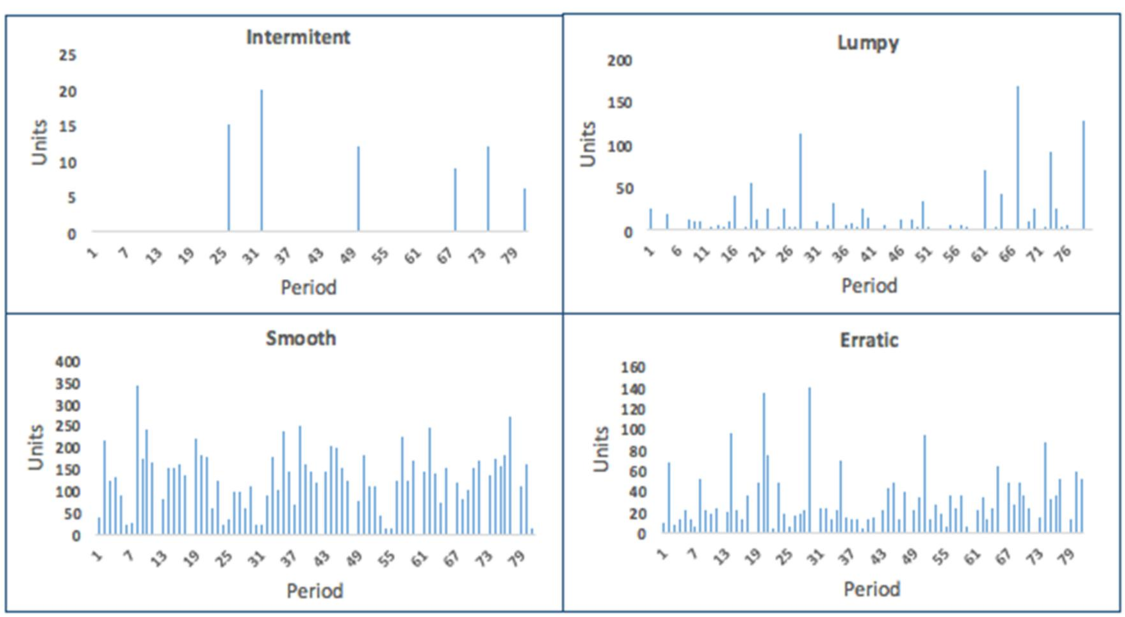

Figure 2. Examples of the four demand patterns

4. Considerations of the simulation:

The simulation was performed for thirty products distributed by the company. In total four iterations of the model were carried out, one for each of the four inventory planning methodologies analyzed ((Q, R) Model - EOQ, (R, S) Model, TOC and DDMRP) and then compared with the current results of the company's current methodology. The simulation was carried out for a period of three months with shipments twice per week from the factory to the warehouse due to limitations on the delivery capacity of the supplier.

For each simulated methodology, corresponding parameters were calculated; order quantity, order point, safety stock, and maximum inventory value and buffers levels for TOC and DDMRP methodologies, among others. Figure 3 describes the results of all four simulations against each other and the current method.

5. Results:

Methodology	Indicator	Smooth	Erratic	IntermitTent	Lumpy	Global
Current (Actual)	Stock average (Units)	3466	18569	641	1209	23885
	Stock coverage (Days)	8	11	3	10	10
	Service Level	96.52%	94.03%	90.74%	94.10%	95.40%
(Q, R) Model	Stock average (Units)	2802	15362	1796	3572	23532
	Stock coverage (Days)	6	9	9	30	9
	Service Level	97.48%	97.01%	93.23%	95.91%	96.75%
(R, S) Model	Stock average (Units)	2177	11632	1402	1099	16310
	Stock coverage (Days)	5	7	7	9	7
	Service Level	99.96%	98.72%	97.80%	93.87%	98.64%
TOC	Stock average (Units)	2448	12480	1496	1144	17567
	Stock coverage (Days)	6	7	8	10	7
	Service Level	100.00%	99.546%	99.074%	94.616%	99.36%
DDMRP	Stock average (Units)	2320	12222	1550	1405	17497
	Stock coverage (Days)	5	7	8	12	7
	Service Level	100.00%	99.615%	99.128%	94.540%	99.40%

Figure 3. Simulation results

As mentioned previously, the simulation was developed by taking into account that the warehouse makes orders twice per week. From that premise and by using (Q, R) Model - EOQ, it was determined that service level was not going to increase significantly (reaching up to 96.75%). These results can be attributed to the fact that in this case, it is impossible to ship every day towards the distribution center due to the dispatching capacity of the supplier. In addition, it was detected that there is not a methodological guide to optimize truck load using references that are not under the order point. On the other hand, it is evident that this methodology can lead to higher level of inventory compared to other ones (comparing to DDMRP, EOQ has 26% more in total average inventory). This could happen because the method to calculate the economic order quantity can become very complex and susceptible to errors.

