Inventory and Restocking Systems in Toronto Retail

Introduction

Creatron is a company based in Toronto that sells student-grade electronic components. Due to the limited time for the assignment and the proximity of one of the branches our team visited the downtown branch, located at 349 College Street.

According to the store manager, J. Chan, the store had an incident last year where they ran out of strain gauges because students from Marc Garneau C.I, a high school, needed several of them for their AP Physics project. Students preferred to purchase items in person rather than online since shipping took much longer than buying in person. Thus, even though there were many strain gauges sold online at the same price, students flocked to Creatron stores to buy them. There were other similar instances where students from other high schools managed to make Creatron go out of stock on certain items.

Creatron, like other retailers, would benefit from an engineered means to estimate the required supply of various products in order to match demand.

Opportunity Legitimacy and Context

The need for a method to gather statistics and communicate effectively with its customer is critical for Creatron, or for stores in general. Finding a suitable solution for this opportunity would be beneficial for the business and its customers.

When considering the value of out-of-stocks (or OOS) reduction to the average store, consider the following:

- 44% of customers encountering an OOS would do without or buy from a competitor rather than buy another brand [2] (Figure 3)
- OOS causes a loss of $800 USD for a typical American grocery store weekly [1]
- Store errors caused 60% of OOS [2] (Figure 3)
- Improper store ordering and demand forecasting systems caused 47% of OOS [1] (Figure 1)

A study by Oliver Wyman found that one of the major causes of OOS was semi-automatic/automatic inventory tools that proved to be overly complex or simply unhelpful to workers [2]. Furthermore, Procter and Gamble showed that three of the root causes of OOS stemmed from such flawed systems (Figure 2):

Cause 1: inaccurate product data

- Inability to manage inventory data or account for products

Cause 2: poor ordering systems

- Overestimate supply or do not update information
- Out-of-stock unknown or unaccounted for

Cause 3: demand forecasting inaccuracy

- Underestimates demand due to incomplete information
- Does not account for replenishment issues like delivery timing [1]

Multiple approaches can be taken to solve this opportunity due to the various aspects of the situation demonstrated by the above stated causes.

To verify that addressing the opportunity would improve communication between salespeople and customers, we went to the downtown Creatron store and conducted a field note analysis, which included speaking to the sales manager [6]. From this interaction we learned that the store tries to accommodate for its demand by creating “starter kit” packages for some university students, but could not do the same for high school students as they do not have the contact information of high school

teachers. [6] The sales manager of Creatron, J. Chan, said that this unknown demand has caused the store to go out of stock on several occasions, and more information from their customers will improve their sales.

We also interviewed a customer, B. Esanu, who tried to buy from Creatron only to realize that the product that she was searching for was out of stock. To meet deadlines, she could not order online, and was therefore inconvenienced as Creatron could not adapt to the rise in the sudden demand of the product [4]. Both the salespeople and customers experienced were disadvantaged as the salespeople did not make money, and the customers did not get what they needed.

Reference Designs

Point-of-sales and perpetual inventory systems are commonly used to keep track of OOS. Point-of-sales has many benefits, including an accuracy level of 85% or higher, but often is not customizable for those with poor computing skills and lacks the capability to analyze delivery and quantity issues [1]. Perpetual inventory systems are sustainable and can be scaled but lack the on-hand accuracy provided by manual work, with an accuracy of only 32 to 45% [1].

We also looked into two alternatives to traditional point-of-sales and perpetual inventory: completely manual auditing and RFID tagging systems. Manual auditing is highly accurate if the worker is careful, but is expensive and hard to scale, making it an unsustainable long-term solution [1]. RFID tags, which track stocking data to compare to sales data, have been proven to reduce OOS by up to 16% for Walmart stores, but remain an inaccessible solution for smaller store owners due to their cost [1][3]. Since items are not tagged individually but by case or pallet, the system also fails to account for partially emptied cases, which can cause inaccuracy [1].

The four aforementioned solutions each have their flaws which leave much room for improvement in inventory and demand analysis.

