Supply Chain Sovereignty and the Implementation of RFID: Daniel's Flowers Inventory Management Quandary, Inventory Shrinkage and Depleting Profits

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Abstract

Radio Frequency Identification (RFID) is increasing as a supply chain management tool. This case study gives students an introduction to RFID and its use in a perishable commodity environment (in this case, flowers). It depicts a real enterprise (Daniel's Flowers in Manhattan New York) and how implementing an RFID supply chain control system enabled the company to save money through better control of inventory. For students, it shows how a fairly simple technology solution can be used even with a small business.

Keywords: RFID, supply chain management, inventory control, small business

Case: This article is a teaching case. Additional teaching notes and materials for instructor's area available for EDSIG members at: http://jisar.org/restricted/.

1. INTRODUCTION

Daniel dimmed his office light and buried his face in the palms of his hands. It was 9pm on Friday night and he was still at work. In fact, Daniel knew the predicament ahead was going to take diligent thinking and steadfast research.

Daniel Banks is the founder and president of Daniel's Flowers, a premiere Manhattan based florist. The monthly staff meeting just hours earlier left Daniel restless. The inventory manager, Thomas Smith, presented the staff in attendance with a spreadsheet depicting startling inventory waste problems and as Daniel continued to read, a grand concern began to plague his thought process. According to a three month long inventory control project, it was now evident that Daniel's Flowers wastes, on average, $2,000 in inventory every month. This figure had adverse effects on profitability, which had steadily declined from past quarters. As Daniel locked the door to his flower shop he knew sustainability was inconceivable without immediate changes to his inventory management strategies.

Origination and Company History:

Founded in January of 1995, Daniel's Flowers serves the New York, New Jersey, and southern Connecticut area for all special occasion and party needs. Located in midtown Manhattan, the firm is centrally located to serve in all three state markets. Daniel's Flowers is most known for its flower arrangements found in extravagant weddings, Bar/Bat Mitzvahs, and seasonal parties. One of the firm's notable core competencies is its ability to build off design arrangements while working closely with any budget. Shortly after defining this strategy, Daniel and his panel of consultants developed the Budget Management program where the carefully constructed computer profit analysis model explains in cost and material how many flowers a client can purchase given a certain budget. The program is also cognitive of all margins, ranging from 20%-50% profitability levels. (Please view exhibit 2 for a budget management example.) The program has seen tremendous success and customer satisfaction has never been higher.

Inventory Management

Boxes of fresh flowers are flown into New York City airports on a weekly basis from flower farms throughout the world. Flowers come from as close as California and as far as Australia. The flowers are flown in temperature-controlled compartments and transported to the store in a temperature-controlled van. Immediately after being unloaded, the boxes of flowers are inventoried and checked against the week's master order form, and promptly placed inside one of the two large refrigerators. This process takes roughly 30 minutes per fifty boxes. On average, 150 boxes of flowers are ordered weekly. Smith, the store manager, and typically one other employee complete the task.

The Monday after a busy party weekend, the refrigerators are thoroughly cleaned and the reorder process quickly begins. Average reorder lead-time for roses, daisies, tulips and regular greenery is roughly one week. Exotic flowers like lotus or cherry blossom take on average 20 days.

Smith had noticed that boxes of fresh flowers are wasted on a weekly basis for no other reason than the staff does not know they are in the refrigerator. Smith recounts on one example, "when dealing inventory that has a very short shelf life, if the inventory is not used before its expiration, the inventory is wasted. About two years ago there was a shortage of red roses for Valentines Day." Smith continues, "Early morning orders were not affected by the shortage but afternoon and evening orders were not filled. Because the beginning inventory of red roses were spoiled, our safety stock was exhausted earlier than expected. Customers were unhappy, orders were not filled, and on a historically strong day for flower sales, our company performed sub par."

The store has two 150-square-foot refrigerators where the flowers are stored in boxes, or water buckets until they are made into arrangements, boutiques or centerpieces. Once the flowers are spoiled, they are not useable for sale and are discarded accordingly. After completing the analysis of inventory control, Smith found that on average, the store discards four boxes of flowers per month (one per week) for a total summing to roughly $2,000 weekly.

