SELLING MORE BOOKS

BY REDUCING SHORTAGES AND SURPLUSES

DEVELOPING AND TESTING A SOLUTION TO SHORTAGES & SURPLUSES WITHIN A BOOK PUBLISHING SUPPLY CHAIN

Author(s): Dr. Alan Barnard

Date: June 2010

Selling More Books
By Reducing Shortages And Surpluses
Using Theory Of Constraints

DR ALAN BARNARD

PAPER PRESENTED AT SAPICS 32ND ANNUAL CONFERENCE AND EXHIBITION 25 TO 28 JULY 2010, SUN CITY, SOUTH AFRICA

ISBN 978-0-620-47117-6

Table of Contents

SECTION 1

1. Research Background

In the spring of 2008, one of the largest trade publishing houses in the world (referred to as PH in this paper) approached Goldratt Research Labs to help them to reduce the high level of returns (surpluses) and shortages within their supply chain.

Like most other publishers, PH has been under significant pressure from their shareholders to protect and increase sales and profitability in what has been an overall flat or even declining market since the early 2000's. Despite all their past initiatives, incentives and collaborations with book retailers to reduce surpluses, returns were still around 30 % of all books sold. At the same time, although accurate data was not available on the real level of shortages, analysis of "Point-of-Sale" (POS) data from Retailers shows that, all too frequently, consumers wanting to buy, find that a specific title they are looking for is either out-of-stock (OOS) or simply not stocked (NS) by their retailer of choice.

The resulting consequences of shortages and surpluses on the publisher and retailer's sales and profitability depends on three factors: Firstly, the extent to which shortages and surpluses exist, secondly the consumer response to such an "out-of-stock", "not-stocked" or over-stocked situation (e.g. buy it later, substitute it with another title from the same or different publisher or simply not to buy at all) and finally on the extent to which shortages and surpluses can be reduced.

To explore possible ways of quantifying the real extent and consequences of shortages and surplus and to find and test a practical solution to reduce shortages and surpluses, PH decided to partner with Goldratt Research Labs (GRL). GRL is part of the Goldratt Group (GG), a global research, education and consulting organization founded by Dr. Eli Goldratt, creator of "Theory of Constraints".

This paper presents the findings of the research project that covered a 12 month period, starting with a new method developed for quantifying the consequences and causes of shortages and surpluses of books at retail level on both publisher and retailers, then presenting the proposed solution for reducing shortages and surpluses and lastly sharing the results achieved and lessons learned from a controlled experiment involving 12 test and 12 control book retailers.

2. Definition of Key Terms

- A ***"shortage"*** is defined as an "out-of-stock" situation at the Retailer of a specific product for which there is consumer demand at that time.
- A ***"surplus"*** is defined as that quantity of a specific title at a retail location that exceeds the inventory level needed to protect against the maximum forecasted sales within the reliable replenishment time
- ***"Lost Sales"*** is defined as sales revenue lost due to the unavailability of a book title at a retailer due to either shortages on stocked items or unavailability of non-stocked items (due to surpluses of stocked items)

3. Quantifying the extent, consequences and causes of shortages and surpluses

Generally, in business, the mantra is "*what you can't* quantify, *you can't justify"* or more explicitly – *"show me the money".* To ensure the supply chain team was working on a problem worth solving for both the Publisher and its retail customers, a financial model was developed to quantify the likely impact of reducing shortages and surpluses on publisher and retailer profitability and then to develop a practical method to quantify the extent to which shortages and surpluses still exist and the extent to which they can be reduced.

Reducing shortages and surpluses could impact profitability through:

a. Reducing Variable Cost - surpluses results in returns that increase printing and distribution costs while shortages can result in increased expediting costs.

b. Increasing Sales Quantity – not only can shortages result in lost sales (on stocked items) but also surpluses can result in lost sales (on non-stocked items) as surpluses typically occupy scarce retailer space and cash that prevent retailers from enlarging the range of stocked items.

c. Increasing average Selling Price - retailers and publishers tend to offer discounts to sell surpluses, which can also reduce the sales volume on other normally priced items.

Table 1 below shows a simplified version of a Publisher's or Retailer's Profit and Loss statement to compare the impact of 1% changes in selling price, sales volume and variable cost. It shows that increasing the average selling price by only 1 % (10 cents on a $10.00 book), it will increase the Net Profit of the company by 10 % (1:10 leverage). An increase of 1 % in sales quantity (at the same average price) will increase the Net Profit by 5 % (1:5 leverage). Since returns are currently 30 % of total sales, a reduction of 1 % in returns will reduce variable cost by 0.33 %, which would increase Net Profit by 1.5 %.

	Current		% Change in Price	Price Impact		% Change in Qty	Sales Qty Impact		% Change in Qty	Returns Impact	
	US$	SR%		US$	SR%		US$	SR%		US$	SR%
Sales Revenue (SR)	$ 1 500	100%	1%	$ 1 515	100%	1%	$ 1 515	100%	0%	$ 1 500	100%
Variable Cost (VC)	$ 750	50%	0%	$ 750	50%	1%	$ 758	50%	-0.3%	$ 748	50%
Contribution Margin (CM)	$ 750	50%	2%	$ 765	50%	1%	$ 758	50%	0%	$ 752	50%
Operating Expense (OE)	$ 600	40%	0%	$ 600	40%	0%	$ 600	40%	0%	$ 600	40%
Net Profit (NPBIT)	$ 150	10%	10%	$ 165	11%	5.0%	$ 158	10%	1.5%	$ 152	10%

Table 1: Impact of a 1% change in Selling Price, Sales Volume and Returns

The opposite is also true. Giving away 1 % additional discount, reduces net profit potential by 10 %, losing 1 % sales volume (due to either a shortage or surplus) would reduce the net profit potential by 5 % and taking actions that will increase returns by 1 % will reduce net profit potential by 1.5 %.

It is also important to note how frequently the impact of a reduction in sales quantity or sales price is under-estimated within retailer because of an assumption of fixed net margin. It is often assumed that, because the Publisher or Retailer's net margin is 10 %, only 10 cents from each additional $1 of sales will "hit the bottom line", while it is assumed that every $1 saved is $1 gained in profitability. No wonder there is such a major emphasis on initiatives that can *save money* rather than on initiatives that can *make more money* through selling more products or to reduce discounting and or test price sensitivity. Figure 1 shows the resulting link between the Profitability Gap (a) and Availability gap (b) for publishers and retailers. The green area represents the current performance. The top of the bar represents the inherent potential in both profitability and availability. The red area represents the gap between the current performance and the inherent potential. Each bar in the red area represents a specific obstacle, which, if removed, would bring the current performance closer to the inherent potential (in other words, close the gap).

The **Profitability Gap** is represented by (a) and shows a number of obstacles that can block the organization from closing the profitability gap. The obstacles of primary interest to the supply chain project team were the obstacles titled "Lost Sales (Stocked)", "Lost Sales (Non-stocked) and "Cost of Avoidable Returns" in figure 1(a).

The ***Availability Gap*** in Figure 1 is represented in its own bar 1(b). As long as a Publisher or Retailer doesn't ensure excellent availability and high inventory turns on all the Publisher's titles that could sell, neither the Publisher nor its retail customers are fully capitalizing on their inherent profitability potential. Best Availability, in this context, implies that every title that a consumer wants is available through every retail outlet with potential consumer demand, 100 % of the time. In other words, *the right books are available in the right place at the right time*. The availability gap consists of two main obstacles: shortages and surpluses. A shortage, as an obstacle to higher availability, is fairly obvious, because if we have a shortage, by definition, the item is not available. Less obvious to many Publishers and Retailers, is that surpluses are also an obstacle to higher availability and therefore to increased profitability. Surplus inventory consumes scarce cash and shelf-space at the Retailer (and Wholesaler) and therefore blocks the ability of the store to expand its selection to include additional titles that are selling at other retail locations.

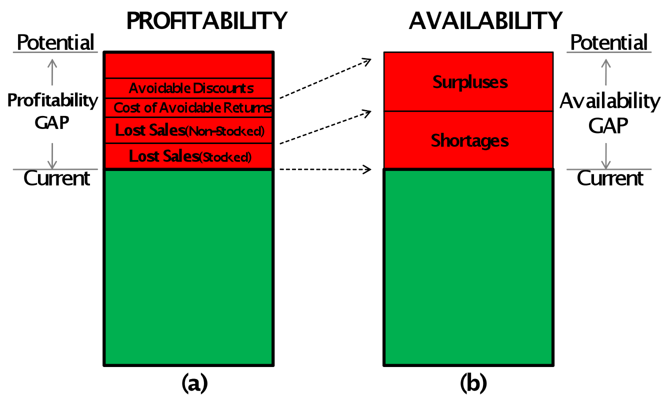

Figure 1: Profitability vs. Availability GAP

4. Quantifying the extent and consequences of Shortages

It is well recognized that all consumer goods industries (including publishing) suffer from both shortages and surpluses at different links in the supply chain simply because of the inherent inaccuracies in sales forecasts and relatively long response times. Over the past two decades, there have been major investments by many consumer goods Manufacturers, Distributors and Retailers to improve forecasting and inventory management as well as to improve responsiveness and visibility throughout the supply chain. These initiatives include Vendor Managed Inventory (VMI), Centralized distribution centres (CDCs), Efficient Consumer Response (ECR), Collaborative Planning Forecasting & Replenishment (CPFR) and Bar-coding/RFID. The net result is that today, availability and responsiveness of most consumer goods are much better than it was 20 years ago – it is now quite normal for Manufacturers and Distributors to achieve a % availability in the high 90's and have the ability to respond from regional warehouses within one or two days to orders from Retailers. However, did these improvements in availability and supply chain responsiveness result in a significant improvement in out-of-stocks and inventory turns (reduced shortages and surpluses) at the Retailer?

Measuring the extent to which actual shortages and surpluses still exist and its impact on sales and profitability was not an easy to question to answer. The project team decided to start by investigating research studies on this problem in other consumer goods industries.

5. Global Research Study on Out-of-Stocks and its Impact on Lost Sales

A ground breaking report on the Out-of-Stock (OOS) situation at Retailers globally across 25 fast moving consumer goods categories, published by the Grocery Manufacturers of America (GMA) in 2002 titled "*Retail Out-of-Stocks: A worldwide examination of extent, causes and consumer response*", showed that the average OOS rate across 40 industry studies around the globe (that reliably measured and reported the extent of OOS) was 8.3 %. The average of the reported highs in the studies was 12.3 %, and the average of the lows was 4.9 %.

Considering the significant investments made in the previous five to ten years, this result was remarkably and disconcertingly similar to 8.2 % OOS that was found in the primary U.S. benchmark study for OOS in 1996, which was sponsored by the Coca-Cola Research Council. This study showed an OOS rate for eight consumer goods categories that ranged from 3.9 % to 11.1 %. The 2002 GMA study indicated that the level of OOS % (around 8 %) did not significantly improve over the 6 years between the two studies - probably because the increased amount of "out-of-stock opportunities" due to an increased number of stock-keeping units cancelled out the improvements in higher availability and responsiveness to the distribution warehouses. The researchers concluded that the remaining causes of the still relatively high OOS were likely to be found within the Retailer's decisions and rules on a.) what products and b.) how much of a specific product it will stock c.) for how long (before returning it), d.) how frequently it will re-order these products and e.) in what quantities.

Another interesting conclusion of the report was that, within those studies that reported OOS rates on both promoted and non-promoted items separately, it consistently showed OOS rates to be higher on the promoted items. And although there were differences between the studies, all studies that reported promotional effects found substantially greater OOS on promoted items than every-day items - in general a 2:1 ratio was found, which means that if the OOS of non-promotional items were 8 %, the OOS on promotional items would be double that – 16 %. The 2002 GMA study also, for the first time, measured the types and extent of the consumer response to OOS and the associated loss of sales to the Manufacturer and Retailer. Table 2 below summarizes the results of this groundbreaking study:

Consumer Response to OOS	%	Sales Impact on Manufacturer	Sales Impact on Retailer
1. Buy Item at Another Store	21 to 43% Avg = 31 %	No *But damages availability and competitive edge*	Yes *Most problematic of all 5 to the Retailer*
2. Delay Purchase	9 to 22% Avg = 15 %	No *But negatively affects cash flow, availability, comp. edge and exaggerates demand fluctuations*	No *But negatively impact cash flow, availability and inventory turns*
3. Substitute – Same Brand	13 to 26% Avg = 19 %	No *But there is a partial loss when the substitute title is cheaper*	No *But there is a partial loss when the substitute tile is cheaper*
4. Substitute – Different Brand	8 to 32% Avg = 26 %	Yes *Most problematic of all 5 to the manufacturer*	No *But there is a partial loss when the substitute title is cheaper*
5. Do not Purchase the Item	7 to 25% Avg = 9 %	Yes *If this happens too frequently, consumers might permanently switch to a competitor*	Yes *If this happens too frequently, consumers might permanently switch to a competitor*
Total Impact	100%	15% to 57% (Avg=35%)	28% to 68% (Avg=40%)

Table 2: Consumer Response to OOS[1] and its impact on Retailers & Manufacturers

These results showed that, depending on the product category, if the OOS % on its everyday products is 8 %, then the Manufacturer is losing somewhere between 1.2 % and 4.6 % of the potential sales (typically equivalent to a 12 - 46 % loss in profitability), while the Retailer with a similar OOS % would lose somewhere between 2.2 % and 5.4 % of sales (typically equivalent to a 22 - 54 % loss in profitability).

Considering that these statistics exclude the even more significant impact of being out-of-stock on a fast mover (which typically contributes to a much larger % of sales than the rest of the products supplied by a manufacturer or stocked by a Retailer) the impact of OOS on both Retailer and Manufacturer's loss in profitability could likely be much larger.

The results of the above study, together with the results from projects done by the Goldratt Group with other consumer goods Manufacturers and Retailers around the

[1] Both the 1996 and 2002 study measured the OOS rate as a percentage of SKUs that are out-of-stock on the retail store shelf at a particular moment in time (i.e. the consumer expects to find the item but it is not available)

world, provided the PH Project Team with a benchmark and the confidence to invest time to quantify the level of shortages that existed for their own titles.

6. Developing a Model for quantifying the extent and consequences of Shortages

Measuring the level of shortages or out-of-stocks by applying different stock keeping and ordering rules simply requires daily Point-of-Sale (POS) and inventory-on-hand data. However, measuring the impact of these shortages requires consideration of a number of complicating factors, some of which are specific to the publishing industry. They include factors such as relatively high variability in daily sales per title, the current slow-down in spending by consumers and the typical "L-curve" for sales on new titles. These factors mean that measuring the real impact of OOS on lost sales is one of the most challenging objectives for any OOS reduction initiative in the publishing or any other FMCG industry.

A simple method for quantifying the likely magnitude of the impact of OOS on lost sales has been developed and tested by the author on a number of other Goldratt Group FMCG projects. It involves simply measuring the number of OOS days per SKU (e.g. book title) at a specific Retailer over a specific period (using daily on-hand and POS data) and then multiplying this "OOS days" number with the average sales velocity per day of that SKU during those days when it was in stock over the measurement period.

As an example, consider a title over a 3-month period (90 days) at a specific Retailer. During these 90 days, the Retailer POS data shows sales of 40 units, which can result in a wrong assumption that sales velocity is 0.44 (40/90). However, the daily "on-hand inventory" shows 10 days that the product was out-of-stock. As a result, the real average sales velocity is 40 units sold within 80 in-stock days (90 – 10), which is equal to 0.5 units/day[2]. We can therefore estimate that during the ten OOS days, the Retailer likely lost sales of 5 units (10 days x 0.5 units/day). Of these 5 units, most likely the Publisher lost sales of only around 40-60 % (in line with the 2002 GMA conclusions on consumer response) or 2 to 3 units.