Stakeholders

Stakeholder	**Stake**
Store personnel	• Quantity of sales determine if company is able to stay in business, and if employees can be paid. • Sales affected by whether demand can be predicted effectively and store supply is able to match demand well [1][2].
Student customers	• Purchase certain products in groups. If supply does not meet the demand, there will be a shortage and some students are unable to acquire necessary parts [4].
Teachers/Professors	• Can affect demand through projects they announce. If they cause too much demand, their students may not be able to easily acquire the necessary parts [4].
Other customers	• Also play a role in affecting demand based on what parts they need. Trends change over time, affecting demand [5]. As Creatron tries to predict this demand, customers are affected by whether these predictions are correct.

Manufacturers	• Produces and supplies Creatron with parts based on what Creatron predicts the demand will be. If predicted demand is high, Creatron will stockpile more in anticipation. The converse is true if demand is predicted to be low [1].
Competitors	• If Creatron is unable to attract enough interest through advertising, prices, etc. or supply enough to satisfy demand, other retailers will be able to take advantage [1].

High Level Objectives:

1. To enable stores* to supply for all customers when demand for a certain product is irregularly high while meeting physical space and cost constraints.
2. To enable store managers** to forecast the demand of products.
3. To maximize profit in the long term for the store.

* - a retail establishment selling items to the public, in-person and online.
** - persons responsible for restocking inventory

Detailed Objectives:

1. Develop a method of effectively tracking demand for all products.
2. Provide a channel for business-to-customer* and customer-to-business communication.
3. Provide a method for store managers to identify patterns in demand for products.
4. Provide a method for store managers to analyze patterns to forecast demand for various products.
5. Enable store managers to effectively restock inventory based on predicted demand - use extrapolations to determine in-store supply status for all products.
6. Enable store managers to always have products readily available to increase customer satisfaction.

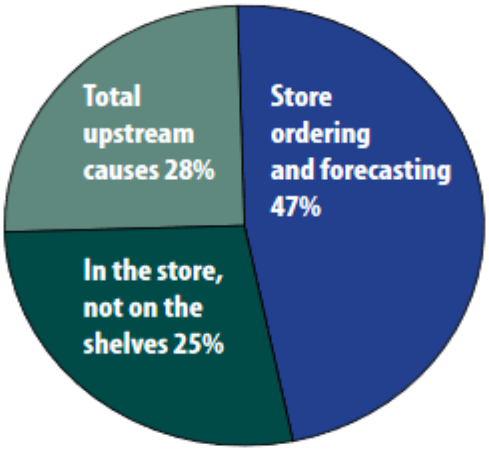
* - a party which dictates product demand; a robotics teacher determines when a project will be assigned which dictates the demand of motors at the local electronics store. Therefore, the robotics teacher is the customer.

Appendix

Figures:

Figure 1: Root Causes of OOS [1]