The problem started with the following flawed process: Without checking stock inventory, the store's manager orders flowers for all occasions. This is done in accordance with the aforementioned discussed lead-time. Daniel outsourced the cold supply logistics of his perishable inventory after an entire order of rare flowers was spoiled in transit. He now ensures all flowers are transported in a climate controlled fashion. This was the first step to prohibit supply chain spoilage. Still plagued by inventory management issues, Daniel began to analyze other computer information systems solutions.

New Industry Trends

Globalization and the widespread practice of outsourcing have increased the rate of rapid growth and expansion in global supply chains.

A supply chain is defined as the flow of goods from tiers of raw materials to finished products through the support of distribution channels, commonly found in producers, manufacturers, wholesalers, and dealers. The end result in a supply chain is providing the customer with a finished good for purchase.

Because the speed and efficiency of global supply chains has briskly increased, the need for an automated supply chain tracking system has never been greater. Implementation of a radio frequency identification (RFID) supply chain management system has become a common practice in the supply chain of perishable goods.

2. RADIO FREQUENCY IDENTIFICATION EXPLAINED

Radio Frequency Identification (RFID) is an information system that enables the accessibility of key characteristics of good within a supply chain system. When coupled to an inventory management system, RFID can automate the data flow of goods in a business system. Through real time databasing, businesses are given a cutting edge look at the data they are using, selling, or stocking. RFID has been used in a wide variety of industries such as transporting perishable, farmed crops, warehousing of dry bulk goods, and administering proper medical procedures and medicines in hospitals (Jedermann, Ruiz-Garcia, and Lang, 2008). Its uses are flexible and versatile. According to Jedermann, Ruiz-Garcia, and Lang (2008), "RFID has been successfully applied to logistics and supply chain management processes because of its ability to identify, categorize, and manage the flow of goods and information throughout the supply chain." This quotes helps to explain the resourceful value in RFID. RFID systems consist of three focal elements: a transponder, a reader and a transmitter. A description of RFID types is below. (Jedermann, Garcia, and Lang, 2008).

(a) Active RFID Tag – Battery powered signal, does not rely on reflection

(b) Passive and Semi Passive RFID Tag – Sends data by reflection or modulation of the electromagnetic field emitted by a reader.

RFID tags have the encrypted ability to present information based on characters of the physical goods. Unlike an antiquated stock keeping unit (SKU), RFID has the ability to track time and date of warehouse departure, temperature of storage facility or temperature of the vehicle while in transit. This technology can even allow outsiders to gain insight to what is in a closed box. Most importantly, all of this information can be transmitted, real time, through the use of a transponder and transmitter. RFID is non-restrictive to any industry and works cohesively in the most diversified of corporate and non-corporate settings (Jajima, 2010). Additionally, corporations operating with perishable goods and cold supply chains where shelf live is limited have adapted RFID (Karkkainan, 2003). Through RFID implementation, stronger supply chain control has been established and cost saving strategies are put into fruition.

RFID has played an increasing role in the management of the perishable goods supply chain (Lee, 2006). Exhibit 1 displays the affect of RFID through times of increasing demand levels. When demand increases, the cost savings from RFID continuously increases. It is easy to surmise that revenues and profits also increase during these periods too (Lee, 2006).

In smaller businesses, the lost value of spoiled inventory can be detrimental to year-end profitability. As shown in the global supply chain of temperature controlled industries, such as the agricultural and horticultural industries, temperature controlled supply chains determine the salability of the transported goods. Explained by Martinez-Sala, Egea-Lopez, Garcia-Sanchez and Garcia-Haro (2009), "Controlling the temperature of perishable products along the supply chain (cold chain control) is an important issues for both sanitary and economic reasons." If food spoils along the supply chain money is wasted and shrinkage occurs. The introduction of RFID along the perishable supply chain has enabled producers, suppliers and retailers to monitor temperature controls, shipping dates, and arrival times. Furthermore, "Technology like RFID will enable an efficient administration of both the quantity and the age of the

inventory in the system." (Brockineulen & Donselarr, 2009) RFID has shaped the supply chain of perishable goods and permits necessary surveillance of goods in transit.

