Dynamic Inventories Management

Brunello Menicucci Qualified Management Consultant APCO CMC™ #2013137

Abstract. Inventories represent for most businesses a wide improvement area: shrinking the amount of inventories, indeed brings a lot of benefits.
Henry Ford used to say: *"I know that half the money I spend on advertising is wasted. My only problem is that I don't know which half"* .
Rephrasing this statement, we can say that in many businesses a big portion of inventories is useless and the real issue is to know which one.

Introduction

In spite of the wider processes automation, the use of advanced ERP and growing forecast employment, warehouses of businesses working in *make-to-stock* systems or in distribution markets are full of raw materials, semi-finished goods, "slow moving" finished products and obsolescences.

It is a phenomenon that negatively affects companies' profitability both in terms of costs and revenues. Indeed, in terms of costs it may cause problems of space, cash tied-up but also an increase in the level of taxation - given that tax authorities consider the stocks of semi-finished and finished products as potential income.

On the other hand, talking about revenues, it's self-evident that lack of products (stock out) is the main cause of **lost sales**.

Problem Definition

So, to better frame the point let's start with a question:

> ***What is the right quantity of product (or semi-finished product, or raw material) to keep in stock?***

As mentioned before, manufacturing companies have sophisticated machines, automated processes and software for production planning; distributors and retailers, in turn, make use of ERP systems and forecasting algorithms that should make it possible to know “exactly” the quantity of product to be delivered to "*points of consumption*" (which can be a store or a company) and the precise moment of the "*delivery*". Nonetheless, most companies still face inventory problems throughout the distribution chain, no matter the power of technology they have in place.

The PUSH logic

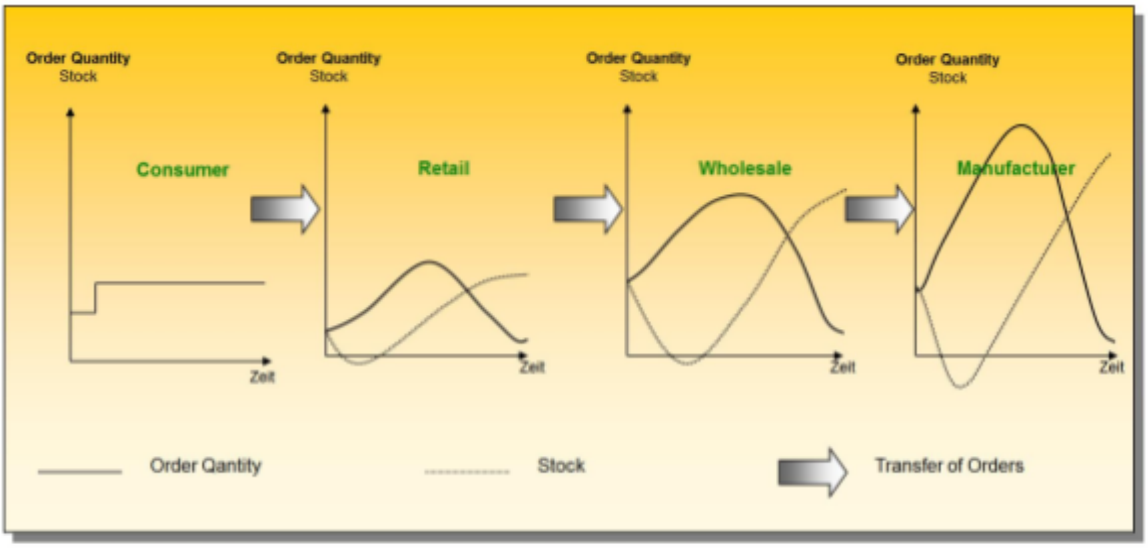
We all know that when a customer wants to buy is unwilling to wait, therefore companies strive to make products available at the customer's closest point, in a logic defined as **push**. To do this, they must necessarily rely on forecasting to define where, when and how much stock it’s needed.

Unfortunately, no matter how accurate and sophisticated forecasting is, it is almost impossible to provide effective forecasts on the level of demand; first of all for a purely "statistical" property: actually, **the smaller the scope** of analysis **the less accurate the result** will be. That means that answering the question "*how much will product X sell at that point of consumption Y?*" is very poor compared to answering "*how much will product X sell overall?*". If you think about it, it’s easy to grasp that fluctuations are the reason for this behaviour: aggregating the sales forecasts of a certain product over 100 "points of consumption" leads to completely different values compared to the same forecast made in terms of overall sales.