Figure 3: Root Causes of OOS

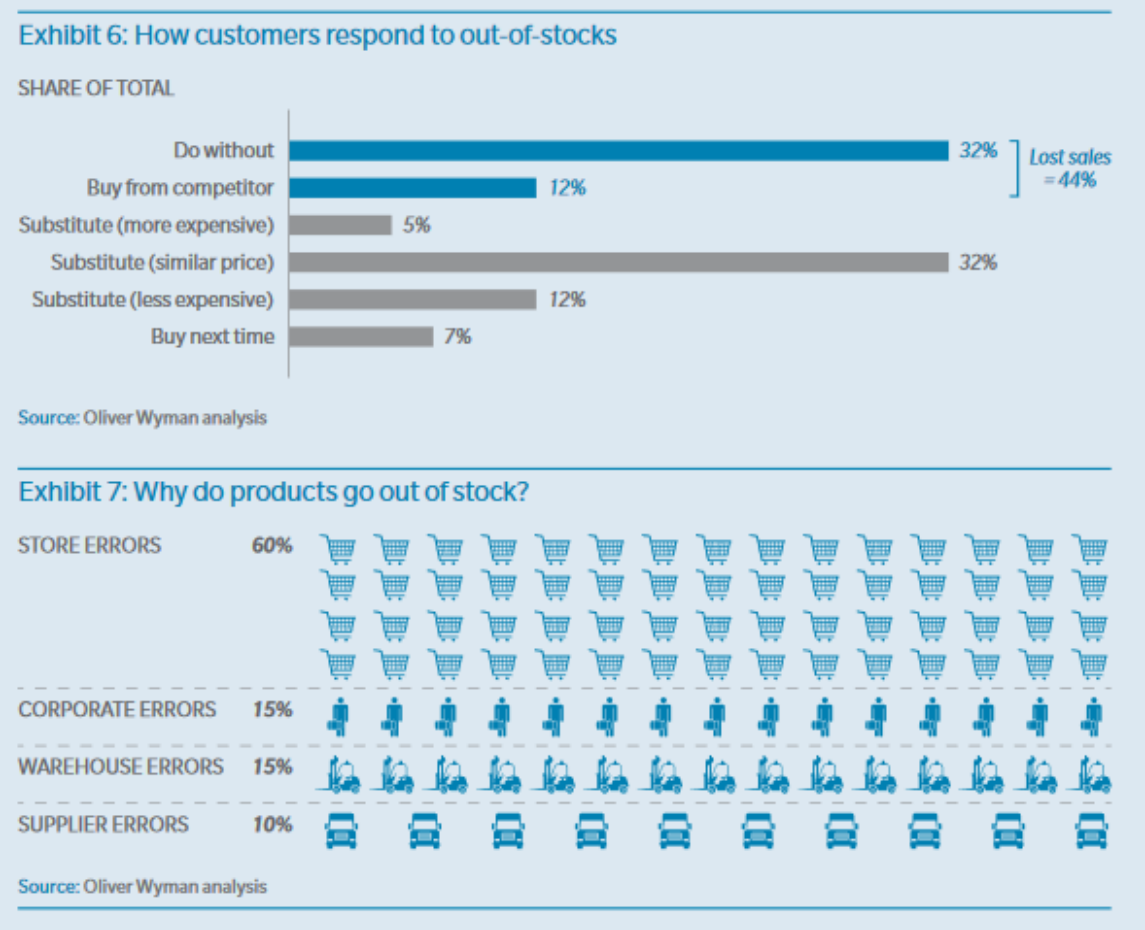


Credit: Gruen, Corsten, and Bharadwaj 2002

Figure 2: Factors Impacting Inventory Systems [2]

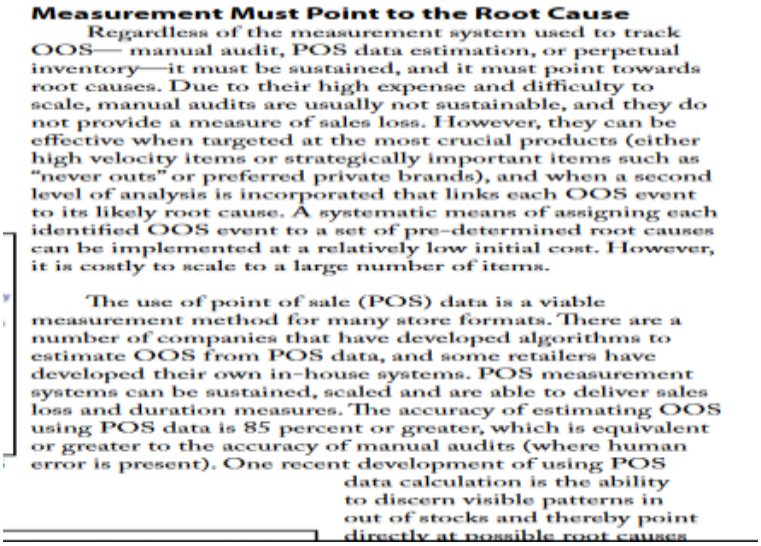
TYPE	ROOT CAUSE AREA	ISSUE DESCRIPTION	Usable Solution
Store Based Out of Stocks "Ordering"	Data Accuracy	Product data is inaccurate; perpetual inventory is inaccurate; POS data is inaccurate.	• Fix product data through data synch • Improve PI accuracy • Review POS scanning practices
	Forecast and Order Accuracy	Sales forecast is understated where OOS are unknown/not adjusted for in sales history. It is overstated where SKUs in history benefited from switching due to OOS from other SKUs. Demand forecast starts with the errors unknown from the sales forecast and attempts to estimate true demand based on unscientific judgment.	Add back measure of lost sales • Due to OOS in the estimate • Due to poor execution • Due to Data Synch errors
	Order Quantity	Demand forecast adjusted by inventory quantity which is frequently inaccurate.	• Enhance PI accuracy • Follow CAO recommendation for safety stocks level • Don't hide product • Use RFID to track cases and pallets
	Replenishment	Delivery cycle is too infrequent to match demand for fast moving items; quantity is different from order; delivery arrives late	• Adjust delivery cycle to meet most "stressed" items • Monitor delivery frequency and timing