The PH project team decided to use the above method to quantify the potential increase in sales for all directly serviced stores that would form part of a test group to test the impact of new replenishment solution on shortages. The same calculation and assumptions would be used for a pre-test and post-test quantification, to determine the relative change during the test period. It was also decided that this method could be applied in a parallel test for retail chains with their own central and regional warehouses that are willing to share their daily POS and on-hand inventory data.

[2] This error in determining the sales velocity is frequently the cause of sales forecasts becoming "self-fulfilling prophecies" – i.e. forecasting that a retailer will sell 5 because it sold 5 in the previous period, ignoring that a significant cause of selling only 5 was due to out-of-stock days.

7. Quantifying Surpluses, its Causes and Impact on Lost Sales and Avoidable Costs

Apart from the data on returns (on average, 30 % of all books sold to Retailers are returned) there is no research studies or reliable data from Retailers that could be used to quantify the real level of surpluses – not just due to Retailers simply ordering too much but also due to Retailers ordering infrequently which means they have to carry additional books for a longer period of time. As previously mentioned, regardless of the cause of the surplus, the real damage is not the wasted cost of distribution and printing, but the fact that a surplus blocks sales of titles that could have been sold from that shelf space.

In order to quantify the real extent and identify the most significant cause(s) of the surplus problem, an analysis and/or test therefore needs to consider the major causes of surpluses separately:

- Over-ordering: It often happens that a Retailer simply orders too much or agrees to take too much (due to pressure from the Publisher or their central buying department) of a specific title and the surplus then has to be returned later. The longer the Retailer waits before returning the surplus, the more lost sales occur due to the surplus occupying scarce shelf space.

- Infrequent re-ordering: The longer a Retailer waits before re-ordering (or returning stock), the more stock it has to keep of a specific title. For example, if a Retailer orders monthly rather than weekly (or even daily) the Retailer not only has to carry a significant amount of additional stock, but also takes the risk of having to use longer term (and therefore less accurate) sales forecasts to determine stock levels. Therefore, the less frequent the ordering, the higher the stock needed to protect sales (a surplus if compared to the more frequent ordering scenario) and the higher the risk of shortages and returns.

It should be noted that the reduction of surplus is only applicable to titles where the Retailer is currently carrying more than one unit of that title on their shelves or where the Retailer could have achieved a higher sales velocity ($/shelf space unit of time) by carrying a title not currently stocked due to shelf space or cash constraints.

Therefore, an analysis to quantify the extent of surpluses and the level to which it can be avoided should focus on identifying those titles with an "in-store" and "on the shelf" stock holding of more than 1 unit and where the current "on the shelf" quantity is more than the minimum needed for effective display[3]. An example of

[3] The minimum amount needed for display to attract customers is a controversial topic on which little scientific research has been done. It is the recommendation of the author that tests should be designed to test the impact of higher and lower display quantities especially on the titles where it will have the biggest impact – i.e. display 3 vs. 2 or 2 vs. 1

such a title could include a title where the Retailer is carrying 4 units when 2 would have been enough to ensure there is no stock-outs within the time to replenish or where the Retailer has to carry 4 units because they order this specific item (with a maximum sales velocity of 1 per week) monthly rather weekly.

But how do you determine the "right amount" of inventory (the target level for the Retailer) to carry of a specific title?

To calculate the target level of inventory of a specific product at a specific Retailer (or any other stock keeping location) is relatively simple - we simply need to consider the "*maximum forecasted demand for this product within the reliable replenishment* time from the supplier*".* This "*replenishment time*" is made up of the Order Lead Time (OLT) plus the Reliable Supply Lead Time (SLT). OLT is determined by how frequently orders are placed by the Retailer on the Manufacturer, Wholesaler or its own supply warehouse – OLT is equal to the time between order placements. SLT is the time it takes from placing the order to receiving the product at the Retailer.

Surpluses happen when Retailers over-estimate the level of demand or simply hold on to inventory for too long. This is quite a common mistake simply because, in practice, two factors combine to result in surpluses. Firstly, Retailers (and Publishers) don't want to lose any sales so they tend to keep additional stock, just-in-case there is high demand and this stock is generally pushed all the way into the Retailers which occupy scarce shelf space and cash. Second is the large number of stock keeping units (a typical book Retailer keeps more than tens of thousands of different titles), the need to deal with so many suppliers (typically hundreds or even thousands of different Publishers or Wholesalers) and the typically slow sales velocity per title per shop (most titles sell only a few copies a year)? This makes it impractical to monitor the actual level of sales velocity and supply lead-time vs. existing target inventory levels for every title in the shop. What this means is that, for a large % of the titles, shops will typically only place orders monthly or even quarterly or when a customer requests a title that is out-of-stock. Therefore it could take a long time for a shop to detect that many of these titles sell much slower than expected (their target levels should be reduced) or are not selling at all at a specific point (or are selling much faster, which causes shortages). This delays the returning of surplus stock, which could release space and cash and allow the Retailer to stock titles that sell elsewhere.

To quantify the level of surplus stock at a Retailer and the potential increase in sales that could be achieved if this surplus could be replaced by titles that sell elsewhere is a relatively simple calculation. This calculation requires the following information:

1. How much stock is currently kept by the Retailer for each title considered?

2. What is the CORRECT target inventory level?

a. How frequently is this title ordered?

b. How long does it take the supplier (Wholesaler, Distributor or Publisher) to reliably replenish this title?

c. What is the maximum forecasted demand within the reliable replenishment time (Order Lead Time + Supply Lead Time)?

3. What is the average sales velocity (in units/day) elsewhere of a title/titles that can be used to replace the surplus inventory (if any)?

The answer to (2c) gives the amount of stock that is really needed now. The difference between (2c) and (1) is the current surplus (or shortage). The potential lost sales is the number of surplus units multiplied by the average sales velocity of the titles not stocked today but which is selling elsewhere (3).

If it is possible to reduce Order Lead Time and/or Supply Lead Time, we can also calculate the potential impact of such a change by recalculating the amount of inventory needed considering the new order lead-time and or supply lead-time.

As an example, if a Retailer orders a specific product weekly, and in most cases it takes the supplier maximum a week to deliver, the Retailer should keep the maximum forecasted demand for a 2-week period (say this is 10 units). One week of this stock will typically be on the way, while the other weeks' worth of stock will be on the shelf. If the Retailer decides to reduce its order frequency to say ordering monthly (OLT = 4 weeks), they will have to have to keep 5 weeks' worth of stock with 4 weeks of this stock having to be on the shelf and one week on-the-way – occupying space that could have been used to sell other products. If however, a Retailer decides to order daily, then they will only have to keep around 1 or 2 days of stock on the shelf while the rest will be on the way, which will release space to sell other products.

This example shows that not only is it relatively simple to calculate the level of surpluses and the potential lost sales, but also that the simplest and most effective way for a Retailer to reduce the level of stock it has to carry in-store (which occupy scarce shelf and storage space) is to order more frequently from a supplier.

8. Quantifying the extent and causes of surpluses and surplus replacements

One of the major insights from the research was that the real cost of surpluses is not just the cost of high returns (wasted printing and distribution costs of around 30 % per annum), but the cost of the lost sales of the titles selling elsewhere but not stocked due to shelf space and or cash constraints. The potential impact of such a "surplus replacement" is quite simple to calculate, and in most cases, out-weigh the potential increase in sales from reducing shortages. Replacing surplus inventory with a title or title mix that sells at the same velocity as all the titles already stocked by a Retailer will give a 1:1 increase in sales – i.e. a 5 % surplus replacement with titles selling at the same average sales velocity of all PH titles already stocked will give a 5 % sales increase. If the surplus replacement titles have a sales velocity of double the average sales velocity of stocked PH titles, a 5 % surplus replacement will result in a 10 % increase in total PH sales. This increase in sales, with a gross margin of 50 % and no significant (if any) increase in cost, will typically result in a 40 to 50 % increase in net profit for both the Retailer and Publisher (see Table 1 in Whitepaper 1 for detailed illustration).

The extent to which surpluses and returns can be reduced is therefore limited by the extent to which over-optimistic forecasting and the pushing of excess inventory to Retailers can be prevented and to what extent display quantities can be reduced through more frequent ordering and shipping of smaller batches of books (without risking lost sales).

Quantifying the opportunity for surplus replacement can be seen in Table 1 below which shows an analysis of data of PH title sales by a major Book Chain (BC) retailer for a period of 185 Weeks (1/1/2005 - 7/18/2008). The line titled "Zero Sales" shows that over a period of 185 weeks, 4950 (22 %) of the PH titles carried by BC had zero sales and typically these were carried for 29 weeks.

This alone occupied 5.5 % of the shelf space (1,243 units divided by 22,943 units), which, if just 50 % could have been replaced by other PH titles just selling at 1 every 10 weeks (2^{nd} lowest sales category), would have resulted in an increase in sales of around 3 % (5.5% x 50% x 22,943 = additional 630 titles selling at 1 per 10 weeks for 185 weeks = 11,672 units on top of current 312,882 sales). As shown in Table 1 in Whitepaper 1, 1% additional sales result in 5% increase in net profit (if Operating Expenses remains unchanged). Therefore, a 3% increase in sales from surplus replace will result in a 15% increase in profitability proving that "*any sale is better than no sale*"

Sales Range	Number of Titles Carried	Weeks Carried / Title	Weeks Containing Sales / Titles	Weekly Inventory	Number of Sales Units	% Total Sales Units
Zero Sales	4 950	29	0	1 243	0	0.0%
1 - 9	11 376	83	3	8 005	42 629	13.6%
10 - 29	4 018	116	13	5 543	65 758	21.0%
30 - 49	933	130	28	2 162	35 607	11.4%
50 - 99	762	136	42	2 482	51 698	16.5%
100 - 199	363	140	66	1 751	49 410	15.8%
200 - 299	78	142	86	602	19 077	6.1%
300 - 399	37	145	102	346	12 434	4.0%
400 - 499	20	142	109	227	8 865	2.8%
500 - 999	24	141	107	393	16 769	5.4%
Over 999	6	95	82	189	10 635	3.4%
Total or Average	**22 567**	**82**	**8**	**22 943**	**312 882**	**100.0%**

Table 1: Store Sales for all PH titles over a period of 185 weeks (1/1/2005 - 7/18/2008).

The biggest contributor (after failed titles) to surpluses and wasted shelf space in slow moving titles was found to be the "larger than 1" display quantities that exceed what is really needed to protect sales as well as failed titles. For fast moving titles (e.g. titles selling more than 1 unit every 4 weeks which make up typically 65 % of total sales), ordering these titles monthly requires up to 4 times the space (keeping 4 or 5 on the shelves rather than 1 or 2) than what is required if they were ordered daily or at least a few times per week.

To quantify the extent and consequences of the surplus replacement potential, the team developed a simplified model of a "PH Bookshop" stocking 5 categories of only PH titles. Category "A" sells on average at 1 per day, Category "B" at 1 per week, "C" at 1 per month, "D" at 1 per quarter and "E" at 1 per year.

Table 2 below shows three scenarios for this shop. Scenario 1 shows the inventory needed and resulting Net Profit and Return on Investment (ROI) with ordering frequencies of weekly for category A and B and monthly for C, D and E. Scenario 2 shows the impact on Net Profit and ROI if categories A and B would be ordered daily, C and D weekly and E monthly. Scenario 3 shows the impact on Sales, Net Profit and ROI if 5 % replacement is possible to fill some of the space released by ordering more frequently. This third scenario shows a 5 % replacement of surpluses will increase Sales by 5 % (since the replacement mix is similar to that stocked today) while Net Profit increases by 55 % (from $28,500 to $44,235) and ROI by 63 % (from 31 % to 51 %).

This simulation model shows the potential for much higher profits to both the retailer and the publisher if retailers can be replenished more frequently just based simply on what was sold every day.

Random House Book Shop: Simulation Model

Scenario 1: Display quantities based on existing Order Frequency

Sales Velocity	Book Category	Replacement Plan	Avg Sales Velocity pa	No of Titles in Stock	Total Sales Units per year	Sales Price	Order Freq / Month	Min Display Qty	Stock Target on F/Casted Sales	Total "On-the-shelf" Inventory	Inventory Value	Total Sales per year	Cost of Goods Sold	Turns
FORMULA	BC	RP	ASV	TIS	TSUPY=ASV*TIS	SP	OF	MDQ	ST = Larger of MDQ and BTL	OTSI = ST*TIS*BC	IV = OTSI * SP * V	TSVPY = ASV * TIS * SP	COGS = TSVPY * VC	T = COGS / IV
1 a Day	A	0	365	25	9 125	$ 15.00	4	10	23	563	$ 4 219	$ 136 875	$ 68 438	16.2
1 a week	B	0	52	200	10 400	$ 15.00	4	4	4	800	$ 6 000	$ 156 000	$ 78 000	13.0
1 a Month	C	0	12	500	6 000	$ 15.00	1	3	3	1500	$ 11 250	$ 90 000	$ 45 000	4.0
1 a Quarter	D	0	4	3 000	12 000	$ 15.00	1	1	1	3000	$ 22 500	$ 180 000	$ 90 000	4.0
1 a Year	E	0	1	6 275	6 275	$ 15.00	1	1	1	6275	$ 47 063	$ 94 125	$ 47 063	1.0
				10 000	43 800					12 138	$ 91 031	$ 657 000	$ 328 500	3.6
												Operating Expense	$ 300 000	ROI
												Net Profit	$ 28 500	31%
												% NP	4.34%	

Scenario 2 – Reducing Ongoing Surpluses through increasing Order & Shipping frequency (but no Surplus Replacement)

Sales Velocity	Book Category	Replacement Plan	Avg Sales Velocity pa	No of Titles in Stock	Total Sales Units per year	Sales Price	Order Freq / Month	Min Display Qty	Stock Target on F/Casted Sales	Total "On-the-shelf" Inventory	Inventory Value	Total Sales per year	Cost of Goods Sold	Turns
1 a Day	A	0	365	25	9 125	$ 15.00	30	5	5	125	$ 938	$ 136 875	$ 68 438	73.0
1 a week	B	0	52	200	10 400	$ 15.00	30	3	3	600	$ 4 500	$ 156 000	$ 78 000	17.3
1 a Month	C	0	12	500	6 000	$ 15.00	4	2	2	1000	$ 7 500	$ 90 000	$ 45 000	6.0
1 a Quarter	D	0	4	3 000	12 000	$ 15.00	4	1	1	3000	$ 22 500	$ 180 000	$ 90 000	4.0
1 a Year	E	0	1	6 275	6 275	$ 15.00	1	1	1	6275	$ 47 063	$ 94 125	$ 47 063	1.0
				10 000	43 800					11 000	$ 82 500	$ 657 000	$ 328 500	4.0
									Surplus Units	5 108		Operating Expense	$ 300 000	ROI
									Surplus %	32%		Net Profit	$ 28 500	35%
												% NP	4.34%	

Scenario 3 – Reducing Ongoing Surpluses through increasing Order & Shipping frequency (with 5% Surplus Replacement)

Sales Velocity	Book Category	Replacement Plan	Avg Sales Velocity pa	No of Titles in Stock	Total Sales Units per year	Sales Price	Order Freq / Month	Min Display Qty	Stock Target on F/Casted Sales	Total "On-the-shelf" Inventory	Inventory Value	Total Sales per year	Cost of Goods Sold	Turns
1 a Day	A	1	365	26	9 490	$ 15.00	30	5	5	130	$ 975	$ 142 350	$ 71 175	73.0
1 a week	B	10	52	210	10 920	$ 15.00	30	3	3	630	$ 4 725	$ 163 800	$ 81 900	17.3
1 a Month	C	25	12	525	6 300	$ 15.00	4	2	2	1050	$ 7 875	$ 94 500	$ 47 250	6.0
1 a Quarter	D	150	4	3 150	12 600	$ 15.00	4	1	1	3150	$ 23 625	$ 189 000	$ 94 500	4.0
1 a Year	E	313	1	6 588	6 588	$ 15.00	1	1	1	6588	$ 49 410	$ 98 820	$ 49 410	1.0
		499		10 499	45 898					11 548	$ 86 610	$ 688 470	$ 344 235	4.0
									Surplus Units	590		Operating Expense	$ 300 000	ROI
									Surplus %	5%		Net Profit	$ 44 235	51%
												% NP	6.43%	

Table 2: Simulation Model of a PH Book Shop to show impact of more frequent ordering

9. Research conclusions and lessons learned on quantifying the extent, causes and consequences of shortages and surpluses

Prior to this research project, there was no practical mechanism in place that could be used within Publishing houses and Retailers to quantify the extent and likely impact of shortages and surpluses on the sales and profitability of their companies.

