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Caryn Espy

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Sustainable Supply Chain Packaging

*Increasing Density for High Cube Low Weight Textiles*

A Capstone Project Submitted in Partial Fulfillment of the Requirements of the Renée Crown University Honors Program at Syracuse University

Caryn Espy

Candidate for B.S. Degree and Renée Crown University Honors

May 2009

Honors Capstone Project in Supply Chain Management

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Samuel Gorovitz

Date: __________________________
Abstract

This thesis explores techniques for efficient, sustainable packaging of high cube, low weight products. It is based on a project initiated at Macy’s Merchandising Group, a product development division of Macy’s Inc. The company challenged its interns to create an environmentally conscious business proposal that would also reduce expenses. This thesis is an extension of the original proposal.

As part of the production of soft goods at Macy’s, samples of each item are sent air freight from overseas manufacturers to the New York City headquarters. Sample shipping amounts to a significant expense because products are sent via air freight.

In the process of sample shipping, waste is produced as packaging, freight expense, and greenhouse gas emissions. To reduce this waste, companies can utilize vacuum sealing of samples for high cube, low weight products, such as comforters, throws, and pillows. This technique reduces the volume of products in a sealed bag with the use of an everyday vacuum cleaner. This technique can reduce the dimensions of products up to 78 percent, a way to significantly reduce the dimensions of shipments.

Vacuum sealing decreases shipping expenses because of the structure of air freight billing. When traveling by air, rates are determined by the greater of two weights, actual weight or dimensional weight. Actual weight is the product weight in pounds or kilograms. Dimensional weight is the length, width, and height multiplied together and divided by a dimensional factor (DIM) of 366 (though negotiable, this is a standard number across the transportation industry). The dimensional weight can be several times the actual weight, resulting in expensive charges for low density products. However, when the dimensions of products are reduced, it decreases dimensional weight and results in lower shipping expenses.

According to calculations, hermetically sealed samples will save over $35,000 in operating expenses annually. Savings increase significantly when applied to in-store product. The following research explores the strategy of vacuum sealing products and its implications for samples and in-store product in more detail.
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I would also like to thank my grandparents, who have taught me so many important life lessons. I am especially grateful to my grandmother, who always encouraged me to dream big and reach for the stars.

Additionally, I would like to thank Becky for sticking with me through all those late night study sessions. You are an understanding and supportive friend, without whom I may have not made it through many of my classes.

I would like to thank Mike, who encouraged my work on this thesis in the first place. Without your suggestions and support, I may never have started this endeavor. When there were obstacles and challenges, you were there to help me through them.

Finally, I would like to express my appreciation to my thesis advisor and reader, Professors LaPoint and Penfield. Thank you for your endless support and countless hours spent guiding me through this process. I really appreciate your dedication and encouragement. As both teachers and mentors, you have given me the foundation to begin my professional career in the supply chain field.
1. Introduction

This thesis was created from a project completed during an internship at Macy’s Merchandising Group (MMG), a division of Macy’s Inc. Working in product development I obtained knowledge about the design, development, and transportation processes of soft goods from initial conception to the finished product in-store. As part of a group of interns, I was challenged to create a cost-saving, green initiative for the company. Observing the vast amount of waste produced by daily shipments, my project team and I focused on minimizing packaging requirements. We created a proposal based on our research, obtaining information internally from key employees as well as externally from outside vendors. The proposal was well received by management and a pilot implementation project was created in Hong Kong. I was interested in further exploring how retail companies could make a difference in their carbon usage and at the same time favorably impact the bottom-line. I expanded my research and conducted interviews with a variety of retail establishments to further examine the issues involved in transportation waste reduction. This thesis is a summary of my research findings.
2. Objective

A division of Macy’s Inc., Macy’s Merchandising Group (MMG), develops private label merchandise. It operates several overseas offices enabling the division to keep in close communication with its suppliers, monitor production, and ensure product accuracy. This structure results in increased communication and process control, supporting Macy’s overall strategy to have merchandise at the right place at the right time.

MMG designs and develops a variety of soft goods such as apparel and home textiles. Early in the production process, samples of every product are produced at overseas manufacturers all over the world, including Hong Kong, Egypt, Taiwan, and many other locations. Samples, which can include fabric swatches or trims in addition to as many as five mock-ups of each product, are sent from the supplier to the closest Macy’s overseas office. They are then consolidated and sent daily to the New York City headquarters. As an essential step of the production process, samples are time-sensitive because final product must be on time to the stores. Therefore, all samples are sent air freight because it provides shorter transit times than ocean freight. Once received, samples are reviewed by the design and technical departments to ensure products are to the original production specifications. Any changes are communicated back to the overseas office and then to the manufacturer electronically. Figure 1 summarizes the flow of samples and information through the supply chain beginning with the overseas manufacturer, to the overseas offices, and finally to the New York City headquarters.
Figure 1: Flow of Sample Goods

Flow of samples and information from the manufacturer, to the overseas office, and finally to the New York headquarters.