When the model is running by the (R, S) Model, results of simulation say that if demand is stable this methodology has a really good level of adjustment (reaching up 99.96%); however, when demand is variable, level service starts to decrease considerably reaching service levels of 93.87%.

DDMRP and TOC are the models that are best suited. However, it was evidenced that the best way to manage inventory is by using DDMRP methodology, reaching a level service of 99.4% and having 7 days of stock coverage. Taking into account the actual results of the forecast replenishment methodology and the results of the simulation with the DDMRP methodology, it would be possible to reduce the total average inventory by 27%, and improve the service level by four percentage points.

6. DDMRP as best practice:

From the simulations results and detailed comparison between different methodologies, DDMRP methodology was chosen as the best of the analyzed ones. Different advantages of the DDMRP methodology over the others are:

- DDMRP includes the net flow equation for definition of supply needs which can detect spikes in demand and achieve an efficient response in inventory replenishment; therefore, DDMRP is a methodology that can better adapt to different types of demand patterns.
- A key component of DDMRP is making dynamic adjustments on inventory levels in order to achieve greater accuracy in inventory needs in launching marketing and sales activities, and even for the launch of new products or making decisions like product portfolio debugging. It is important to mention that DDMRP has ADU alerts, which tell planning teams about unexpected changes in demand behavior and validates them with marketing and sales teams.

There are many factors to highlight in DDMRP methodology, but it is essential to mention that it is not only an inventory management tool. DDMRP is a part of a larger methodology and integrated toolset to manage and synchronize the whole supply chain called the Demand Driven Adaptive Enterprise (DDAE) Model. The DDAE model spans from strategic planning through Adaptive S&OP (Demand Driven Adaptive Enterprise), to tactical reconciliation using DDS&OP (Demand Driven Sales & Operations planning) and operational planning, scheduling and execution by the DDOM (Demand Driven Operating Model). Thus DDMRP is a method designed to fit into a larger framework enabling next steps for driving better ROI.

7. Bibliography.

Clavijo, Sergio. 2016. *Alimentos y bebidas: Desempeño reciente del sector.* Colombia : Centro de estudios Económicos, 2016.

Valentina Gutiérrez, Luisa Fernanda Rodríguez. 2008. *Diagnóstico regional de gestión de inventarios en la industria de producción y distribución de bienes.* Colombia : Departamento de Ingeniería Industrial, Universidad de Antioquia, 2008.

Ballod, Ronald H. 2004. *Administración de la cadena de suministros.* s.l. : earson Education, Inc, 2004.

Woeppel, Mark J. 2001. *Manufacturer's Guide to Implementing the Theory of Constraints.* New York Washington, D.C : CRC Press LLC, 2001.

Carol Ptak, Chad Smith. 2016. *Demand Driven Material Requirements Planning.* South Norwalk : Industrial Press, Inc, 2016.

Abdul Zuluaga Mazo, Paula Andrea Molina Parra, Érica Yaneth Guisao Giraldo. 2011. *Supply chain management strategies based on demand planning in Colombia.* Colombia : Revista politécnica, 2011.

A A Syntetos, J E Boylan, J D Croston. 2005. *On the categorization of demand patterns.* s.l. : Journal of the Operational Research Society, 2005.

8. About the Author.

Sebastián González is an Industrial Engineer and a Certified Demand Driven Planner (CDDP). He has a Master's Degree in Supply Chain Management & Logistics and has over 3 years of experience in reengineering projects of organizational processes. He has experience in a wide array of industries including construction, legal services, advertising and television, food and consumer goods and a number of capabilities such as purchasing, maintenance, storage and especially in supply and planning.

LinkedIn profile: www.linkedin.com/in/sebastian-gonzalez-93809b109