The models developed as well as the results achieved from its application provided the following insights:

- If a Publisher (or Retailer) wants to ensure it gets all the sales (and profits) possible from its portfolio of existing titles, it should aim to help ensure Retailers always have stock of all the titles that sell – and replace those that don't as soon as possible with titles not stocked that are selling at faster sales velocities elsewhere.
- Since a major part of the costs for a Publisher (and Retailer) is not totally variable, even a relatively small increase in sales will result in a significant increase in profitability (e.g. a 1 % increase in sales would typically result in a 5 % increase in net profit for the Publisher and Retailer, rather than the 1 % when we incorrectly assumed fixed margins – i.e. that all costs will increase in proportion to any sales increase.
- At the same time, if the average selling price can be increased, neither variable or fixed costs increase which means profits typically go up by 10 % for every 1 % increase in average price or 1 % lower discount. This leverage is a strong argument for publishers to supply shops directly wherever possible rather than through a Distributor or Wholesaler who normally gets a higher discount than the shop.
- Interviews showed that the leverage from increasing sales and/or increasing price/lowering discount is frequently under-estimated and the impact of cost savings is frequently over-estimated. As a result, Publishers and Retailers do not give this the necessary focus. For example, it was surprising to find that, with so much POS data and on-hand inventory data available at each link in the supply chain (compared to other industries), very seldom this data is utilized to really analyze the extent, consequences and causes of shortages and

surpluses and or whether changes implemented actually resulted in a reduction or not.

- Although there are many factors that make quantifying the extent and impact of shortages and surpluses difficult, with the availability of daily "point-of-sale" and "on-hand" inventory data from most Retailers, it is relatively simple to estimate at least an order of magnitude of both the extent and consequences on lost sales.

- The work done to quantify the extent and consequences of shortages and surpluses to a large extent validated the direction of the solution needed to make a significant reduction in both these issues.

  - Shortages result not only from too low initial sales forecasts, but also from the long "time to detect" (Order Lead Time) and the long "time to correct" (Supply Lead Time) when a specific title is selling faster than expected at a specific Retailer. The longer the time to detect and to correct, the higher the level of shortages, surpluses and lost sales.

  - Shortages also result when inventory is "pushed" in equal quantities to shops with different sales velocities. Those with faster sales velocities will potentially have shortages while those with slow sales will end up with surpluses and, frequently, because too much inventory was pushed, the central warehouse might not have enough to supply those shops that sold out. So we can have shortages and surpluses at the same time on a specific title, which means we cannot just look at a net number to judge the performance of the Supply Chain.

  - Compounding the impact of shortages of titles that are fast-movers and/or have a short shelf-life (i.e. a small window of opportunity to capitalize on their full sales potential) is the fact that a long delay in detecting or correcting shortages could turn a potential best seller into a disappointment.

  - Surpluses result not only from too high initial sales forecasts, but also because of the long "time to detect"

(Stock review or Order Lead Time) and the long “time to correct” (Return Lead Time) a surplus. The longer the time to detect and to correct the higher the level of surpluses, wasted shelf space and lost sales on items that could have been stocked and sold.

  - The key, therefore, to solving the problem of shortages and surpluses is simply to find a solution where the Order Lead Time (or “time to detect”), the Supply Lead Time (or “time to correct”) and the review and correction frequency become much shorter than the current practice.

- The extent of shortages for the representative sample of shops and titles per shop were significantly higher than previous estimates. Typical estimates by both PH and Retailer respresentatives interviewed were in the range of 2 - 5 %, while the data analyzed showed out-of-stock % of between 5 and 25 %. The average for the sample of 12 shops analyzed was around 14 %, which translated into a likely loss of sales of around 4 to 8% (average of 5%).

- The extent of surpluses, considering the known level of returns of 30 %, was no real surprise. However, the impact of these surpluses was shown to be much worse than just the costs of additional printing and distribution. The reality is that these surpluses consume scarce shelf space and cash at the Retailer and therefore blocks the Retailer from selling more of the titles not currently stocked, but which are selling elsewhere. The data analyzed showed that identifying and replacing surpluses with titles that sell elsewhere, even with relatively conservative assumptions, could result in an increase in sales of anywhere between 2 and 31 % (average of 5 %).

- Therefore, the combined impact on sales of preventing shortages and replacing surpluses could be around 10 %. This would be sufficient to increase profitability by around 50 %, after subtracting the estimated cost and investment to implement the solution.

In summary, the first part of the research showed that the extent and consequences of shortages, but especially surpluses, have been under-estimated and therefore should receive much more focus by both the Publisher and reseller. The analysis also validated that there were significant opportunities to reduce lost sales from both shortages and surpluses through ensuring high availability of the right titles at the right place at the right time. However, finding a way to prevent and/or replace surpluses faster with titles not previously stocked (due to shelf space or cash constraints or simply not expecting it would actually sell) but selling elsewhere, would likely contribute the most to the potential increase in sales and profitability.

The other major insight from the research is that the major cause of shortages and surpluses is likely the same. The major cause is not the inherent uncertainty and variability in demand and supply (particularly high in publishing), but rather the unnecessarily long order and supply lead times and relatively slow detection and correction of changes in demand and supply. This creates the need to use inaccurate, long-term demand forecasts that inevitably result in shortages and surpluses.

This insight might also explain why shortages and surpluses have not been significantly improved at the Retailer level despite the extensive efforts to improve collaboration in forecasting and planning to use much more sophisticated forecasting and planning algorithms. Unless the cause of inaccurate forecasts is addressed (the cause of the long order and supply lead times), we are unlikely to see significant improvements in the level to which shortages and surpluses exist today.

The new insights gained in the process of analyzing and really thinking through the problem and the possible simplicity of the solution, as well as the potential increase in both sales and profitability for the PH and its customers, that could result from significantly reducing shortages and preventing and or replacing surpluses much faster, has given the Supply Chain team the confidence to move forward with the next steps in the implementation of the solution.

The next section of this paper provides details on the solution design as well as on the tests that were developed to validate both the acceptance of the solution and its potential impact on the sales and profitability to both PH and the Retailers that would implement such a solution.

SECTION 2

10. Finding a generic solution to shortages and surpluses

There are a number of challenges within Book Publishing that makes solving the problem of shortages and surpluses so difficult: the high level of uncertainty and variability in the demand for a specific title; the relatively short market life of most books that seems to be getting shorter (known as the “L” curve to show rapid decay in demand over time); the relatively slow sales velocity of most titles per shop (only 10 % of PH titles stocked by a typical retailer sell more than 1 per month per shop); the large number of titles stocked and large number of new titles released every month and returned every month (to make space for the new titles) and finally the pressure on Publishers and Retailers to support a new book only for the period of time that its sales velocity justifies it and to then find substitutes to maintain sales rates.

The high uncertainty and variability makes it a real nightmare for Publishers and Retailers alike to accurately forecast the demand for a specific title. This becomes even more difficult if they need to forecast the demand for a specific title at a specific shop. The higher the uncertainty and variability, the longer the forecast horizon (due to long supply lead times) and the more titles (higher chance of substitution), the more inaccurate the demand forecast becomes for a specific title. And the more inaccurate the demand forecast, the more shortages and/or surpluses occur, which, in turn, result in lower sales and higher costs and inventories for both the Publisher and Retailer. This adds pressure to launch even more titles to make up for the sales gap. This is quite a vicious cycle that is difficult to break.

To most in the industry, it seems the only solution is to invest even more into better forecasting, planning & scheduling technology and better and more frequent collaboration with other supply chain partners as a way to further improve forecast accuracy.

But to break the above vicious cycle, a significant improvement in forecast accuracy will be required – something that most experienced supply chain practitioners will say, considering the large number of titles and variability on especially the large % of slow moving titles, is simply not possible (unless the industry takes drastic steps like moving to Print-on-Demand for all slow moving titles). But are there any other viable alternatives?

Ackoff 4(1978:39-40) identified two ways of dealing with problems:

Resolving the problem by accepting the conditions that created the contradiction. Such solutions achieve the goal at the expense of other goals or at the expense of the same goal in the long run. It suggests strategies that aggravate the conflict (e.g. competition) or seeks to alleviate it through compromise (e.g. negotiation or fair distribution of losses).

Dissolving the problem by changing the conditions that create the contradiction so that the problem disappears. This way is preferable as it uncovers innovative

[4] ACKOFF, RL. 1978. The Art of Problem Solving. New York: John Wiley & Sons.

solutions that enable the achievement of goals at a lower opportunity cost (or achieving more at the same cost). Finding the dissolving conditions requires empirical research

We can find a good example of how different the outcome of these two approaches can be, with a comparison of the approach taken by the US car manufacturers such as General Motors vs. the approach of Toyota in dealing with the problem of the significant losses in production output due to long setup times which increased as the models and permutations of cars expanded (a setup is incurred every time they switch from making or assembling parts for one model to another – the more models offered, the more setup losses and the lower throughput of the plant). GM decided to invest in sophisticated planning and scheduling technology to reduce the impact of long setup times on their production output – typically running long batches of one model before switching, just at the right time according to their new optimized schedule, to another model. The solution helped them offer a larger model range while minimizing setup losses, but with the penalty of long supply times between models in the manufacturing cycle. The longer supply lead times made forecasts less accurate and required high inventories at the manufacturer and dealerships to prevent lost sales, which made these manufacturers slow to respond to changes in market demand and frequently added pressure to cut margins significantly to get rid of excess stocks that impacted the successful launch of new models. A vicious cycle that is difficult to break.

On the other hand, Toyota took a very different approach. Taiichi Ohno realized that the cost of a long setup was not just the cost of labour to do the setup, but also the cost of lost production, the cost of the higher inventories that would have to be carried if large batches were produced to reduce the impact of long setups and the cost of not being responsive to changing market demand. Therefore, it made sense to them to focus on the root cause directly – to reduce setup times until it no longer became an obstacle to rapidly respond to changes in market demand.

Toyota applied the same thinking to solving the problem of shortages and surpluses of spares within the dealerships. Instead of dealers ordering monthly or weekly from suppliers in large batches, or spares warehouses "pushing" the spares inventory made by factories onto dealers according to their long term and inaccurate forecast, why not just get dealers to order daily from regional warehouses whatever was sold that day and the regional warehouses simply ordering from the central warehouse every day what was shipped that day to dealers? The result of this elegant (simple and powerful) solution over two years (1994 to 1996) was a dramatic reduction in total flow time (from 120 days to 30 days), much lower inventories (one third of the inventory in 1994 with higher demand), service levels of 98 % within 1 day and fewer emergency shipments resulting in a lower cost/unit and much fewer stock-outs and lost sales.

Toyota was not the first to realize the problem of shortages and surpluses has less to do with the inherent uncertainty and/or variability of the demand, but more to do with the way the system is either over- or under-reacting to the uncertainty and or variability (due to the long time between placing orders and the long supply lead time).

Prof Jay W. Forrester of MIT, the founder of System Dynamics, which deals with the simulation of interactions between objects in dynamic systems, already proved this in the 1960's with the Beer Distribution Game[5]. This game is still played today in most business schools and shows the chaos that results in a production-wholesaler-distribution-retailer system that have long delays between orders and or large batching of orders even when a relatively small change in demand happens.

Forester's team developed and tested a very simple solution (validated with the most sophisticated computer simulation that was available at that time) – each link in the beer supply chain (the Retailer, Distributor and brewery) should simply order every day from the previous link what was sold that day. The impact of this simple change is quite remarkable. It achieved significantly lower inventories throughout the supply chain while at the same time achieving higher service levels (higher availability) and responsiveness to changes in real demand without going into vicious cycles of over-reaction seen with long delays or large batching in ordering between links. Their research also concluded that it was the "rules of management" that create the undesirable performance of the system. Changing the people or technology without changing the rules doesn't improve things permanently. Therefore, to change the performance of the system, management should focus on redesigning the planning, execution and feedback rules of the process.

11. Finding a viable solution to shortages and surpluses in Book Publishing

[5] Jay W. Forrester, "Economic Theory for the New Millennium", Plenary Address at the International System Dynamics Conference, New York, July 21, 2003

The quote below by Womack and Jones on page 25 of "Lean Thinking", published in 1996, hints strongly that the generic solution developed by Toyota and others can and should be applied to Book Publishing:

> *"Let's take a practical example: the book you hold in your hand. In fact, your copy is lucky. One half of the books printed in the United States each year are shredded without ever finding a reader. How can this be? Because publishers and the printing and distributor firms they work with along the value stream have never learned about flow, so the customer can't pull. It takes many weeks to re-order a book if the bookseller or warehouse runs out of stock, yet the shelf life of most books is very short. Publishers must either sell the book at the peak of reader interest or forgo many sales. Because the publisher can't accurately predict demand in advance, the only solution is to print thousands of copies to "fill the channel" when the book is launched even though only a few thousand copies of the average book will be sold. The rest are then returned to the publisher and scrapped when the season is over.*
>
> *The solution to this problem will probably merge in phases. In the next few years, printing firms can learn to quickly print up small lots of books and distribution warehouses can learn to replenish bookstore shelves frequently (using the method described in Chapter 4). Eventually, new "right-sizes" book printing technologies may make it possible to simply print out the books the customer wants at the moment the customer asks for them, either in a bookstore or, even better, in the customer's office or home. And some customers may not want a physical copy of their "book" at all. Instead, they will request the electronic transfer of the text from the "publisher" to their own computer, printing out an old-fashioned paper version only if they happen to need it. The appropriate solution will be found once the members of the publishing value stream embrace the fourth principle of (Toyota's) lean thinking: pull."*

There have been others that have been lobbying within the publishing industry to adopt similar practices to those developed separately by Toyota (TPS application to Distribution) and Dr. Eli Goldratt (Theory of Constraints' solution for Distribution) in the late 1980's and early 1990's and further developed for the Fast Moving Consumer Goods industry by pioneers such as Wal-Mart, P&G and later Dell computers. These practices are known today by different names such as Vendor-Managed-Inventory (VMI), Efficient Consumer Response (ECR), Collaborative Planning Forecasting & Replenishment (CPFR), Demand-Driven Retailing (DDR) and TOC for Distribution but they all share the same underlying principles of increasing order frequency to daily or as frequently as possible based on actual consumption, investing in better collaboration and technology to share information about daily consumption and changes in demand much quicker between supply chain partners and investing in a more responsive supply chain with shorter supply lead times with more frequent review of stock holding policies.