Furthermore, there is a problem in data analysis due mostly to the use made of statistical data: basing our decisions on “averaged” data means that while some "points of consumption" will suffer from a lack of

product (shortage) - and therefore will lose sales, others will find themselves in excess of inventory, creating problems in terms of space and capital tied-up.

Finally, no forecasting process is able to predict sudden changes in behavior patterns, which on the other hand is happening more and more often in hyper-competitive environments such as the one we live in. A concrete example of this phenomenon is well depicted in the "**Bullwhip Effect**" i.e. the occurrence for which a small fluctuation in final demand (+/- 5%) is interpreted by components of the distribution chain as a very high variation (**up to +/- 40%**!!).



picture 1 - "Bullwhip" effect - by Grap - Own work. Licensed under CC BY-SA 3.0 via Commons

The PULL logic

However, overcoming difficulties related to the PUSH logic is possible: what is needed is to adopt a replacement solution based on producing, distributing and supplying a certain product ONLY when consumption occurs (PULL logic).

So, looking back at the initial question with this new perspective (what's the "right" quantity to keep in stock), the answer should be intuitive: we need a sufficient quantity to meet customer's request (a customer here can be a downstream department in the production process, a company or the final consumer). Breaking down this statement, we can identify at least three elements that need to be clearly detailed:

- Customer's needs (the "demand")
- Quantity to keep in stock
- "Lead Time", or the period of time necessary to procure the goods

Let's start with the last of these elements: lead time is of fundamental importance because it directly affects the quantity to be kept in stock; if we have to wait 4 weeks to have a certain product, the stock quantity must consider it.

Lead time, as a reminder, is the period of time needed to produce and distribute a certain product. Hence, it is the sum of the days required for reordering (Order Lead Time, i.e. the frequency of replenishment of a specific item), making (Production Lead Time), bringing it to distribution centers and, possibly, delivered to the point of consumption. (Transportation Lead Time).

Each of these elements should be checked and critically analyzed, with the aim of minimizing the Replenishment Lead Time (RLT); in particular, the Order Lead Time should tend to ZERO, it means that for each item sold, a replacement order should be issued on the same day. Cutting replenishment times means:

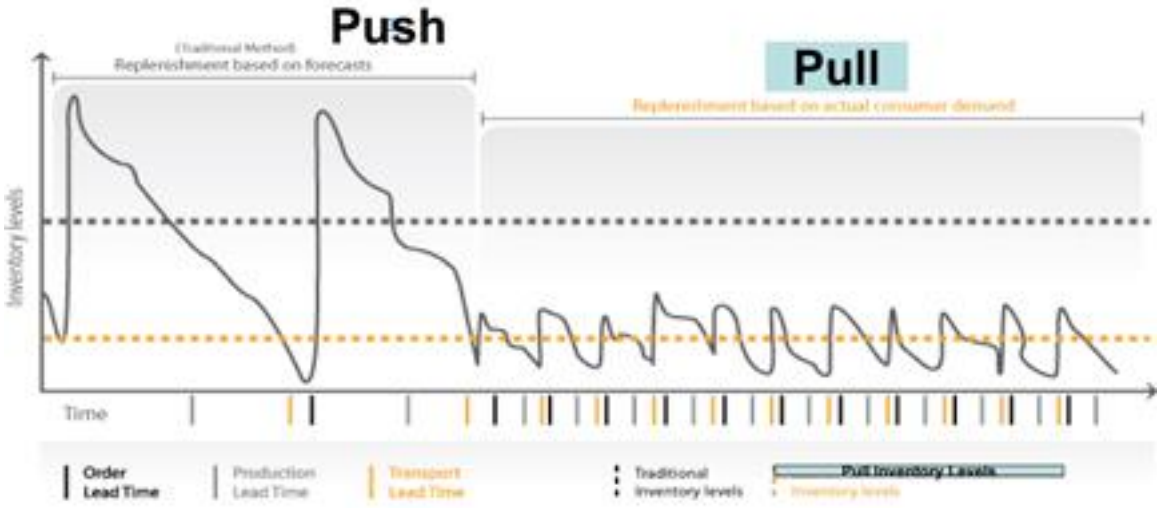
- significantly reduce the level of fluctuations
- better forecasting capacity, having to foresee shorter periods
- response time faster than market demand
- lower stock level

It is not uncommon, however, that the reduction of RLT (supply days) is being "opposed" for different reasons ranging from discounts offered for purchasing in quantities, to the crave for shipment optimization. However, with a little common sense, you could easily find a "trade-off", a balance point between the additional costs to bear, due to a greater shipping frequency, and the cost of unavailability or excessive stocks: this is a point we'll discuss later.