3. LITERATURE REVIEW

Perishable goods are defined as ingestible foods or agricultural goods such as plants and flora. Inventory managers are concerned with a dual threat that continuously plagues the supply chain of perishable goods. The first main concern is fluctuations in temperature while goods are in transit, and the second is shrinkage while goods are inventoried in the place of sale. The use of radio frequency identification in the supply chain of perishable goods attempts to dispel concerns that perishable goods will spoil while moving throughout the supply chain.

According to Liu and Pei-Huang (2008), "A RFID system can communicate with products and update the data on RFID tags simultaneously." Because supply chain efficiency and precision are imperative when dealing with perishable goods, the real time transmission of data such as time of origin, freshness dating, and temperature play an important role in determining whether or not the goods are usable. The authors continue, "…The technology provides opportunities in the automation of the data capture, product item visibility, and particularly the business process transparency and integration, which will greatly improve the management of perishable food." Without RFID, the perishable goods industry would resort to antiquated measures of data capture. Shelf life of perishable products is limited and new controls, such as temperature monitoring need to be instated (Liu & Huang-Pei, 2006). Arguably the most beneficial attribute of RFID in the perishable goods industry is "…end-to-end traceability in the supply chain" (Kelepouris, Pramatari, & Doukidis, 2007). Tracking perishable goods along the supply chain can prevent sickness, and ensure the customer is receiving a fresh product for use or consumption. Without RFID, tracking goods negatively influenced by time is troublesome.

While in transit on the supply chain, the biggest risk to perishable goods is fluctuation in temperature levels. Operators of transportation companies are regularly faced with a challenging feat: how to deliver goods without risking contamination or spoiling? (Jederman, Ruiz-Garcia & Lang, 2008) This problem has been assuaged by the integration of radio frequency identification systems. Jedermann, Ruiz-Garcia & Lang (2008) report new developments in semi-passive RFID systems called shock measurements, which portray new break through advances in RFID technology. This system of electronically controlling temperature is becoming an industry norm.

RFID is not only restrictive to use while perishable goods are physically moving along the supply chain (Ranky, 2006). Because the supply chain does not end until the customer has taken ownership of a good, store inventory is considered another section of the supply chain where RFID is used and can assist in bettering the provided products. One of RFID's greatest attributes is its ability to provide inventory managers with an updated report of the firm's inventory. This can be achieved at a moment's notice.

> One of the underlying assumptions in the formulation of classical inventory problems is that there are no anomalies in the expected physical and information flows and as a consequence, the inventory manager operates with accurate inventory records. In real practice, due to failures in operational processes, this assumption may not be verified, resulting in poorer performance. (Rekik et al. 2009)

Managers using inaccurate information when assessing inventory can potentially lead to ordering too much (overstock) or too little (stock out) inventory. In some detrimental cases, assessing inventory from inaccurate sources can lead to the sale of perishable goods that are not safe to consume nor safe to sell. Legal compliance because of national and international government regulation has provided managers with necessary cause to implement new RFID technologies. As further government demands for real time data transmission is enforced, RFID stands alone as the single technology to deliver real time data (Jones et al., 2005). A problem identified by

Karkkainen (2003) is the threat of shelf life restrictions on the sale of perishable goods. Continually, "Spoilage is an additional problem in the short shelf-life product supply chain, and it is caused principally from excess stock and flawed stock rotation" (Karkkainen, 2003). In this situation, mismanagement of perishable inventory can lead to astronomical period costs. Karkkainen (2003) argues that perishable inventory needs to be sold before freshness dates expire otherwise waste and spoilage will ensue. Through the transmission of RFID generated reports, managers are able to make proper stocking decision that will help decrease the amount of spoiled perishable goods. Implementing an RFID system saves money lost by inefficient supply chain management systems.