One such person who has been lobbying within the publishing industry for more than a decade that VMI should be offered by Publishers (or demanded by Retailers) is Mike Shatzkin – a well-respected publishing industry advisor. In a speech to the Publishing Industry at the Frankfurt Book Fair in 1997, Mike had this to say about VMI:

"*VMI is a sensible idea for a supply chain that is desperately looking for one. It gets easier every day as EPOS technology spreads to universality. VMI has become a concept that no publisher concerned about the level of its sales, the level of its returns, or its costs of doing business, can afford to ignore. Operating with VMI, every publisher would find it possible, within today's inventory levels, to stock more titles in more stores, have fewer sales lost to out-of-stocks, and boost sales substantially on midlist and bottom-of-the-list books that are now doomed by their low initial expectations.*"

Over the past 5 years, there have been retailers such as Barnes & Noble that have adopted some of the recommended practices of VMI and CPFR. BC is now using Automated Replenishment on all their backlist items that make up 65 % of total sales. BC reported a 30 – 40 % reduction in inventory and improvement of demand forecasts to 85 %[6]. However, compared to the "best practice" achieved in other industries – both in terms of logistical and financial performance - it is clear that a major gap still exist. Why? What has blocked Publishers and Book Retailers to fully adopt best practice in applying the concepts of PULL throughout their supply chain?

The research showed that there are typically five obstacles that can block the full adoption of even a relatively simple solution, which has to be overcome in sequence to ensure success. Table 3 below gives a summary of these 5 obstacles and how they relate to the problem and solution to shortages and surpluses within book publishing:

OBSTACLE	RESPONSE	EXAMPLE
Extent and/or Consequences of the Problem is under-estimated	Problem does not receive the necessary management focus	Shortages & Surpluses and/or their impact on profitability has been under-estimated in the past

[6] "Demand Visibility: Supply-chain transparency reduces inventory costs", **Author:** Lisa Terry Date: 5/1/2005

OBSTACLE	RESPONSE	EXAMPLE
Cause(s) and/or solution to remove these are counter-intuitive	A Vicious cycle evolves where the intuitive "solution" makes the problem worse	Major Cause of shortages & surpluses is long order and supply lead time, which increases due to batching by links trying to be more efficient or effective
Proposed solution is still only "half-baked" – not yet fully specified	Until the solution can be fully detailed, it cannot be implemented fully or mistakes can be made	A replenishment on actual consumption solution must include ways to deal with seasonality and special events, else it will be considered "half-baked"
Proposed solution could result in potential significant negative effects on one or more stakeholder	Until it can be shown that it is possible to minimize or prevent major negatives, it will be too high risk to adopt the solution	Ordering, Picking and Shipping daily in very small quantities can cause a bottleneck that will make it difficult to meet existing demand.
Proposed Solution has significant implementation obstacles.	Until the implementation obstacles can be overcome in a cost-effective way, the solution will not be (fully) implemented	Not being able to reliably and efficiently obtain daily POS and Inventory data for every title from a large number of Retailers will make the solution non-viable.

Table 3: Obstacles to adopting a Solution such as VMI/CPFR

The first part of this research on the extent, consequences and causes of shortages and surpluses attempted to ensure the adoption of the proposed solution is not blocked by type 1 or type 2 obstacles. To ensure the adoption is not blocked by type 3, 4 and or 5, the full details of the proposed solution will now be defined together with the lessons learned on how to prevent potential negatives and how to practically overcome implementation obstacles.

12. Key Supply Chain decisions to improve on

As we consider the life cycle of any product or title, there are 5 key decisions that have to be made by each link in the supply chain (once a link has decide to stock a specific title). The magnitude of the mistakes made in any of these decisions will determine the extent of shortages and/or surpluses in a supply chain at any point in time. These 5 decisions are:

1. How much initial stock to keep at a specific storage location or selling point?
2. How frequently should re-orders be placed on upstream links?
3. How much should be re-ordered at a time?
4. When should the initial target stock level be changed and if so, by how much?
5. When should slow or non-moving inventory be returned (and what to replace it with)?

To prevent or minimize mistakes in these decisions, we need better rules (or at least better guidelines) that will help each link ensure they will “have the right stock at the right place and time” – not too much or too soon but also not too little or too late.

The proposed generic changes in rules for better managing and continuously improving a supply chain can be derived from the same four Supply Chain Management concepts that Ohno discovered and used to develop the Toyota Production System mentioned earlier and the same concepts used by Goldratt to develop logistical solutions for managing operations and distribution.

We can use these four concepts as a framework to develop both a generic and specific, necessary and sufficient solution to shortages and surpluses.

13. The Four Concepts of Managing and Improving Supply Chains

The four supply chain management and improvement concepts[7] are:

1. Improving flow in a Supply Chain (equivalent to reducing the total lead time from raw material to receiving the cash from the consumer) should be the number one priority for each link, since achieving it, will also help each link achieve the secondary objectives of increasing throughput, improving reliability/availability and reducing unnecessary inventory and costs.

2. To improve flow, each link needs a practical planning and execution mechanism.

    a. The planning mechanism should prevent overproduction (or underproduction) through controlling the release based on actual consumer demand (Pull not Push) and should allow buffering against “Murphy” in the most effective and efficient way.

    b. The Execution Management mechanism should use a single priority system for the whole supply chain and provide the means to reduce or recover flow delays by reducing management’s time-to-detect and time-to-correct (fast feedback loop).

3. All forms of Local Efficiency (that jeopardized supply chain efficiency and flow) should be identified and abolished.

[7] The four concepts were first defined formally by Dr. Eli Goldratt in an article released in 2008 titled “Standing on the shoulders of Giants”.

4. To ensure continuous improvement and maintaining a balance between demand and supply (not too little but also not too much supply), there is a need for a Focusing Mechanism to identify where in the supply chain to focus process improvement or capacity elevation (the major sources of delays and or unavailability) where these will have the largest impact on the "system performance" as a whole (high availability of all books).

14. Applying the four concepts to reducing shortages and surpluses

The four concepts provide a useful framework to develop or at least explain the full solution to the problem of shortages and surpluses and specifically how they apply to the publishing industry.

Reviewing Little's Law that describes the relationship between Flow Time (Lead Time), Flow Rate (Throughput or completion rate) and Work-in-Process (Inventory) provides the key of applying the **first concept** to any distribution environment.

Little's Law states that: The Average WIP in the system is equal to the Throughput of the system multiplied by the total Lead Time or "*WIP = Throughput x Lead Time*". Therefore, the key to both reducing WIP and increasing Throughput is to reduce total lead time (order lead time + supply lead time). Every time we can reduce the total lead-time, we will need less inventory to protect against lost sales, our forecasts will be more accurate (if done at aggregate level) and variability will reduce (i.e. availability will go up).

Similar to manufacturing and projects where the wait time is normally significantly longer than the work time (and therefore we should focus on reducing wait time and then work time), in consumer goods supply chains, the order lead time (the time a link waits between placing orders for the same item) is normally equivalent or even longer than the supply lead time (and therefore the focus should be on reducing order lead time first and then on reducing supply lead time). It is quite common to find a Distributor or Retailer that can or is already ordering daily or multiple times a week, while they order a specific item only once its "Re-order Point" (ROP) is reached, which can be only monthly or once a quarter.

Moving from an order frequency of monthly to weekly has a major impact on both the level of the inventory needed to ensure high availability and on the risks of shortages and surpluses as illustrated by Figure 1 below:

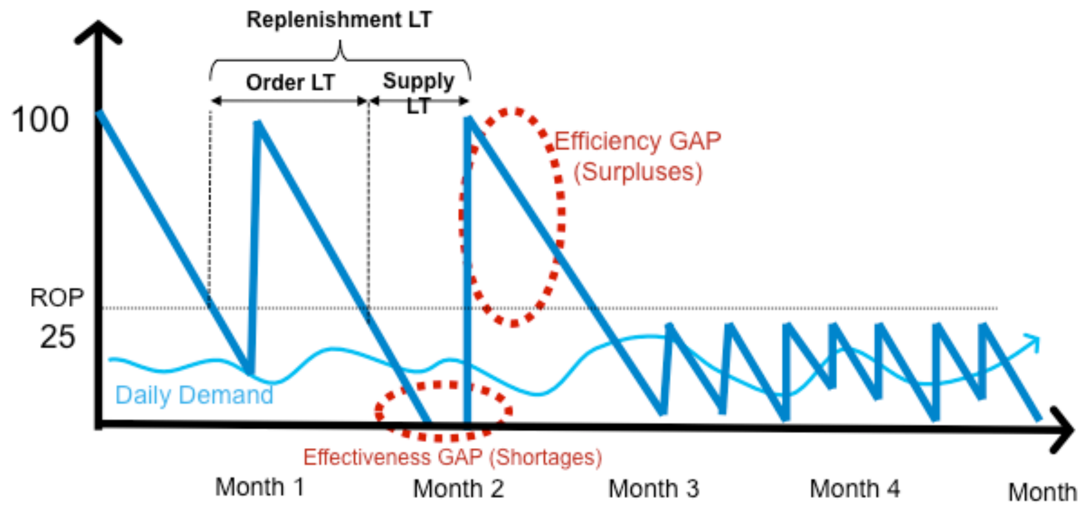

Figure 1: Impact of ordering weekly rather than monthly

So why is ordering and shipping more frequently a real win-win for both the customer (Retailer) and the supplier (Publisher or Distributor)?

The level of stock that the Retailer needs to carry is dependent mainly on the order frequency that they have decided on for a specific title. If they order it monthly, they will have to carry at least a month's worth of inventory, while if they can order daily and get daily shipments or at least a number of shipments a week, their inventory on hand can be reduced dramatically as shown in Figure 1. The supply lead-time determines how much stock will be "on-the-way" – i.e. the stock carried by the supplier. Reducing the supply lead-time will reduce the amount of inventory on the way. For the supplier, receiving daily orders also has major benefits. Firstly, they are receiving daily POS and "on-hand" information about the actual consumption of their products, which will help them to ensure there are no shortages and surpluses, that the Retailer has the most profitable product mix and that, if it is really more efficient for them, to ship only in full truck loads to the Retailers in that area (e.g. a milk run).

The application of the **second concept** - having an effective and efficient planning and execution mechanism in place to ensure improving flow is the number 1 priority for each link - will be explored through the 5 decisions relating to the title life cycle.

15. How should any link decide how much initial stock to keep?

Today, the initial stock kept at Publisher's warehouses, at Distributors and Retailers, is more a function of the Publisher's Pressure to print as much as the market will tolerate and to push this inventory all the way to the Retailers than of the "maximum forecasted demand within the reliable replenishment time".

Following this simple rule provides an answer to how much inventory should be kept at each storage and selling link in the chain:

Inventory Target Level = Maximum Forecasted Demand within Reliable Replenishment time

Where Reliable Replenishment Time = Order Lead Time + Reliable Supply Lead Time

If each link is simply ordering daily what was shipped or sold that day, then the Inventory Target is based on the maximum forecasted demand within the supply lead-time. In the case of the Publisher, supply lead-time is the time to print, bind and ship the books to the Publisher's central distribution centre (CDC). For a Publisher's Regional Distribution Centre (RDC) or a Distributor, the inventory target is based only on the maximum forecasted demand within the shipping time/frequency from the CDC. For the Retailer, the inventory target is based on the maximum forecasted demand within the shipping time/frequency from the RDC or Distributor/Wholesaler's warehouse. Figure 2 below shows how the inventory profile (days of stock at each link) changes when we move from a PUSH-based to PULL-based fulfilment strategy.

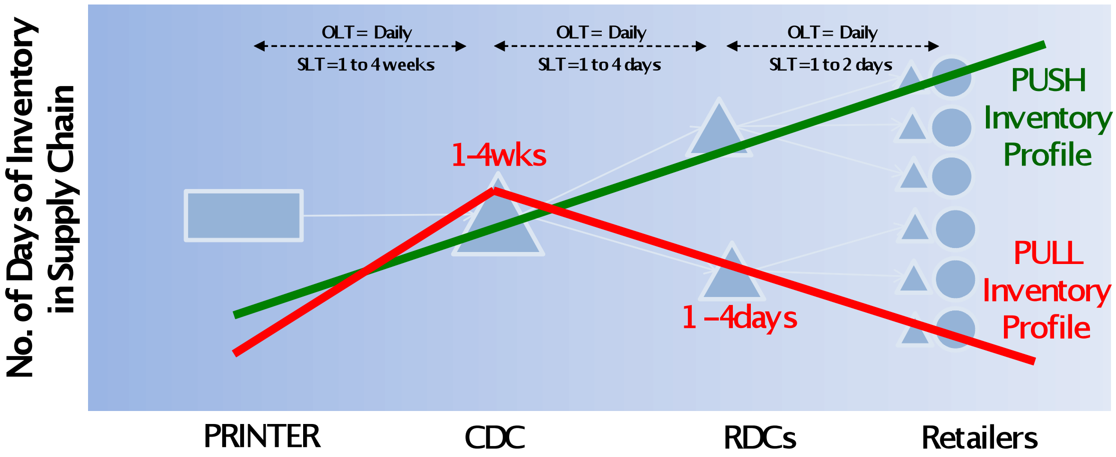

Figure 2: Inventory Profile of PUSH vs. PULL based Fulfilment Strategies

With a PULL based Supply Chain network design (Red curve), the majority of the inventory resides at the CDC and RDCs where it also provides the greatest flexibility to respond to changes in demand at the retail level. In PUSH (Green curve), the majority of the inventory is at the sales points (retailers), which frequently results in shortages at some retailers while there are surpluses at others. The change (reduction where current levels exceed minimum display or maximum sales per day) also releases space at the Retailer, which can be used to stock a wider variety of titles resulting in increased sales to both the Retailer and supplier.

To fully capitalize on higher protection offered by CDC and RDCs, it is also good practice not to "pre-sticker" inventory for specific clients until the day of shipment. In this way, the entire inventory is available to respond to changes in demand, which will allow CDCs and RDCs to really benefit from aggregation.

16. Desired Display Quantity vs. Required Display Quantity

As with most consumer goods sold through retailers, the display quantity on the shelf has a significant influence on the sales – if the display quantity is either too small or too large, it could result in a lost sale. If it is too small, consumers might not find it or ignore it while if it is too large, it will occupy space that could have been used to stock products that consumers did want. The above formula for determining the required level of inventory to ensure consumers wanting to buy a specific title have a very high chance of finding the title gives one reference for how much of a specific title should be stocked. The minimum display quantity and even the way the title is displayed (front- or side facing) provide the other reference. What we do know from the inventory target formula is that due to the very slow sales velocity of more than 90% of titles, retailers seldom if ever need more than 1 unit on the shelf of these titles if they can be replenished daily. The decision about how many of these titles, that currently occupy more than 1 unit of shelf space, can be reduced to 1 unit, is an area where more research is required.[8]

It should also be noted that, although a PULL-based fulfilment strategy is not dependent on forecasts to determine when and what to ship on a daily basis, forecasts are still needed to proactively identify possible changes in demand, which might require changes in the inventory targets or even in the distribution network. But even here, we expect an improvement - with reduced flow time in the supply chain and the fact that we will forecast at the highest points of aggregation (CDC and RDCs), rather than forecasting at the lowest points of aggregation and summing these (quite a common mistake) – we should also see a significant improvement in the forecast accuracy.

17. How should a link decide their order and or shipment frequency?

Any form of batching in a supply chain significantly increases the lead-time, which results in higher inventory and lower throughput (as per Little's Law), as well as the risk of over-reaction or under-reaction to changes in demand. The objective in a PULL based fulfilment strategy is to challenge and possibly reduce all batching to be in line with actual consumption units. E.g. if consumers buy in 1's a retailer should be able to order in 1's and receive shipments in 1's.