Figure 3: Responsibility for and Response to OOS [2]



Research

[1] Corsten, Daniel and Thomas W. Gruen. "A Comprehensive Guide To Retail Out-of-Stock Reduction In the Fast-Moving Consumer Goods Industry." *Procter & Gamble Companies.* 2007. Web. http://www.nacds.org/pdfs/membership/out_of_stock.pdf



Measurement Must Point to the Root Cause

Regardless of the measurement system used to track OOS— manual audit, POS data estimation, or perpetual inventory—it must be sustained, and it must point towards root causes. Due to their high expense and difficulty to scale, manual audits are usually not sustainable, and they do not provide a measure of sales loss. However, they can be effective when targeted at the most crucial products (either high velocity items or strategically important items such as "never outs" or preferred private brands), and when a second level of analysis is incorporated that links each OOS event to its likely root cause. A systematic means of assigning each identified OOS event to a set of pre-determined root causes can be implemented at a relatively low initial cost. However, it is costly to scale to a large number of items.

The use of point of sale (POS) data is a viable measurement method for many store formats. There are a number of companies that have developed algorithms to estimate OOS from POS data, and some retailers have developed their own in-house systems. POS measurement systems can be sustained, scaled and are able to deliver sales loss and duration measures. The accuracy of estimating OOS using POS data is 85 percent or greater, which is equivalent or greater to the accuracy of manual audits (where human error is present). One recent development of using POS data calculation is the ability to discern visible patterns in out of stocks and thereby point directly at possible root causes

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A third approach to measurement, perpetual inventory (PI) measurement systems can also be sustained, scaled and deliver sales loss and duration measures. However, PI systems suffer from the lack of on-hand accuracy necessary to make them consistently good measures. Algorithmic

Root Causes and Solutions

Moving from left to right across the trapezoids shown in Exhibit A, we researched seven key, different root causes and solution areas.

1. **Product Item Data Accuracy**. Product data inaccuracy creates an unstable foundation for ordering and forecasting. Commonly referred to as "data synch," there are clear impacts on out of stocks when product data issues are excessive. The primary recommendation focuses on collaborative synchronization of data between suppliers and retailers using a third party vendor. We also show how the use of a parent-child product relationship system can enhance product data accuracy.
2. **Ordering and Inventory Accuracy**. We identified a variety of store issues that create PI system inaccuracy (especially on hands). The level of PI inaccuracy was stunning, as PI accuracy (where the PI exactly matched the on-hands) ranged from 32 percent to 45 percent in the four studies we conducted or examined. Exhibit D shows the distribution of PI accuracy for the best case we encountered. Phantom inventory (when PI system on-hand is greater than true physical product on-hand) is a major cause of OOS, particularly store OOS, because the reorder system does not recognize how low store inventory levels are. For the retailer shown in Exhibit D, items with correct on-hands had OOS event rates of 4.1 percent and had a rate of 8.9 percent where on-hands were not accurate.

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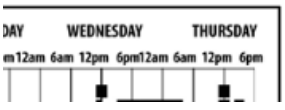


3. **Demand Forecasting Accuracy.** Ideally a demand forecast should be the same as a sales forecast, however they invariably differ, largely because of the impact of sales variances caused by OOS. Whenever a shopper does not buy or shifts their buying pattern due to an OOS, it adjusts the demand history away from the sales history and no one can see the true demand history. Merging POS lost sales history with the sales history can more closely represent true demand and lead to better demand forecasts. When we further examined the impact of individual store managers adjusting merchandising quantities from suggested computer assisted ordering (CAO) quantities, we found that store personnel underperform even imperfect CAO demand forecasts.