Regulation and RFID

Capital investments have negative repercussions and Daniel did know that the perishable goods industry is moving towards radio frequency identification based system of computing and managing inventory. Because of new legislation brought forth by both the European Union and the Food and Drug Administration (FDA), firms are mandated to present documents stating place of origin and final destination for most consumable goods. Abad et al. (2009) provided an excerpt from the EU's direction on proper perishable goods industry norms. Firms must possess "the ability to trace and follow a food, feed, food-producing animal or substance intended to be, or expected to be incorporated into a food or feed, through all stages of production, processing and distribution." Furthermore, firms are striving to achieve the International Standard Organization (ISO) levels of managerial and logistical excellence. As a result, firms need a competitive advantage to aid in compliance across all facets of regulation. The industry trend shows a technological shift toward RFID capabilities. Daniel understood that this did not directly translate into an increase bottom line for his firm, but he thought if the most complex firms were implementing and seeing success from RFID, then there was no reason why his business plan could not adopt an RFID infrastructure.

4. SOLUTION TO DANIEL'S FLOWERS PROBLEM

Daniel called Thomas into his office and asked him to sit down. It was now Monday morning and Daniel spent the weekend observing inventory controls on the existing inventory. Again, the refrigerators were cleaned and flowers were disposed. Smith started the conversation. He exclaimed, "Over $500 per week is spent on flowers that inevitably end up in the garbage!" He continued, "…if the store can implement a system where automated inventory updates are provided before new orders are placed, the company could potentially save $2,000 per month or almost $24,000 per year." Costs saving strategies naturally pique the interest of business owners and Daniel is no exception. He began by investigating alternative options for his firm.

Daniel spent hours toiling with his predicament when his analysis led him to radio frequency identification. During the next staff meeting, Daniel excitedly, pitched the idea to his colleagues… "RFID is a three step system that enables us to have an instantaneous, real time view of our inventory. I surmise we will not order unnecessary inventory nor will we allow inventory to spoil through implementing the system. The store will be able to order flowers in accordance with existing inventory." He continued, "the installation seems rather simple! A transceiver, installed on the doorway of the refrigerator, will transmit a message to the company's intranet database every time a box with an RFID tag enters or exits the refrigerator."

The idea is predicated on the theme of obtaining a real-time picture of inventory. Why spend money on expensive inventory when stock already exists? Another key attribute of the system is that the oldest inventory is used first. This system mimics the accounting principle of "FIFO" where the first item inventoried is the first item to be sold. While the idea seems like a possible solution for Daniel's Flowers inventory woes, many coworkers were naturally skeptical. For the majority of the skeptics, project cost and learning curve were of concern. It is certainly tough to justify project cost without conducting

further investigation. A business development team was formulated and investigation began.

Business development found an RFID wholesaler on the Internet selling RFID tags for $.25 each and new tags can be created daily. The transceiver for the refrigerators cost roughly $500 total and having a qualified technician install the transceiver and necessary software costs approximately $700 (a couple days of labor). The project cost-to-benefit analysis is outlined in exhibit 4.

After making a few phone calls to local RFID experts, the installation occurred. Different identifiers were used for different flowers. The computer database was arranged so different colors indicated different types of flowers. Preprogrammed codes on the RFID tag enabled the database to segment the same type of flowers in different colors. The database stored all necessary information in an Excel spreadsheet. When Smith needed to place an order for flowers, he consulted the inventory spreadsheet first.

The initial investment for the project was less than $2,000. Daniel was baffled when he offset the cost of the RFID system in saved inventory within the first three months after the RFID system was installed. Daniel's Flowers was able to save over $15,000 in the first year of operation with its new RFID system. Most importantly, through the implementation of the RFID system, Daniel was able to sustain his perishable goods supply chain!