We typically observe three types of batching that increase the total flow time: Batching in placing orders, batching in production/printing and batching in transportation. Orders are batched before being placed either because of an incentive by the supplier to buy in large quantities or because it is too much hassle to order more frequently. Jobs in production is/printing are batched to minimize

---

8 Past research like that conducted by Borin, Farris, and Freeland, to determine optimum retail product category assortment and shelf space allocation, (Decision Sciences 25, 1994. pp 359–383) have shown that display space allocation has the biggest influence on fast moving and impulse buy items. For items that are slow moving and which are not generally bought on impulse, the impact of having 1, 2 or 3 on the shelf is much less significant than for items that are either fast moving or are generally bought on impulse. Past research has been consistent in identifying the following 3 general trends: 1) Sales rate increases at a decreasing rate as shelf space increases.2) Faster moving and impulsive products have significant space and cross elasticity. 3) Products with higher market share and staple products have insignificant space elasticity

setup related losses in output while transportation batches strive to achieve full truckloads and therefore to reduce the transportation cost per unit.

As we've already seen, a major part of the flow time currently is made up of the order lead time, which normally makes this the largest leverage point to reduce lead time and therefore inventory. In PULL, the recommendation is that each link simply orders daily what was shipped or sold that day up to the target level as per previous calculation. This change to "order daily" can typically be implemented very quickly because the daily ordering process can in most cases be automated to address the concern about "too much hassle", volume discounts can normally be re-negotiated to be based on the total volume orders rather than the volume for each individual order and as far as getting "buy-in" from its customer (next downstream link) to order more frequently, they will be the major beneficiary of the daily ordering, since order lead time is what determines their level of stock holding.[9] Most Distributors and Retailers appreciate daily ordering as they know reducing order lead time from weekly to daily on items that sell daily could result in a potential inventory reduction of 7 times (depending on sales variability) which will release significant space and cash to be used to stock and sell other items.

With regards to batching in production (e.g. printing), it is normally possible to get significant reductions but achieving single unit production could require significant investment and time. The benefits of reducing batching in production should be compared with the required cost and investment. Where the benefits is significantly more than the costs/investments, these changes should be implemented as soon as possible since each link in the chain will benefit from reduction in batch sizes at the beginning of the supply chain (in both inventory reductions and better responsiveness).

With regards to batching in transportation, it is normally possible to still ship in "full-truck loads" on a daily basis if all the small orders for a specific region are batched together in the way of the traditional "milk run". If this can be achieved, shipping daily will actually reduce the transportation cost/unit rather than the normal assumption that more frequent shipments will increase costs.

So, the general rule used in PULL-based fulfilment strategies is that "*each link should order daily what was shipped or sold that day*" and that production and transportation batching is reduced to the point where the benefits no longer exceed the incremental costs.

18. How should a link decide how much to reorder for a specific title?

In a PULL-based fulfilment strategy each link determines the target level of inventory for each "stock-keeping-unit" or SKU. The simple rule in PULL for

[9] Order lead-time determines the "on-hand" stock for the link placing the orders while Supply lead-time determines the "on-the-way" inventory. This is true unless the consumption rate is very slow which means if we only sell 1 per week, ordering daily will not reduce the "on-hand" to less than 1.

deciding how much to order every day is based on the objective to maintain the target level of inventory – not more and not less.

If, for a Retailer, the Order lead time is daily and the supply lead time (from the RDC) is maximum two days, then the target level is calculated based on the highest units sold (after removing exceptions from the data) in a 3 day period (not the "highest daily sales x 3 days" which is a common mistake, which inflates the inventory without giving better protection). If we assume the highest units sold in 3 days were 5, then the target level would be 5. If, by the end of the day, the Retailer has 3 on-hand, none on-order, they would simply place an order for 2 units. This simple rule is used by every link in the chain to decide how much to order. The only addition to this rule of ordering up to the target level every day is when a special (abnormally large) order arrives that was not "buffered" for. In such a case, this special order quantity is added to the daily replenishment order. As per the previous section, any reasons why a link would order more than their daily sales (e.g. to get volume discount or save shipping cost) should be investigated and the total cost on the "system" calculated vs. the benefit rather than just the local cost.

To ensure high availability with low inventory is maintained, it is also important that all the links in the supply chain operate according to a "single priority system" – not only the replenishment quantity but also this order's priority in comparison to other orders should be communicated and updated daily. Priority should be based on an eminent shortage at the retailer where a shortage can and frequently do result in a lost sale. To achieve a single priority system", each title's target level at any storage location can simply be divided in 3 equal zones of 1/3 each. The top zone is green and the lowest zone is red which implies eminent danger of a shortage. Every time an order is placed by a link, it will include the inventory status of each title to ensure that its order can be prioritized against the orders of other links in the chain. A typical daily order list will have all the "black" items at the top (items out-of-stock), then the "red" items (items about to go out-of-stock unless they expedited) and then the yellow and lastly the green items.

We already mentioned that Book Publishing does have complicating factors that requires some modification to the standard PULL rules. These include a relatively low sales velocity per title at a specific book Retailer, relatively large variability in sales units per period as well as, like most other consumer goods, the impact of seasonality (higher sales over weekends and public holidays) and the impact of the "L-curve" of the rapid decay in demand after a launch and also special events such as an appearance of a book on the Oprah show.

These complications are dealt with in the next section – i.e. the calculation of the order quantity is always equal to Target Level – (On-Hand + On-Order) + Special order quantity.

19. How should a link decide when to change the initial stock quantity & by how much?

There are two situations that require a change in the target level of inventory at a specific location to prevent shortages and or surpluses – predictable changes and unpredictable changes in supply or demand.

In the case of a predictable change, the expected change should be immediately communicated to all links in the supply chain. Each link can then simply recalculate the required Target Level for each SKU at its location that will be impacted by the change.

As an example, if we have information that a specific title will go on promotion and we normally sell 3x as much of a title on promotion, then the target level should be adjusted accordingly. Also, if we have information that a specific supplier has an upcoming shutdown that will last for 2 weeks, while their normal supply lead-time is 1 week, the target levels should be adjusted accordingly.

In the case of unpredictable changes, the only real protection we have is that we should have an automated tracking process to identify when there is a significant change in demand or supply (significant means it is outside of the buffer allowance for variability) and to ensure that we have the protective capacity (*sufficient buffer capacity to reliably meet the expected maximum rather than average demand*) to react to these when the change is significant. It is in this area that the Goldratt Group has done a lot of research and testing to develop simple yet effective rules to decide when to make a change in target level and if so, by how much.

The “up-sizing” rule that Goldratt recommends based on both extensive testing and the need to be more responsive when there is a risk of a shortage, is to increase the target level of inventory only when the level of red zone penetration is too much within the most recent replenishment cycle. In most cases, “too much” can be defined as when “the sum of the red zone penetration exceeded the size of the red zone within one replenishment period”.

For example, if the target level is 6 units with a red zone of 2 and a total replenishment time of 4 days, the level of red zone penetration is monitored. If, during a 4 day period, the sum of the red zone penetrations was equal to or more than 2 units, then the target level will be increased by a full red zone to 8 units. This upsizing rule works well for all target levels of 2 and more but require a slight modification when the target level is 1.

The “down-sizing” rule that Goldratt recommends, also based on extensive testing and the need to be more conservative (longer review period) when down-sizing, is to reduce the target level by again a full zone only when the stock-on-hand did not go out of the green zone for two replenishment periods in a row.

Figure 3 below shows how Goldratt’s Auto Resizing rule will respond automatically (no intervention) to four typical demand profiles within book publishing.

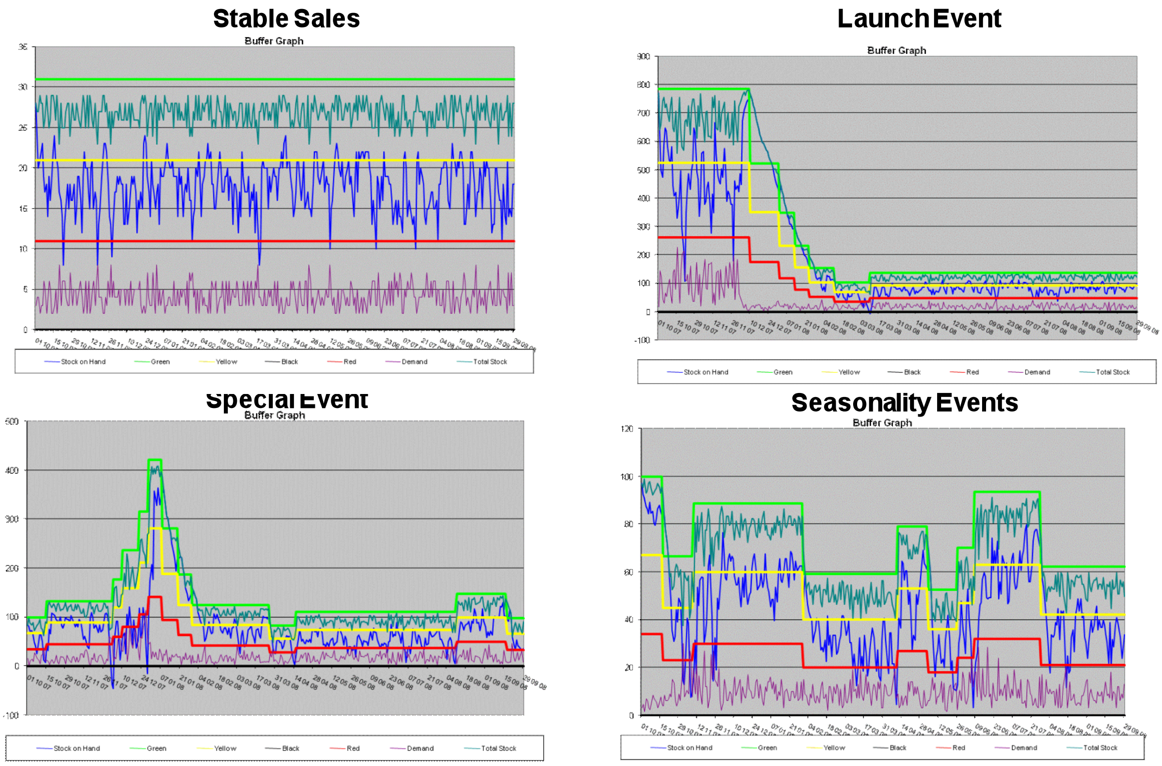

Figure 3: Dynamic buffer management rule applied to 4 demand profiles

To identify where local efficiencies are causing system inefficiencies or where additional capacity is needed, the recommendation is that each link analyses the reasons why specific titles went into the red or black every week. The above buffer graph shows when the inventory on-hand goes into the red or black, but does not identify the cause of that status. It could be red or black either because demand increased or supply deteriorated (vs. the original assumption in target level calculation). Since these two causes require different corrective actions, we need "buffer statistics analysis" that can separate between these and processes to identify and implement corrective actions (called "Active Buffer Recovery" in TOC).

How to decide when to return stock and what to replace it with?

As mentioned previously, the real cost of surplus stock to each link in the supply chain, is not (only) the cost of the returns, but the cost (lost sales) of the surplus stock occupying scarce shelf space and or cash at the Retailer that could have been used to sell other titles.

To a large degree, the decision on when to return stock of a specific title, is dependent on whether the released shelf space and/or cash can be utilized to stock other titles not stocked today with higher sales velocities or not. As an example, if a specific title has not sold 1 copy in the last 3 months and the Retailer is not stocking a title that is selling elsewhere at 1 copy per month, clearly the Retailer and Publisher can gain sales by replacing this slow mover as quickly as possible.

Making these types of decisions dynamically on typically tens of thousands or even hundreds of thousands of titles at a Retailer will require the capability by the Publisher to monitor and compare sales velocity per title across Retailers. Although most of the data, if not all, already exists, the research shows that few if any Publishers has a automated mechanism in place to monitor sales velocity per title per Retailer and make recommendations on when to return surplus or slow moving inventory and/or what to replace it with that will give the highest sales velocity per square feet of shelf space. Such a capability could potentially unlock a significant amount of lost sales opportunities neither the Publisher nor the retailer were previously aware of and could even be turned in a decisive competitive advantage for the Publisher.

The last two concepts of managing supply chains (abolishing local efficiencies and having a focusing mechanism to maintain the balance between supply and demand) are practically implemented through ongoing review of the major causes of “reds” (stocks that fall to below 33% of target level) and “blacks” (stocks that reach a stock-out), and identifying and abolishing those “local optima” policies, measurements or behaviours within any of the supply chain links contributing to “reds” or “blacks” and improving or elevating capacity of resources where the protective capacity is insufficient to deal with the current level of uncertainty & variation (“Murphy”) within demand and or supply.

20. Summary of Proposed Solution to reduce shortages & surpluses

The Publisher and Retailer should recognize the importance of making the reduction of flow time (lead time) the primary objective for supply chain improvement, simply because finding ways to reduce flow time will reduce inventory and cost/unit, reduce supply variability, increase throughput and, in general, make the supply chain more responsive and robust against changes in demand or supply.

To ensure this change in focus can be implemented, we need to have a simple control mechanism in planning and execution. The Planning mechanism should ensure that the production and shipment (release) of goods at each link is based on actual consumption (PULL not PUSH) and that the system is effectively and efficiently buffered. This means utilizing CDC and RDCs to reduce the order and supply time, which reduces the inventory, needed at Retailers and increases the responsiveness of each link to changes in demand. The reduction in order and supply lead times also enables Retailers to stock more titles with the released space while keeping sufficient stock of each title to satisfy the maximum forecasted demand within the reliable replenishment time.

The Execution management mechanism utilizes a single priority system across the whole supply chain (expediting red orders based on buffer status and pro-actively identifying and replacing slow moving titles with titles that sell well elsewhere).

The solution should also have a mechanism to identify and abolish any form of local efficiency that jeopardizes system effectiveness or efficiency and lastly a focusing mechanism to identify the areas where process improvement and/or capacity elevation is needed to always maintain a balance in supply and demand.

The full logic of the solution (the what, how to and why) was defined and validated with a Theory of Constraints Thinking Process called a "Strategy & Tactic" (S&T) Tree using the Harmony S&T Expert system software (www.goldrattresearchlabs.com)

The research team concluded, after quantifying the likely extent and consequences of shortages and surpluses and designing a solution that potentially addresses each of the major causes, that the following benefits could be expected:

- Reducing OOS from 14 % to around 2 % with a resulting increase in sales of at least 2.5 to 5 %.

- Replacing surpluses at the Retailer with between 5 % and 10 % additional titles that are not currently stocked (and with a similar average sales velocity as current PH title mix that is stocked), should result in a 5 % to 10 % increase in sales. The research showed that it is likely that for many shops, even a higher replacement potential exist which should make surplus identification and replacement one of the major contributions of this research and a primary focus for unlocking sales growth.

- An increase in sales of only 5 % (whether from a reduction in shortages or replacement of surpluses) could result in an increase in Net Profit and ROI of between 25 % and 50 % (depending on the current Net Profit % and ROI % baseline).

- Even the space released from reducing Surpluses that cannot be replaced (e.g. if there is not enough replacement titles) can be utilized to either display more titles as "front facing" (rather than side facing) or simply to increase inventory turns for Retailers.

- Reducing Returns from around 30 % to below 10 % will result in a Supply Chain cost reduction of 20 % of which most if not all will flow to the "bottom line".

The above conclusions set the (high) expectation of what should be possible. But the theory (and expectations) had to be tested across a representative set of shops and a representative sample of PH titles with each shop as well as with more data analysis using the models developed in this project to quantify the extent and consequences of shortages and surpluses at retailers that have daily POS and On-Hand data available, such as BC. The next section deals with the design and execution of such a test to determine the acceptance level of Retailers for the proposed solution, the results achieved and lessons learned.