RFID Technology and Shelf Out of Stocks

Due to technological and financial reasons, most radio frequency identification (RFID) applications have been limited to tags on pallets and cases and have not descended to the individual item level, where RFID shows great promise to address shelf OOS. However, at the case and pallet level, RFID applications can track when the cases are delivered to the store's backroom, and when they move from the backroom to the store floor and vice versa. As a result, RFID has been shown to reduce shelf OOS for high velocity items that require that the store hold large levels of backstock. RFID applications can enhance sorting of cases coming off a delivery truck. Items that are known OOS get identified quickly for immediate stocking, while items that are still available to the shopper but have room on the shelf for a full case get secondary attention. Cases that are back-stock remain in the backroom, rather than being taken to the sales floor and returned. RFID requires disciplined shelf stocking practices. A case that cannot be completely stocked on the shelf becomes a problem when returned partially full because the RFID does not recognize a partial case in the backroom. In addition, RFID is being effectively applied to recognize shrink at the case level, where the impact of unrecognized shrink can have a large effect on OOS due to its large impact on inventory inaccuracy.

In sum, there are a variety of reasons, but we have identified the primary reasons:

- Demand forecasts are made with incomplete information, and thus often under-estimate demand;
- Inaccurate data from inventory systems provide incorrect ordering information;
- Traditional retail practices such as using only case-pack size to determine shelf allocation (86 percent of the dollar inventory on the shelf represents more than 7 days of supply) prevail, choking shelf space from the relative few fast movers, without consideration of time of supply;

Inventory record inaccuracy is a substantial problem for retailers using automated inventory management systems. Overall we found in our research that inventory records match actual inventory on-hand at a surprisingly low rate. In spite of large investments by retailers in perpetual inventory (PI) systems that link to POS systems, physical audits consistently show that PI data are typically accurate for less than half of the items in the store.

Accuracy can work two ways, with the actual on-hand inventory exceeding the recorded inventory level, or the actual on-hand inventory lower than the recorded inventory level. The physical audits show that about half of the time the PI shows more inventory to be in the store than is actually on-hand (referred to as "phantom" inventory), and that about half of the time the PI shows less inventory to be in the store than is actually on-hand (referred to as "hidden" inventory).

[2] "Optimizing Store Operations." *Marsh & McLennan Companies.* October 2015. Web. www.oliverwyman.com/content/dam/oliver-wyman/global/en/2015/oct/OW_Optimising_Store_Operations.pdf.

Poor on-shelf availability 	Out-of-stocks are often caused because automatic or semi-automatic ordering systems are too complex and ordering tools for staff are not helpful; hence sales may not be backed by sufficient supplies.	Screen most common reasons for out-of-stocks and check forecasting systems and inventory tools for weaknesses – if possible adjust system parameters and simplify tools. See Case Study 3.

CASE STUDY 3

REDUCING THE NUMBER OF OUT-OF-STOCKS

THE CHALLENGE

High product availability is a key driver of satisfied customers and prevents a loss of sales (Exhibit 6). The reasons for out-of-stocks can be many and varied. At one particular retailer, while 60% of out-of-stocks were caused by the stores themselves (for example, by problems with replenishment, manual order management, or shelf maintenance), 40% of all out-of-stocks had their origin in head office processes (Exhibit 7).

THE SOLUTION

Head office made adjustments to the product forecasting systems, optimised delivery frequencies, and delivered better tools for inventory management. In-store training complemented the improvements and allowed all employees with an influence on availability to role-play the most critical scenarios and to learn new tips and tricks to avoid out-of-stocks.

THE OUTCOME

On-shelf availability increased by several percentage points, especially during critical periods such as before national holidays or events. The improvements made to the automatic forecasting systems resulted in fewer manual interventions being required. Overall, the process for restocking and replenishing became much leaner.