So, at this stage the level of demand can be easily determined: working with a "PULL" logic, and a replacement order is issued for each product sold by end of the day, we can identify the demand needed analyzing the sales for a period equal to lead time. Let's consider the following example: our company buys and resells a product P, whose lead time is

10 days; pretending that during this period we have sold 100 pieces, this is the level of demand.

As a result of this, we can easily calculate the quantity to keep in stock: provided that within this period we find a "sales peak", the quantity to be kept in stock will be equal to **the highest quantity** times **the number of days** needed to supply that particular product. Also, to ensure a safety margin, we can apply a “correction factor” according to the market type, seasonality and the product itself.



Dynamic Inventories Management

Let's have a look at the whole process: in the previous example our company buys and resells a product P, whose lead time is 10 days; so we will look back at the last 10 days of sales quantities, starting from today (a time equal to the lead time). Then we’ll look for a sales peak (if any) which, let's pretend is 3 pieces. We also assume that our company has established a safety margin of 10% for the products marketed; with these data the quantity to be kept in stock for product P will be

3 x 10 x 1,10 = 33 pieces

that is (max qty sold) x (days for replenishment) x (safety margin).

In the logic of TOC (Theory of Constraints), referred to a "distribution" environment, the quantity that we want to keep in stock is defined as a buffer, while the missing quantity of the buffer is defined as

"consumption" of the buffer itself (***Buffer Penetration***) . This allows us to define different buffer "zones", colored according to the level of penetration reached according to the formula (total buffer - missing) / (total buffer):

- less than 33% penetration: GREEN
- between 33 and 67% penetration: YELLOW
- between 67 and <100% penetration: RED
- 100% penetration: BLACK

The coloring of the zones is functional to provide immediate indications regarding the need to proceed with a replacement order: the GREEN label suggests indeed that the quantity in stock is enough to cover the demand; the YELLOW label leads to the need to restock while the RED shows the need to request delivery (if the order has already been issued) or to issue an urgent order. Finally, the BLACK label highlights a situation of "*stock out*" with consequent loss of turnover!