SECTION 3

21. Defining the solution that should be tested.

Achieving the objective of higher availability with lower inventories and costs by reducing the total replenishment lead time will require relatively simple changes to the planning and execution rules and continuous improvement measurements used by each of the supply chain links. The changes to move to a full PULL based replenishment mode of operation include:

1. *Increased Order Frequency:* Each link orders daily what was shipped or sold that day to reduce order lead-time.

2. *Aggregated Stock Buffering:* The Supply Chain use RDC's and CDC's as aggregation points to buffer against variability and to provide rapid replenishment to retailers.

3. *Supply Lead Time Reduction*: Each supply link makes the necessary improvements to fulfil all orders received every day or as quickly as is cost-effective (smaller quantities more often – minimize batching) to reduce the total supply lead-time.

4. *Re-evaluation of Order Fulfilment Strategies*: Each link that keeps stock should re-evaluate its order fulfilment strategy for every stock-keeping unit (SKU). With reductions in supply lead times from (3), it will open opportunities for retailers to move any product where the consumer tolerance time is less than the supply lead time to "buy-to-order" rather than "buy-to-stock".[10]

5. *Consistent Inventory Target Level determination*: Each link calculates the initial target level of inventory for each title based on "maximum forecasted demand within the reliable replenishment time (order lead time + supply lead time). Retailers should also consider the "Minimum Display Quantity" in this calculation. If the minimum display quantity exceeds the calculated target level, it should be flagged for review.

6. *Synchronized Priority System*: Each link monitors and communicate their on-hand inventory status to all links to ensure priorities are aligned and synchronized throughout the supply chain

7. *Dynamic Buffer Management*: Each link implements a dynamic feedback loop to determine when to resize target levels and by how much.

8. *Dynamic Surplus Management*: Publisher monitors and compares sales velocities and display quantities of titles per channel to help retailers

[10] A consumer that walks into a retailer looking for a specific book might be willing to wait a day or two if the retailer ensures that the consumer firstly knows that he can order it from the shop even though the shop is not carrying it and secondly that the retailer can quote a reliable delivery date due to visibility of inventory of this title at supply points.

determine when to return surpluses (titles not selling or not selling fast enough) and what to replace it with.

To allow the Publisher to be proactive in helping each link implement these 6 rules they should have full visibility of the daily POS data and on-hand status of inventory of each title at link in the supply chain and should proactively share and collaborate not only on setting initial demand forecasts but also on communicating observed changes in market demand to all supply chain partners to ensure no supply chain bottlenecks jeopardize availability.

22. Need for testing the proposed solution

Although the significant benefits achieved by other industries in moving from PUSH to PULL based fulfilment has been widely published (e.g. Toyota, Dell, Wal-Mart etc), the level of acceptance, potential benefits and the associated costs, capabilities and investments needed to secure these benefits within a Book Publishing supply chain is not known.

This third section (covering phase 3 of the research project) provides an update on the first efforts by the PH Supply Chain team to design a series of tests to validate (or invalidate) the following assumptions with regards to a change from PUSH to PULL:

1. Retailers and distributors, contrary to popular belief, will accept an offer from a publisher to take responsibility for the ordering of titles (what, when and how much)

2. Most, if not all of the capability and systems to implement daily ordering and daily shipment already exists or that if it does not, it can be established quickly and with relatively low investment.

3. The benefits achieved by both the publisher and book retailers could be measured and it will be sufficient to justify the needed management time and investment of making this change.

23. Criteria of Success for Tests

Based on the three objectives, the PH Supply Chain Team decided on the following measurements of success for the test:

1. The % acceptance rate by retailers for an offer from PH based on a transition to a PULL mode of operation

2. The impact of changing rules 1 (Daily Ordering), 3 (Daily Shipments), 5 (Consistent Inventory Target Determination) and 8 (Surplus Replacement) on reducing shortages (measured as OOS %) and surpluses (as inventory that

exceeds what is needed to protect against maximum daily sales or minimum display) both for the Publisher and Retailer.

3. The % requests at the end of the test to continue or expand the rollout of PULL based replenishment.

4. The level of learning achieved on how to conduct such tests (and probably more important, how not to conduct such tests).

24. Design of the Test

The team decided on two tests. The first would involve selecting a specific number of test shops that are directly serviced by PH and a specific number of test titles within each of these shops and actually replenishing these shops daily on actual consumption. The second "parallel" test would be a virtual test, involving a joint analysis with a large book chain doing their own distribution (BC was selected) to determine whether data analysis could be used successfully to identify the extent, consequences and causes of shortages and surpluses and the likely impact and investment to fully implement PULL based replenishment.

For the first test to be statistically representative, the combination of test shops and titles needed to be between 500 and 1000 data points. As a result, the team decided to target initially 15 shops, each with between 50 and 100 test titles. This would mean that even with a 50% acceptance level, the minimum data points would be achieved.

Since it was important to complete the tests within a 3-month period (not to impact the peak sales period in November and December), it was decided to select only titles with a sales velocity of 1 or more units per month per shop. In was also important that shops had the ability to order and receive orders 7 days per week and that test shops were not under contractual replenishment commitment with a distributor/wholesaler

25. Preparations for the Test

To prepare the Sales Team that had to "sell" the test offer both internally (to obtain agreement from account managers) as well as to the targeted book shops and book chain, a short script and presentation was prepared. These preparations and role-plays really helped the teams to clarify exactly what should be included in the test offer and what not and how to communicate it clearly. It was also decided that a debriefing would be done with the sales team after each meeting with targeted books shop to identify % acceptance rate and to record reasons for acceptance or rejection that could be used to modify, clarify or enhance the offer to other shops.

To prepare the order processing and order fulfilment team for the "physical" test with directly serviced shops, a series of "stress tests" were conducted to ensure that the order processing, picking, packing and shipment capabilities was in place to receive all the replenishment orders from test shops every day and to deliver these orders within 24hrs of receipt (with a maximum of 48hrs).

To minimize disruptions to day-to-day operations and minimize changes to internal systems, it was decided to setup a separate area to manage the daily order capturing and shipments.

For shops that accepted the offer to participate, the following preparations were done:

1. Identify the titles to be included in the test. There were three categories of titles included. Titles already stocked by the shop prior to the test (In-Stock), New Titles launched just prior to the test (New Titles) and titles not previously stocked used to replace surplus inventory (Brought Backs)

2. For each of the titles, PH to obtain 90 days of point-of-sale (POS) and "on-hand" inventory data both to be used as a baseline as well as to calculate the target inventory level at each shop based on daily ordering (order lead time of 24hrs) and a maximum supply lead time of 48hrs. The target level would be calculated based on the maximum past sales within the reliable replenishment time of 3 days and modified to meet minimum display quantities.

3. The calculated target level would then be reviewed with the shop and adjustments made (up- or down) where appropriate.

4. Put in place a daily ordering process at the shop based on a daily replenishment order for each test title, calculated from subtracting the On-Hand inventory at close of business from the agreed Target Level for that title (i.e. Replenish what wasl sold the previous day)[11].

5. To put in place a picking and shipping capability to supply each shop daily what was ordered the previous day (with a maximum supply lead time of 48hrs)

Considering the significant variability and low sales velocity of daily sales per shop of any title (over 90% of titles sell less than 1 unit per month), the fact that titles

[11] Once the target level for a specific title is achieved (e.g. if the shop previously stocked 5 but the new target level is only 3 – and 3 has been achieved through sell-down or returning the excess), the daily Replenishment Order would simply be equal to the daily sales of the title on that day unless there is changes made for seasonality or special events.

tend to sell less and less over time (the famous "L" Curve) combined with seasonality in sales and the possible impact of special events (convention in the area, Oprah appearance, Scandal etc), the team realized that actually measuring the impact of the change to PULL replenishment on sales will not be easy at all and would probably make a simple "before vs. after" comparison out of the question.

It seemed the only option was to use a comparative measure over the same period of time such as measuring the sales of test titles at the test shops vs. the sales of the same titles at a similar "control" shop or even for all other shops where this title is sold. So, part of the preparations was therefore to:

6. For each test shop, identify a "Control" shop that not only stocks the same test titles as the test shop but also a shop for which PH could obtain daily Point-of-Sale (POS) and Inventory on-hand data as a comparison.

Table 1 shows the final list of test shops, how many test titles were selected for each test shop per category (number of stocked titles, new titles and brought back titles included in the test), when the test was started with each shop and the agreed inventory reduction method.

Test Store Name	City	State	*No. of Test Titles	% of RH stocked tiles	No. of In Stock Titles	No. of New Titles	No. of Brought Back Titles	***No. of Days/Week Replenished	**Total RH stocked titles	No. titles reduced in inventory to meet target	Inventory reduction method	Go Live Date of Test
Annie Blooms Books	Portland	OR	100	5%	83	5	12	7	1935	5	Sold down	05 Aug 08
Bookpeople	Austin	TX	50	1%	45	5	0	7	8009	15	Sold down	05 Aug 08
Boulder Book Store	Boulder	CO	49	1%	38	5	6	7	6174	13	Sold down	05 Aug 08
Changing Hands	Tempe	AZ	100	4%	90	3	7	7	2603	33	Reduced from O/H	11 Aug 08
H. Schwartz – Brookfield	Milwaukee	WI	99	3%	93	3	3	7	3168	7	Sold down	18 Aug 08
H. Schwartz – Shorewood	Shorewood	WI	99	3%	93	4	2	7	3446	12	Transferred stock	18 Aug 08
Harvard Book Store	Cambridge	MA	100	2%	87	4	9	7	4519	28	Transferred stock	11 Aug 08
Lake Forest Book Store	Lake Forest	IL	81	3%	69	4	8	6	2936	38	Reduced from O/H	25 Aug 08
Northshire Bookstore	Manchester	VT	99	2%	89	4	6	5	5925	31	Sold down	03 Sep 08
Square Books	Oxford	MS	100	3%	86	4	10	7	3729	1	Returned	05 Aug 08
Tattered Cover – Lodo	Denver	CO	50	1%	42	5	3	7	4552	8	Transferred stock	14 Jul 08
Third Place Books	Lake Forest Park	WA	100	1%	93	5	2	7	9539	36	Sold down	11 Aug 08
Number of data points			**1027**		**908**	**51**	**68**			**227**		
Number of unique titles across all stores			**298**									

Table 1: Listing of Test Shops and Test Parameters

The only preparations needed for the Parallel "virtual" test with BC, was a workshop where the objectives and logic of the test was shared with BC's supply chain team. They responded positively and made available daily POS and inventory data from 4 representative BC shops for a joint analysis.

26. Determining Inventory Targets for the test

The formula that was agreed on to determine the inventory target for a specific title at a shop was:

Inventory Target = Maximum Forecasted Demand within Reliable Replenishment Time (RRt)

Where RRt = Order Lead Time (OLT) + Reliable Supply Lead Time (SLT)

As an example, if a shop ordered every day (OLT = 24hrs) and the Supply Lead Time would vary between 24 and 48 hrs (Reliable SLT = 48hrs), then the Inventory Target for this title would be set at the maximum past or forecasted sales within 72 hrs (RRt = OLT + SLT). If the maximum sold by this shop (excluding under promotional conditions) per day was 3 but the maximum sold for this title within 72 hrs (3 days) was 6 units, then the target level would be set at 6 units. Since the Order Lead Time is daily, we would expect about a day's worth of "maximum sales" on the shelf of the retailer (e.g. around 2 to 3) while the rest would be "on-the-way" (around 3 to 4).

The previous example is simply to illustrate that the "target level" calculated in this way is the total inventory on-hand plus on-order. This target level is therefore not necessarily equivalent to the "Model Quantity" used by retailers currently, since current "Model Qty" refers only the "Maximum On-Hand" quantity.

As previously mentioned, there is a potential conflict between the inventory needed from a logistics point of view (to protect against the maximum sales within reliable replenishment time) vs. the inventory needed from a marketing point of view to achieve the level of display units to attract more consumers. The test provided an environment where the team could compare the traditional rules used by PH and retailers to resolve such inventory target conflicts (typically they error on the "just-in-case" quantity) vs. the proposed use of the same formula. This conflict is especially emotional when a team has to agree on whether to stock 1, 2 or 3 units of a specific title when it is clear that the probability of selling more than 1 in a day is negligible[12] but there is a fear that keeping 1 rather than 2 or 3 will negatively impact sales due to lower visibility to consumers. As previously mentioned, this hypothesis need to be further tested.

Table 2 below gives an indication of the significant changes that were made to the model quantity during the tests and also gives an indication that the way the rules were applied even during the test was not consistent between shops.

Model Qty	Count Pre-Test	Count Post-Test
Model Qty = 0	134	0
Model Qty = 1	165	23
Model Qty = 2	191	245
Model Qty = 3	179	255
Model Qty = 4	91	192
Model Qty = 5	61	86
Model Qty = 6	44	61
Model Qty = 7	23	13
Model Qty = 8	27	42
Model Qty = 9	14	0
Model Qty = 10	21	60
Model Qty > 10	75	50
Totals	891	1027

Change in Model Qty	Count incl NonStocked	% of Total
Increase by =>5	59	3.0%
Increase by 4	30	1.5%
Increase by 3	86	4.4%
Increase by 2	150	7.7%
Increase by 1	209	10.8%
No change	266	13.7%
Reduce by 1	86	4.4%
Reduce by 2	50	2.6%
Reduce by 3	29	1.5%
Reduce by 4	10	0.5%
Reduce by =>5	965	49.7%
Totals	1940	100.0%

Change in Model Qty	Count excl NonStocked	% of Total
Increase by =>5	21	1.3%
Increase by 4	12	0.7%
Increase by 3	54	3.2%
Increase by 2	109	6.5%
Increase by 1	204	12.2%
No change	266	15.9%
Reduce by 1	86	5.1%
Reduce by 2	50	3.0%
Reduce by 3	29	1.7%
Reduce by 4	10	0.6%
Reduce by =>5	831	49.7%
Totals	1672	100.0%

Table 2a, 2b, 2c: Counts of Model Quantity Pre- and Post-Test vs. Counts of Change in Model Quantity incl & excl Non-Stocked Titles

[12] Most titles sell less than 1 per month per shop. For a title selling at 1 per month, the probability of a sale occurring on a specific day would be 1/30 or 0.03. The probability of selling 2 units on the same day would be 0.03 x 0.03 = 0.001 or less than 0.1%.

Table 2a shows for example that prior to the test, 165 of the 891 title locations[13] (18.5%) were at model quantity of 1. During the test, only 23 of the 1027 title locations (2.2%) were at a model quantity of 1 while 192 were at model quantity of 4 (18.6%) vs. only 91 pre-test (10.2%).

Table 2b shows the count of changes in model quantity including "non-stocked titles" (i.e. titles not carried pre-test) while Table 2c shows the same count per category of change in model quantity excluding the non-stocked titles. Both tables show that 49.7 % of the title locations in the test had a reduction in their model quantity of more than 5 due to the increased order and shipment frequency.

Table 2c also shows that an almost 24% of titles previously stocked had their model quantities increased during the test. The reasons for this is likely that the model quantities on some titles were increased to fill the space opened by the reductions and not filled by the surplus replacement quantities [*to be investigated further*]

Once the shops agreed, the logistics processes were put in place and tested and the target levels of each title per shop was agreed, the tests could be started.

27. Managing the Execution of the Tests

The starting dates of the tests with the 12 book shops directly serviced by PH was phased with the first shop "going live" on the 14th July 2008 and the last shop starting on the 3rd September 2008. All the tests were run until the 2nd November 2008. The average duration per test was around 80 days or just under 3 months.

In general, the execution of the test went quite smoothly. The PH warehouse would receive every day the replenishment orders from each shop and ensure that these are picked and shipped the next day.

As expected, one of the challenges during the test was obtaining accurate daily sales and inventory levels from every shop every day. Normally this data is reported on an aggregate level only and special changes had to be made to the reporting systems to get the daily data. There are cases where especially the pre-test data could not be obtained or that the accuracy is still in question.