[3] Roberti, Mark. “EPC Reduces Out-of-Stocks at Walmart.” *RFID Journal*. Oct 15 2005. Web. http://www.rfidjournal.com/articles/view?1927/

The RFID-enabled stores receive SKUs tagged at the case and pallet level from either Wal-Mart's own distribution centers or directly from suppliers. The improvement in out-of-stocks comes from using RFID to monitor how many cases have arrived at the store and how many have been brought out to the shelves, then comparing that information with how many items from those cases have been sold (Wal-Mart uses conventional point-of-sale data to determine sales).

For example, if each case of Pantene shampoo holds 24 bottles and the shelf can hold 48 bottles, Wal-Mart can determine that a shelf is close to being out of stock when 40 bottles or so have been sold. Pantene shampoo is then automatically added to a list of SKUs that must be picked from the back room and brought out to the shelves, or "merchandised." (The processes involved in detail in a case study published in the March/April 2005 issue of RFID Journal magazine, which is available online to premium content subscribers. See Wal-Mart Tackles Out-of-Stocks.)

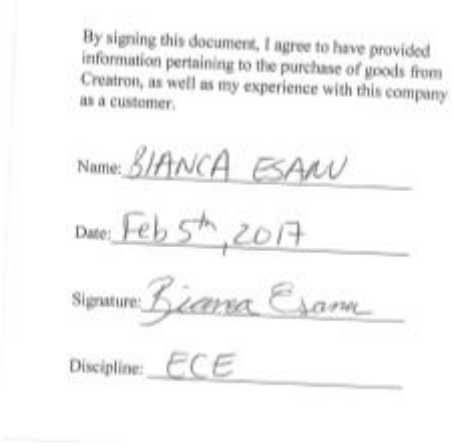
The study found that automatically creating these pick lists, rather than having associates walk around and add items whenever they found an empty shelf, resulted in SKUs tagged at the case level being replenished three times more often than untagged SKUs. Moreover, it reduced in-store inventory by reducing the number of times an associate placed an order for more cases when cases were already somewhere in the back room.

"With the RFID-enabled stores, we alert them to the fact that there is product in the back room, and that they should merchandise that first before ordering more product,"

[4] Interview with customer (Bianca Esanu):

- *From Marc Garneau Collegiate Institute*
- *Visited store for school project*
- *Did not find everything they were looking for due to unexpectedly high demand*
- *Could not order online, shipping takes too long and project has a deadline*
- *Lose - Lose*
    - *Customer did not get what they needed*
    - *Store did not profit from the interaction, may have lost a customer due to lack of customer satisfaction*

Evidence of Interaction:



By signing this document, I agree to have provided information pertaining to the purchase of goods from Creatron, as well as my experience with this company as a customer.

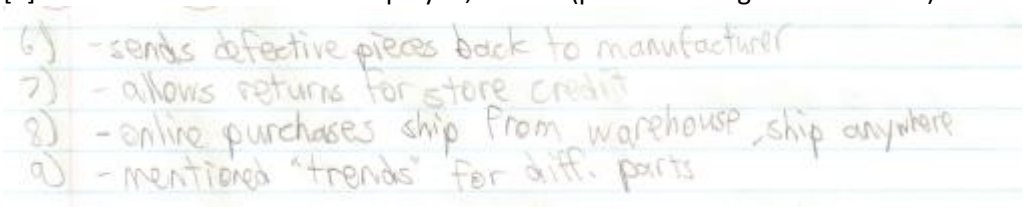
Name: BIANCA ESANU

Date: Feb 5th, 2017

Signature: Bianca Esanu

Discipline: ECE

[5] Interview with Store Employee, J. Chan (portion of original field notes):



6) - sends defective pieces back to manufacturer
7) - allows returns for store credit
8) - online purchases ship from warehouse, ship anywhere
9) - mentioned "trends" for diff. parts

[6] Interview with Store Employee, J. Chan (portion of original field notes):

Customers:
students in university and high school
- University of Toronto
- Ryerson University
- OCAD

Communication with customers:
Starter kit for universities
- Know about the components needed for University projects
- Group required component as a kit to be sold as a package

Does not have starter kits for students in high schools
Because:
- Too many high schools
- High school curriculum relatively unknown because it changes year to year

An incident from last year:
Students from Marc Garneau CI bought out all strain gauges from all Creatron branches in Toronto