Codart	Descart	Non venduto da (gg	Data Ultima Vendita	LTP (Lead Time Period	Giacenza	Buffer	Ultimo Prezz	Valore Scorte	Qty Eccedei	Qty da Riordinar	Max Sales nel LT
0A001-0010050(	VDSGY AAMPKAU	214	25/06/2015	1	1	2	€ 21,00	€ 21,00	0	1	1
0E7IOZF0-BI 1EA	GMR 34 3 UPC X.H. VPFMS 63C	98	19/10/2015	1	12	7	€ 40,52	€ 486,24	5	0	5
0E7IOZZ0-BR 1E/	RCA 14 7 DQV HSTUY 22R KNR Y.N.	67	19/11/2015	3	28	64	€ 21,84	€ 611,52	0	36	17
3BR-CBR2000D	VXEA TCE NTEB.- CI9645 - JX4003 I	635	30/04/2014	1	1	2	€ 22,95	€ 22,95	0	1	1
006R03151	MWMNJ GWL F130 951 CTCJF	63	23/11/2015	4	1	10	€ 26,36	€ 26,36	0	9	2
6VC-02073	DAWZPEVSNYZW 14 BOD LV PKRTFM	88	29/10/2015	3	2	19	€ 121,28	€ 242,56	0	17	5
8E4519	JEX VMG5.7 3W LPOI. USULDWZ	307	24/03/2015	1	2	3	€ 8,62	€ 17,24	0	1	2
8E4546	L0CQ81C3 1I YKY UJYXL 50.2J	209	30/06/2015	1	1	2	€ 32,99	€ 32,99	0	1	1
10NXAD0706002	ACJDJUDV GRR-ZQU 98/144/8123 TUY YC	84	02/11/2015	3	46	4	€ 8,86	€ 407,56	42	0	1
10NXCR12SM00	WOMPKHG WYEAU JLXQ HWFSCJPARPOEHAW	117	30/09/2015	3	1	57	€ 10,99	€ 10,99	0	56	15
10NXFD0800001	WNNRRHO DIHTFB VVBRQBA GKB 2.0	89	28/10/2015	1	1	2	€ 16,90	€ 16,90	0	1	1
10NXKBST26001	WOHPCDCL SG3/KFA QZJRY	200	09/07/2015	1	2	2	€ 5,00	€ 10,00	0	0	1
11A3540	FCOHAY D HMUKY 23ZB/13MS XQSH.6	123	24/09/2015	1	3	8	€ 9,52	€ 28,56	0	5	6
16NXADULUS001	GCL 0.5 WR XEC 35/190 WYXLADY	69	17/11/2015	4	3	30	€ 7,90	€ 23,70	0	27	6
40X5345	YBIDU 574Z	461	21/10/2014	1	2	2	€ 126,00	€ 252,00	0	0	1
40X5451	QTACSX UGPISR 9166/1043	220	19/06/2015	1	5	2	€ 4,13	€ 20,65	3	0	1
193V5LSB2	209B7HVU4	490	22/09/2014	1	3	8	€ 61,80	€ 185,40	0	5	6
203V5LSB26	485U5DMA11	124	23/09/2015	1	1	4	€ 68,90	€ 68,90	0	3	3
0255B002AA	ELZG M ZPD5760/7755	214	25/06/2015	2	2	3	€ 0,00	€ 0,00	0	1	1
0256B002AB	CUCX Y UGD7925/4815	214	25/06/2015	3	2	4	€ 0,00	€ 0,00	0	2	1
0257B002AA	OWAT Y NNG8841/2895	214	25/06/2015	1	1	2	€ 0,00	€ 0,00	0	1	1
0258B002AA	BNLT N QCI3076/0596	119	28/09/2015	1	5	2	€ 122,38	€ 611,90	3	0	1
0259B002AA	Z-LDH 07 Pwfbq Qnsfnk	104	13/10/2015	2	1	3	€ 123,59	€ 123,59	0	2	1

In the previous example, the buffer is equal to 33; if the stock, at a certain time, was 20 pieces (and therefore 13 are missing to reach 33) we would have had a penetration of 40% (13/33), therefore we would be in the yellow zone; instead, if the stock was 10 pieces, the penetration would have been 70% (red color).

With this mechanism (called **Dynamic Buffer Management**) we can continuously compare the value calculated with the actual stock, checking that we have the right stock. Furthermore, in a logic of continuous improvement, it would be possible to check how long a given product would stay both in the GREEN zone (for example for a

period longer than the supply period (RLT) and in the RED zone. An excessive buffer (too much staying in GREEN zone) for example, would suggest reducing the buffer by at least one third. However, before cutting it, it would be useful to consider how strategic the product is, and make an assessment with the following questions:

- Has demand dropped?
- Did supplier has significantly improved their lead time
- Did we set the initial buffer too large?
- Does demand fluctuate too much (in this case it is advisable to widen the analysis period before lowering the buffer!)

Similarly, in the event that the product remains excessively in the RED zone, the buffer must be raised, always taking into consideration the strategic nature, criticality and riskiness of the product itself.

Conclusions

Inventory management is clearly an area of great improvement, whose benefits can positively affect companies, both in terms of "***agility***" of the structure and in terms of working capital that, in turn, improves cash flow.

It is a matter of trying to adapt and change perspective, moving from the "*traditional*" logic (push) to a more adequate one, able to manage the variability and uncertainty typical of current markets. The use of "buffers" becomes a systemic measure, valid for all people/departments involved in management and hence allows to align and bring continuous improvements with regards to the global goal.

References

Forrester, Jay Wright (1961). *Industrial Dynamics*. MIT Press.
Li, Rong-Kwei (2002) *Enhancement of Theory of Constraints replenishment using a novel generic buffer management procedure*. International Journal of Production Research
Schragenheim, Amir (2007) *Managing Distribution.* Inherent Simplicity