Also, although in general, the agreed replenishment rules were followed (i.e. replenish daily up to the target level for each title), the analysis of daily data did show cases where the agreed rules were not followed as intended. This resulted in shortages or surplus inventory in some shops, serious enough to cause two of the shops to decide not to continue the tests after the 2nd November 2008. In both cases, shops were replenished daily based on the actual sales that day, rather than replenished up to the inventory target. This meant that titles where the starting on-

[13] "Test Location" is defined as the unique titles shop locations in the test. For example, if there is 2 test shops each with 100 titles, there is a total of 200 title locations. For the Test, there was 298 unique titles, but over a 1000 title locations since not all titles were in each shop.

hand inventory was less that the agreed inventory target, was simply replenished on daily sales and therefore frequently at risk of a stock-out. In other cases where the inventory target was significantly less to the original model quantity, simply replenishing on daily sales meant that the inventory levels were never reduced resulting in surpluses.

It seemed the non-conformance were caused by a combination of poor communication of what the replenishment rule is (replenish daily up to the target and not just to replace the daily sales) as well as having to deal with cases where the daily on-hand inventory was simply not available.

One of the objectives of the test was to determine whether a full implementation of PULL based replenishment would require any significant additional investment or increase in distribution and warehousing costs. Part of the management of the tests therefore was for the PH management team to monitor whether or not new materials handling equipment would really be required to ensure picking and packing of the smaller quantities every day would not cause a bottleneck and or whether the distribution and warehousing costs would increase, remain the same or in fact come down.

The provisional answer to these questions, together with the answer on whether the test proved a PULL distribution model would actually reduce shortages (OOS) and surpluses is summarized in the next section.

28. Results from the Test

Despite the concerns about whether it would be possible to really measure the impact of the proposed solution on sales considering the current declining market (some even call it a recession) and the normal difficulty to control all the parameters in a retail test environment that can influence sales, the PH team were confident that the tests would provide sufficient information to make a decision about whether the benefits of a full roll-out will exceed the costs and investment required to implement and sustain the capability to deliver daily based on actual consumer demand.

Results from joint Data Analysis of 4 Shops from large Book Chain (BC) company.

BC is considered an industry leader with respect to their level of OOS and Returns. Therefore, the analysis of their sales and inventory data would provide important information on what, if any, potential for improvement in shortages and surpluses could still be possible, even for a retailer that is considered the best in the industry.

For each shop and for each PH title within the shop, the sales and on-hand inventory data were analyzed to determine the number of OOS days for each title and then the likely lost sales were estimated after applying agreed and conservative filters that would remove possible distortions in the data.

Table 3 below provides a summary of the OOS days and likely lost sales due to OOS after the application of the agreed conservative filters. The data is for the period

1/6/2008 to 8/9/2008 and shows net sales at retail level. Filters applied include exclusion of daily POS greater than or equal to 20 units and data from titles that were only sold or stocked for only day (typically special orders) and a filter to cap missed sales at 50% of actual sales over the period.

All	Baseline					Filters				Adjusted					
Store	Units Sold	Out of Stock Days	Missed Sales	Number of Titles with Missed Sales	Percentage Sales Lift	Units Sold	Out of Stock Days	Missed Sales	Number of Titles with Missed Sales	Units Sold	Out of Stock Days	Missed Sales	Number of Titles with Missed Sales	Percentage Lift of filtered sales	Percentage lift of actual sales
3rd Street Promenade	46 997	497 101	10 220.42	5 429	21.75%	-3 684	-428 224	-7 838	-2 132	43 313	68 877	2 382.67	3 297	5.50%	5.07%
Charlottesville	54 258	551 931	24 916.11	6 174	45.92%	-3 213	-462 140	-21 939	-2 155	51 045	89 791	2 977.10	4 019	5.83%	5.49%
Del Amo	45 404	586 638	16 697.56	5 464	36.78%	-5 034	-504 722	-13 832	-2 017	40 370	81 916	2 865.21	3 447	7.10%	6.31%
Rockville Pike	49 336	492 840	12 414.63	5 740	25.16%	-2 934	-419 987	-9 928	-2 233	46 402	72 853	2 486.14	3 507	5.36%	5.04%
Average	48 999	532 128	16 062	5 702	**32.40%**	-3 716	-453 768	-13 384	-2 134	45 283	78 359	2 678	3 568	5.95%	**5.48%**

Table 3: Analysis of Shortages (OOS) for 4 representative BC Shops

Table 3 shows that the estimated lost sales due to the current OOS on PH titles carried without any filters is 32.40% based on the sum of the OOS days per title multiplied by the average sales velocity per day of that title. This estimate drops significantly after applying realistic filters to 5.48% of total sales. This means that it is likely that if a solution could be found to reduce OOS to zero, it will likely result in an increase in PH sales for BC and PH of around 5.5% - still very significant for a retailer considered to be the best in the industry.

Further analysis of the OOS data against known events showed that PH is definitely losing sales on the major events, probably losing sales on the minor events, but that it is not clear whether PH is losing sales on random variation in demand (i.e. where the current model quantity is too small to deal with randomness in daily sales)

But what about the extent of surpluses at BC and the opportunity for surplus replacement considering that most of their stores stock already a large % of PH titles and are already replenished daily or at least weekly? Table 4 below shows a summary of the unit sales for PH titles over a period of 185 weeks.

Sales Range	Number of Titles Carried	Weeks Carried / Title	Weeks Containing Sales / Titles	Weekly Inventory	Number of Sales Units	% Total Sales Units
Zero Sales	4 950	29	0	1 243	0	0.0%
1 - 9	11 376	83	3	8 005	42 629	13.6%
10 - 29	4 018	116	13	5 543	65 758	21.0%
30 - 49	933	130	28	2 162	35 607	11.4%
50 - 99	762	136	42	2 482	51 698	16.5%
100 - 199	363	140	66	1 751	49 410	15.8%
200 - 299	78	142	86	602	19 077	6.1%
300 - 399	37	145	102	346	12 434	4.0%
400 - 499	20	142	109	227	8 865	2.8%
500 - 999	24	141	107	393	16 769	5.4%
Over 999	6	95	82	189	10 635	3.4%
Total or Average	**22 567**	**82**	**8**	**22 943**	**312 882**	**100.0%**

Table 4: BC Santa Monica Store – Concentration Analysis for period of 185 Weeks (1/1/2005 - 7/18/2008)

The analysis in Table 4 provided the PH and BC team with a few key insights on both the extent of surpluses as well as the potential for surplus replacement. Firstly, it showed that over a period of 185 weeks, this Santa Monica Store (one of BC's super-stores) carried "only" 22,567 of the around 38,000 active PH titles. This meant there is definitely opportunity for surplus replacement, although probably, the majority would be at sales velocities significantly below 1 per month (but remember, "*any sales is better than no sale*")

Secondly, the analysis showed that 4,950 PH titles out of the 22,567 (24.1%) had zero sales over the 29 weeks on average that they were carried while occupying 1243 units of the total inventory of 22,943 (5.4%). Almost as bad, is the 11,376 titles (50.4 %) that sold between 1 to 9 units over the typically 83 weeks that they were carried while occupying 8005 units of inventory (34.89 %). These titles were generally sold in only 3 week period over the 83 weeks. These statistics confirmed not only the very slow sales velocity of about 75% of all PH titles (if viewed at a shop level) but also provided an indication that there is likely significant opportunities for increasing sales if surpluses can be identified and replaced earlier.

As a comparison, Table 5 below shows a similar "concentration analysis" obtained from Bookscan (a service that aggregates most retail store sales on all titles). The Sales range is the number of units sold per title across all retailers that carried it for year-to-date in 2008. Unfortunately, this data do not show how many retailers carried a specific title but again it proves that PH sales are VERY concentrated. Most of the titles (>20K) had minuscule sales and some of this might be simple due to the fact that they are not available at retailers where there is a demand for them. It also shows how critical it is for a Publisher to not "push" titles that don't sell and how important it is to both the publisher and retailer that if this did happen, to identify such titles and replace them with titles that are selling in similar retailers at a higher sales velocity.

Sales Range	Number of Titles	Sales Units	% of Total Sales	% of Total Titles
Zero Sales	0	0	0.00%	0.00%
1 - 4	7 211	13 705	0.03%	18.59%
5 - 9	4 312	29 140	0.07%	11.12%
Total 0 - 9	**11 523**	**42 845**	**0.10%**	**29.71%**
10 - 19	3 622	49 263	0.11%	9.34%
20 - 29	1 716	41 198	0.09%	4.42%
30 - 39	1 148	39 314	0.09%	2.96%
40 - 49	816	36 103	0.08%	2.10%
Total 10 - 49	**7 302**	**165 878**	**0.38%**	**18.83%**
50 - 99	2 726	195 674	0.45%	7.03%
100 - 199	2 979	430 968	0.99%	7.68%
Total 50 - 199	**5 705**	**626 642**	**1.44%**	**14.71%**
200 - 299	1 918	473 637	1.09%	4.94%
300 - 399	1 333	463 636	1.06%	3.44%
400 - 499	1 073	479 154	1.10%	2.77%
Total 200 - 499	**4 324**	**1 416 427**	**3.25%**	**11.15%**

Sales Range	Number of Titles	Sales Units	% of Total Sales	% of Total Titles
500 - 999	3 163	2 267 072	5.20%	8.2%
1,000 - 1,999	2 628	3 725 184	8.55%	6.8%
2,000 - 2,999	1 221	2 980 405	6.84%	3.1%
3,000 - 3,999	688	2 381 411	5.47%	1.8%
4,000 - 4,999	398	1 780 938	4.09%	1.0%
5,000 - 5,999	306	1 672 426	3.84%	0.8%
6,000 - 6,999	246	1 596 492	3.66%	0.6%
7,000 - 7,999	162	1 207 151	2.77%	0.4%
8,000 - 8,999	120	1 018 609	2.34%	0.3%
9,000 - 9,999	114	1 081 146	2.48%	0.3%
10,000 - 14,999	366	4 499 323	10.33%	0.94%
15,000 - 19,999	174	2 978 755	6.84%	0.45%
20,000 - 29,999	190	4 611 949	10.59%	0.49%
30,000 - 39,999	62	2 136 876	4.90%	0.16%
40,000 - 49,999	28	1 256 765	2.88%	0.07%
Over 49,999	68	6 120 005	14.05%	0.18%
Total over 499	**9 934**	**41 314 507**	**94.83%**	**25.61%**
Total	**38 788**	**43 566 299**	**100.00%**	**100.00%**

Table 5: PH annual Unit Sales concentration analysis for all active titles

Results from the Test of direct delivery to 12 Book Shops based on actual demand.

The objective of these tests was to get actual data from the field to answer four simple questions. Would shops accept an offer from a publisher to manage the replenishment and surplus replacement of its own titles based on actual daily sales, would such a change to a PULL based replenishment reduce shortages, would it reduce surpluses and if so, would the benefits (impact on sales) be sufficiently more than the cost (additional operating expenses and investment) for the publisher and retailer to view it as a win: win?

1. Acceptance of the Offer by Book Shops

The first success criteria of the test was to determine the level of acceptance by shops for an offer by PH to manage and replenish between 50 and 100 PH titles daily based on actual sales. A 50% acceptance rate of the shops targeted was needed for statistical significance and there were some doubts whether this would be achieved due to the perceived resistance by retailers to allow a publisher to take over their daily ordering.

It was therefore quite a surprise to many at PH that ***80% (12 out of 15) of the shops accepted the offer to participate in a test***. And the reasons given by the other 3 were mostly internal issues (we are too busy now, we have our own RDC, we can't change our system for a small test and we do not have capacity to receive shipments over weekends etc) and not related to the attractiveness of the offer.

2. Impact on Shortages / Out-of-Stock

The second success criterion of the test was to determine the impact of a PULL based replenishment on the level of shortages or out-of-stocks (OOS). Table 6 below shows that prior to the test, the average *OOS% for the 12 shops were 14.1%. This was reduced to only 2.3% during the test – a reduction of 83.7%.* This should translate to a reduction in lost sales from 6.7% to 2.4% (reduction of 64.5%)

Test Shop	Pre-Test OOS %	Test OOS %	% Change in OOS	Expected sales increase from Pre-Test to Test (1)	Additional unrealized sales increase in Test (2)	% Change in Lost Sales
Annie Bloom's	26.0%	4.1%	-84.0%	17.1%	4.2%	-75.4%
Bookpeople	5.5%	1.5%	-72.1%	4.5%	2.3%	-48.9%
Boulder	14.9%	2.1%	-85.7%	7.2%	3.2%	-55.6%
Changing Hands	13.8%	3.6%	-74.1%	11.1%	5.3%	-52.3%
Harvard	20.0%	0.7%	-96.7%	12.0%	0.4%	-96.7%
Lake Forest	24.7%	3.0%	-87.7%	5.8%	2.4%	-58.6%
Northshire	9.6%	0.4%	-95.8%	2.7%	1.1%	-59.3%
H. Schwartz Shorewood	6.1%	1.6%	-74.0%	2.2%	1.5%	-31.8%
H. Schwartz Brookfield	8.3%	2.6%	-68.7%	5.7%	1.4%	-75.4%
Square Books	18.4%	3.0%	-83.8%	10.3%	3.9%	-62.1%
Tattered Cover	11.8%	3.5%	-70.0%	8.1%	3.2%	-60.5%
Third Place Books	10.7%	3.3%	-69.2%	4.0%	1.4%	-65.0%
Average	**14.1%**	**2.3%**	**-83.7%**	**6.7%**	**2.4%**	**-64.5%**

Table 6: Comparative Analysis of Out-of-Stock and Calculated Lost Sales Pre-Test and Post-Test[14]

As mentioned earlier, the team knew from the beginning that it would be very difficult to find a way of measuring whether actual sales on the test titles within the test shops increased compared to what it would have been if there were no test. It was decided that control shops (shops with the same titles as the test shop) might provide a good comparison.

Table 7 below shows the comparative change in sales and inventory for each of the 3 categories of titles included in the test – "In-Stock Titles", "New Titles" and "Brought-Back Titles" (titles that was used to replace surpluses). As can be seen from the "In-Stock Title" comparison between Test and Control shops, it shows that (probably due to the overall slow-down in the economy), both test and control shops experienced a major reduction in sales post go-live. The difference, although favouring the test shops were not significant enough to be considered "out-side-the-noise", especially considering that there was a larger reduction in inventory in the control shops. However, when compared to what happened with all PH titles in the test vs. control shops, the test results are quite promising. For all PH titles, the sales in the test shops were down 20% vs. 11% for control shops. Therefore, the fact that PH test titles in the test shops outperformed the test PH titles in the control shops is significantly outside the noise and convincing evidence that the daily replenishment did positively impact sales compared to the control shops.

What was also encouraging from the comparison is to see the significantly larger increase in sales on new titles in test shops compared to control shops with about the same increase in inventory and off-course, the increase in sales from the Brought-back titles (surplus replacement titles not stocked by the test shop pre- go-live).