5. CONCLUSION AND THE FUTURE OF RFID

As new advances in the RFID passive and non-passive chip evolve, more firms are going to integrate RFID tracking in their supply chains. Whether perishable goods are moving in transportation, sitting as inventory, or awaiting departure in procurement, the benefit of RFID is its adaptability throughout all modal areas of the supply chain and logistics (Jajima, 2007). RFID benefits include real time automation of supply chain traits such as date and time of shipping, origin of oods, weight of package and average temperature of package (or palate). While RFID is not a new technology (Jajima, 2007), significant advances in supply chain management have triggered continuous advances in the use and capabilities of the RFID chip, especially in perishable or cold-supply chain uses. Radio frequency identification has become an industry norm. Nagia et al. (2007) argues that RFID "has emerged as part of a new form of inter-organizational system that aims to improve the efficiency of the processes in the supply chain." As a result, the cost of technology is decreasing and the capabilities of the technology are increasing. Soon regulatory bodies are going to enforce the use of RFID in the perishable goods markets. Similar to the inventory management solution at Daniel's Flowers, firms embracing the technological shift will continue to seek advantages and cost saving while firms without RFID capabilities will remain an antiquated figment of the past.

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APPENDICES

Exhibit 1:
RFID implementation during times of increasing demand

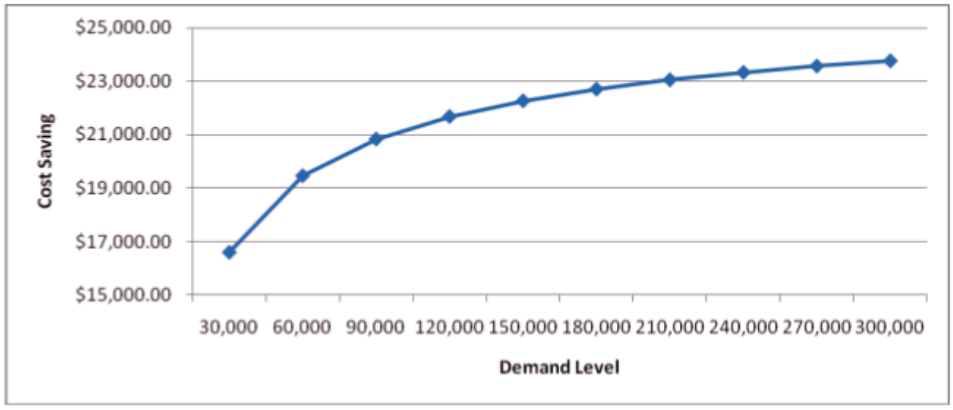

Exhibit 2:
Budget Management Program

Daniel's Flowers - Budget Management Seltzer/Lemon Wedding: May 25, 2011.
Ceremony: Westchester Reform Temple, Scarsdale, NY.
Reception: Cipriani, West 59th Street, NY, NY.

BUDGET			$5,000		
Main Flower	500	600	700	800	900
Greens	50	75	100	125	150
COST	$2,000	$2,500	$2,800	$3,100	$3,375
PROFIT	$3,000	$2,500	$2,200	$1,900	$1,625

Exhibit 3:
RFID System Implemented by Daniel's Flowers

Exhibit 4:
Daniel's Flowers RFID Cost/Profit Analysis

RFID Project Costs:

Tags:	(1000 x $.25) =	$250
Transceiver:		$500
Software/Install:		$700
Total:		$1,450

Refrigerators

RFID reader

Computer – tied to inventory database from RFID reader

Mock up of Daniel's Flowers storage and RFID reader / computer

Special thanks to Joshua Doonan for creating this mock up for us!!

Questions for students:

1) What are the main advantages of RFID over bar codes?
2) When receiving new inventory, how can Daniel's flowers accept the shipment without inspecting all flowers?
3) How can Daniel tell that the flowers were kept at the proper temperatures during shipping?
4) In inventory control of perishable goods, could RFID be used in other areas than flowers?
5) In recent years, there have been major food recalls for peanuts and peanut butter, eggs, tomatoes, spinach and eggs. If the specific items had been tagged with RFID devices could the impact of the recall be lessened?
6) This is a small business with one location. Does the investment in RFID pay off quickly? What is the ROI after two years?
7) What training do the employees of Daniel's Flowers need to use the RFID inventory system?
8) What are other uses of RFID chips / tags?
9) What might be the disadvantages of using RFID tags for a small business?