[14] (1) Expected percentage sales increase in units from reducing out-of-stock % to zero; sales increase for each title calculated as Pre-Test OOS % x Days in Test x Velocity per Day. (2) Sales increase in test results if out-of-stock% during test actually were zero; sales increase for each title calculated as Test OOS % x Days in Test x Velocity per Day

	Sales				Inventory			
	Average Pre Go-Live	Average Post Go Live	Difference	% Inc / (Dec)	Average Pre Go-Live	Average Post Go Live	Difference	% Inc / (Dec)
All Test Titles								
Test Stores	153	147	-6	**(3.67%)**	608	926	318	**52.34%**
Control Stores	1 759	1 539	-220	**(12.50%)**	4 526	4 758	233	**5.14%**
In Stock Titles								
Test Stores	152	93	-59	**(38.65%)**	600	679	79	**13.13%**
Control Stores	1 722	1 003	-718	**(41.72%)**	4 438	3 510	-928	**(20.90%)**
New Titles Titles								
Test Stores	1	43	43	**8571.22%**	4	208	204	**5281.52%**
Control Stores	11	514	502	**4403.19%**	21	1 170	1 149	**5432.56%**
Brought Back Titles								
Test Stores	1	11	10	**2009.98%**	3	39	36	**1060.27%**
Control Stores	26	22	-4	**(15.59%)**	66	78	12	**17.62%**
All RH Titles								
Test Stores	7 106	5 670	-1 437	**(20.21%)**	90 977	105 754	14 778	**16.24%**
Control Stores	7 619	6 786	-833	**(10.93%)**	61 722	73 824	12 101	**19.61%**

Table 7: Comparative Analysis of Sales and Inventory Pre-Test and Post-Test for Test vs. Control Shops[15]

3. Impact on reducing Surpluses replacing Surpluses with non-stocked titles

Table 8 below shows a more detailed analysis of the sales increase (leverage) that was achieved by the introduction of brought-back or non-stocked titles used for surplus replacement.

To determine the real impact of "non-stocked" titles on sales, table 8 separated the impact of the original non-stocked titles as well as those introduced later in the test.

TEST SHOP NAME	TEST SHOP LOCATION	TEST DAYS	NEW TITLES			NONSTOCKED TITLES			NONSTOCKED TITLES NEW			STOCKED TEST TITLES			TOTAL TITLES IN TEST			ALL RH TITLES STOCKED IN TEST		
			Test Titles	Test Sales	Avg Velocity /mnth	Test Titles	Test Sales	Avg Velocity /mnth	Test Titles	Test Sales	Avg Velocity /mnth	Test Titles	Test Sales	Avg Velocity /mnth	Test Titles	Test Title Sales	Avg Velocity /mnth	Total RH Titles	All RH Test Sales	Avg Velocity /mnth
Annie Bloom	Portland	88	5	105	7.16	12	33	0.94				83	503	2.07	100	641	2.19	3618	2852	0.27
Bookpeople	Austin	90	14	97	2.31							45	775	5.74	59	872	4.93	13417	2852	0.07
Boulder	Boulder	89	5	96	6.47	6	8	0.45				38	630	5.59	49	734	5.05	18953	9881	0.18
Changing Hands	Tempe	81	3	37	4.57	7	21	1.11				90	505	2.08	100	563	2.09	4246	3197	0.28
Harvard	Milwaukee	81	4	57	5.28	9	19	0.78				87	1186	5.05	100	1262	4.67	6917	8288	0.44
Lake Forest	Shorewood	67	4	72	8.06	8	46	2.57	31	35	0.51	69	696	4.52	112	849	3.39	4668	2532	0.24
Northshire	Cambridge	59	4	131	16.65	6	7	0.59				89	540	3.09	99	678	3.48	10380	4729	0.23
Schwartz Shorewood	Lake Forest	74	4	56	5.68	2	7	1.42	33	30	0.37	93	389	1.70	132	482	1.48	6940	2690	0.16
Schwartz Brookfield	Manchester	74	3	42	5.68	3	1	0.14	36	32	0.36	93	280	1.22	135	355	1.07	6037	2340	0.16
Square Books	Oxford	89	4	27	2.28	10	16	0.54				86	627	2.46	100	670	2.26	6588	5134	0.26
Tattered Lodo	Denver	108	5	86	4.78	3	12	1.11				42	1328	8.78	50	1426	7.92	10025	10022	0.28
Third Place	Lake Forest Park	82	2	104	19.02	2	3	0.55				93	899	3.54	97	1006	3.79	15219	6645	0.16
Totals / Averages			57	910	**7.33**	68	173	**0.93**	100	97	**0.41**	908	8358	**3.82**	1133	9538	**3.53**	107008	61162	**0.23**
	% of Test Title Totals		**5%**	**10%**	208%	**6%**	**2%**	26%	**26%**	**17%**	12%	**80%**	**88%**	108%	**100%**	**100%**	100%			
	Leverage 1:X		**1: 1.9**			**1: 0.3**			**1: 0.7**			**1: 1.1**			**1: 1.0**					
	% of All RH Title Totals		**0.1%**	**1.5%**	3224%	**0.1%**	**0.3%**	408%	**0.6%**	**3.3%**	181%	**0.8%**	**13.7%**	1680%	**1.1%**	**15.6%**	1552%	**100.0%**	**100.0%**	100%
	Leverage 1:X		**1: 27.9**			**1: 4.5**			**1: 5.9**			**1: 16.1**			**1: 14.7**			**1: 1.0**		

Table 8: Analysis of Title vs. Sales Leverage from introducing additional Titles (Non-Stocked)

---

[15] ***Assumptions:*** Test Period Data: Store test start date to 11/2/2008, "All PH Titles" include all PH titles carried at the store, regardless of sale price or special sales
Data Exclusions: Day sales greater than 20, Returns greater than 20 (= sales < -20), Titles in stock only 1 day over length of test, Titles sold only 1 day, Inventory > 50, Books sold at price other than retail

As an example, Annie Bloom added ONLY 0.3% (12 added to 3618) additional titles not previously stocked but these 12 titles resulted in an overall PH increase in sales of 1.16% - a leverage of over 1:3.5. Our minimum expectation for the tests was 1:1 - i.e. if we add 1% titles not previously sold that could sell at the same average daily sales velocity as the shops existing PH title mix, sales for the retailer and PH should go up by 1%. Obviously, if the Surplus Replacement titles introduced is selling at a higher sales velocity than the existing PH average, the leverage will be higher - i.e. adding 5% titles would result in potentially much more than 5% increase in sales (with 1:3, 5 % more titles would give 15% more sales). The better the average sales velocity of the titles added (which was previously not stocked due to space or cash constraints), the higher the resulting % increase in sales.

If we consider all the test shops, we can see that the 68 original non-stocked titles added (only 0.1% of total PH titles) resulted in an increase of 0.3% in PH sales – a leverage of 1:4.5. The 100 non-stocked titles introduced in the last month of the test (once the PH team realized the major opportunity seemed to be in surplus replacement) contributed 3.3% to the total PH sales – a leverage of 1:5.9!

Table 8 also shows the disproportionate contribution to sales of new title introductions. New Titles introduced in the test made up only 5% of titles in test but contributed 10% to total test sales. These new titles made up 0.1% of total titles and contributed 1.5% of total sales (27.9x the norm).

Previously stocked titles made up 88% of Titles tested, and as expected, contributed 88% of total sales of all titles in test. They made up typically 0.8% of all the PH titles in these test shops and contributed 13.7% of total sales (16.1x the norm)

The results achieved from the test can be summarized as follows:

Retailers are more likely to accept an offer from a Publisher to take responsibility for the replenishment of its titles and the dynamic management of model quantities and surplus identification and replacement. As seen in other industries, acceptance rates for such an offer (especially once it has been "polished") would be in the high 80's or 90's.

Replenishing daily on actual consumption will likely result in a major reduction in OOS%. The test showed a reduction of 84%.

Applying a consistent formula for determining the inventory target based on maximum forecasted demand within order lead time plus supply lead time, will enable publishers and retailers to really capitalize on the reduction of order and supply lead times as well as the aggregation of inventory within CDC's and RDCs. Determining the inventory targets for direct delivery shop in this way should result in a significant reduction in inventory on-hand on all titles where the current model quantities exceed 1.

It will always be difficult to reliably measure the impact of such a reduction on "lost sales due to shortages". A conservative way to estimate the impact using POS and On-Hand data shows that a OOS reduction as achieved in the tests will likely result in increased sales of around 5% (compared to what would have been sold with the prevailing OOS%). This number could increase if a significant portion of the previous stock-outs occurred on titles with high sales velocities which normally occur when actual sales exceed the demand forecasts for this title at a specific shop and the shop do not react fast enough to replenish stock.

The real opportunity for increased sales seem to lie within the faster identification and replacement of surplus inventory exposed from more frequent ordering and shipments.

A cost-benefit analysis done based on the experience from the tests showed that there will in fact be some savings related to shipping smaller quantities more frequently. However, establishing the capability to pick, pack and ship smaller quantities more frequently and more rapidly for all directly serviced shops and distributors, will require the investment in an automated sorter. The ROI on this investment due to a combination of a likely increase in sales and reduction in operating expenses would be at most a few months.

29. Lessons learned from Research Analysis and Experiments

1. Although it is difficult to measure the real impact of changes in retail and specifically in the book business due to low sales velocities, there are ways where the measurable extent of a undesirable effect such as OOS can be translated into a likely (after applying conservative filters) loss in sales and profitability to both publisher and retailer

2. The impact of OOS on week days vs. weekends is different due to generally higher sales velocity over weekends which means any analysis should not simply apply the average sales velocity x OOS days but match when the OOS took place with the average sales velocity during such as period. An interesting observation was that the test results did not show the expected significant jump from weekday to weekend days. Counter to our assumptions, what we saw is that weekend sales account for ~30% of total sales rather than more than 50 % which is normally assumed.

3. Unless we can ensure that a test vs. a control shop is impacted by exactly the same events, it will not be possible to find a good control for any bookstore.

4. Due to high levels of variability, we should NOT be testing in aggregate (without at least analyzing the variation) as highs and lows can be cancelled out that could lead to the wrong conclusions

5. We need practical solutions for receiving accurate daily POS and on-hand data as well as a practical solution for replenishing on weekend – we can either keep treating it like a regular day, or build in buffering rules to increase buffer for the weekend. We need also

to look at special measures for receiving on weekends, getting skilled staff and/or deliveries to back door. It would behove us to check with the customers on which of those options would be most attractive.

6. PH should set up a series of tests across significant sales channels to test the hypotheses that changing (from side to front facing) would increase sales or that reducing the "Display Quantity" will reduce sales or not reduce sales.
7. Sales and Supply Chain team members supervising the tests must ensure that inventory targets are achieved at the start of the test (not rely on sell-down) to validate the impact of changes in target levels. This also implies ensuring that participants are re-ordering to the TARGET quantity (not simply what was sold the previous day)
8. A critical part of preparing for tests is for the team (with all stakeholders) to really indentify which research questions need to be/can be answered and what data will be needed to provide such answers.

30. Additional Pilot programs and results

Since this initial test, the pilot program has been further rolled out to one of the largest online book dealers as well as to another very large chain. The lessons learned in the original pilots were applied to ensure for example that the execution of the tests strictly adhered to the new Theory of Constraints based Replenishment Planning and Execution rules, that surpluses was replaced as soon as possible and also that a more reasonable baseline was used to compare performance.

The results on all these new pilots have been very inspiring. In the first case, by moving from weekly to twice weekly ordering, but with properly calculated inventory targets and replenishment on actual consumption, sales on the titles in the pilots increased by 13% while inventory was reduced by 10%. Overall sales in the same period for all titles was down by 5%, showing an almost 20% net gain in sales. For the large book chain pilot, the results were of similar magnitude and were so convincing for the book chain, that they agreed that the publisher should in future take over the day-to-day responsibility for setting target levels and replenishment as well as adjusting target levels using the TOC Dynamic Buffer Management algorithms.

SECTION 4

31. Research Summary and Recommendations

In the current economic conditions where there is a market constraint, losing any sales is the opposite of “fully exploiting the potential of a Publisher’s titles” and the opposite of “fully exploiting” the shelf space and cash constraints of the retailer.

The analysis of the extent and consequences of shortages and surpluses, together with the test of a simple yet robust solution, has shown that most likely; the combination of shortages, surpluses and especially not replacing surpluses with titles that do sell is likely reducing the potential sales for the Publisher and Retailer by between 10 and 20 %. Considering that each 1% sales loss is equivalent to between 10 and 20% loss in profitability for both Publisher and Retailer, the impact will far exceed previous assumptions.

The major lesson for the research team was that unlike other industries, the key for increased sales and profitability might NOT be the reduction of shortages. The key most likely is reducing the surpluses to release space and cash at the retailer – the real system constraint for the whole supply chain. Surpluses can be reduced by both making sure that new titles that are released are “pushed” in smaller quantities initially (made possible by rapid replenishment from aggregated inventory buffers at CDCs and RDCs to react quickly if actual sales exceed initial forecasts) and also by dynamically adjusting (using the DBM algorithms) the inventory needed to really protect sales, especially considering that it is possible in most cases to cost-effectively reduce both order and supply lead times even further.

Offering more direct deliveries should also have a positive impact on the average selling price achieved by the publisher as the margin loss through selling through wholesalers can be eliminated.

Therefore, considering the pressure to find ways to protect and increase sales, the relatively small investment needed to put in place the capability for rapid replenishment that could likely be turned into a significant and sustainable competitive edge for PH and the inspiring results achieved from the initial and subsequent pilots, the PH Supply Chain team received approval to proceed to invest the necessary management time and capex to establish and roll-out the capability to replenish shops and distributors daily based on actual sales at the retailer on a full-scale basis.

32. What further research is needed?

Dr. Eli Goldratt always reminds us that when initial results and buy-in were so impressive, further testing might just be a *sophisticated way to procrastinate*. However, ongoing research and experimenting should be done to gain more insights into a number of important aspects such as:

1. What is the real impact of display quantity on sales? Do larger display quantity drive higher sales and when do scarcity (lower display quantity) drive higher sales and abundance lower sales?

2. Since the supply chain constraint is the no. of end consumers entering the store and potentially would buy, to "*better exploit this system constraint*" we need to measure the gap between those buying and those that would have bought and further, what conditions could have closed this exploitation gap. Are there practical ways of measuring?

3. "*Elevating the supply chain constraint*" means getting more customers to enter the shops and having more shops to enter. To what extent to higher availability of a wider range contribute to more customers entering the shop and to what extent can higher availability with lower inventory reduce the risk to expand the number of shops faster to accelerate growth?

4. Is there a way to prevent the typical "L-Curve" (very large sales initially due to marketing and then a fast deterioration once marketing is moved to new titles) that depicts the sales of most new titles?

5. To what extent will "Print-on-demand" reduce the problem of the "long tail" – the large portion of books that sell at very low sales velocities?

6. Will access to lower priced e-books and exciting new e-book readers such as the Kindle and iPads result in a net loss in revenue for Publishers (due to lower pricing) or a net gain in revenue as consumers might buy (and even read) significantly more books due to the convenience the new technologies provide

7. What would be the best dynamic target level resizing rules for the "1's" and "2's" at book retailers?

8. Are there ways to further reduce order and supply lead times and at what point will the cost and benefit curves cross?

About the Author

Dr Alan Barnard is currently CEO of Goldratt Research Labs, Director of Goldratt Group Africa, Chairman of Realization Africa and Chairman of The Odyssey Institute TOC has provided Alan the practical means to help achieve his personal goal to help organizations and individuals identify and unlock their inherent potential

-

Alan was a President of SAPICS in 1999 to 2001 and founding board member and chairman of TOCICO from 2003 to 2005. Alan received the TOCICO Lifetime Membership award in 2006 for his global contribution to TOC.

He has worked with companies such as ABB, Cisco, Seagate, SAP, Random House, BC Rail, Tata, Larsen & Toubro, Premier Foods, Shatterprufe, SABMiller, and with UN DP and InWent on applying TOC to City Councils in Africa

Alan is married to Laura and they have two young sons Christian and Francois who are becoming real TOC practitioners, as they never stop asking WHY!

CONTACT

eMail alan@goldratt.co.za

Website www.goldrattresearchlabs.com or www.toc-goldratt.com