The sample process described above is utilized to ensure the accurate and timely production of products. However, this flow of goods creates significant waste of corrugated (cardboard), plastic, and energy. Additionally, air travel causes harmful effects to the environment. Excess waste is particularly prevalent with home textiles. Products in this category include comforters, pillows, and throws as well as other bedding items. Samples amount to a significant number of air shipments each day. The challenge, therefore, is reducing waste in the sample shipment processes in a way that will save money and be sustainable.

2.1 Hypothesis Statement

Reducing the dimensions of home textiles can result in a significant reduction of transportation expense as well as reducing the environmental impact that shipping samples presently creates.
3. Literary Review

Research conducted for this thesis is largely primary, but is supported by secondary sources. This section explores the existing sources on this subject as well as those used to support my analysis.

Retrieved April 2, 2009 from:

This article is the closest source to the research in this paper. It focuses particularly on blankets, exploring the effects of vacuum sealing on the product integrity. Products were tested under different conditions for the retention of fabric quality and the appearance of wrinkles.

http://www.hometextilestoday.com/article/CA6572466.html?q=supply+chain+shipping+costs

Marks discusses the advantages of domestic suppliers when transportation costs are on the rise. The piece discusses the high cost of shipping bulky products internationally, but does not suggest a way to reduce these costs.


In my personal interview with Sagan, a sourcing manager at IKEA, I learned about the company’s utilization of vacuum sealing and compressed packaging strategies. He discussed the main benefits and challenges of these types of strategies.


This thesis explores IKEA’s packaging systems in terms of logistics, marketing, and environmental practices. It takes a holistic approach to packaging in all product categories within this retailer.
4. Background

4.1 Home Textile Industry

The current economic downturn has reduced revenues for manufacturers and retailers in the textile linen industry. In 2008, sales in the top of bed category, which includes shams, duvet covers, comforters, bedspreads and quilts, amounted to approximately $2.67 billion, down more than 13% from 2007 (Rowen, 2009, p. 10). The chart below illustrates the decrease in sales in several bedding categories from 2007 to 2008.

Overall trends in the bedding industry are towards value driven products. Carmen Waite, Vice President of Bedding Merchandising, Spring Global U.S. stated: “The consumer is looking for value right now, so value products – those at lower price points – bed in a bag and open stock comforter products are doing

Figure 2. Source: Home Textiles Today

<table>
<thead>
<tr>
<th>Category</th>
<th>2007</th>
<th>2008</th>
</tr>
</thead>
<tbody>
<tr>
<td>Comforter / Bedding</td>
<td>$1,860</td>
<td>$1,575</td>
</tr>
<tr>
<td>Comforters</td>
<td>$565</td>
<td>$491</td>
</tr>
<tr>
<td>Bedspreads / Coverlets</td>
<td>$185</td>
<td>$176</td>
</tr>
<tr>
<td>Duvet covers</td>
<td>$74</td>
<td>$64</td>
</tr>
<tr>
<td>Quilts</td>
<td>$410</td>
<td>$363</td>
</tr>
</tbody>
</table>
well in a softer economy” (Rowen, 2009, p. 42). Blanket sales are also strong because they are seen as an investment to reduce heating costs (Rowen, 2009, p. 42). Figure 3 shows product categories as a percent of total sales of textile products in 2008.

![Figure 3. Source: Home Textiles Today](image)

Suppliers are feeling pressure to cut prices due to declining sales and requests from retailers. “The driving factor in business today is price…if a certain pillow normally averages for $20, its now $15, and if it used to sell for $10, now it’s $7” said Loren Sweet, President of Brentwood Originals (Corral, 2008, p. 9). Additionally, the liquidation of two companies, Linens and Things and Mervyns, is creating additional inventory at lower prices, further increasing the pressure for suppliers to cut prices to compete successfully (Corral, 2008, p. 9). Price declines hurt margins and profitability for a company, directly impacting profitability, or the bottom line. For example, Dan Scheckter, Vice President of Carpenter Co., the largest manufacturer of comfort cushioning in the world, expressed “lots of
misery on profitability and margin erosion, due to sale prices” (Rowen, 2008, p. 6). With the inevitability of lower prices in this type of economic climate, companies must look to decreasing expenses in order to restore margins and profitability.

Figure 4 shows the market share of different retail categories. Discount department stores took 41 percent of the market in 2008, up from 39 percent in 2007 (Rowen, 2008, p. 6). This demonstrates consumers’ preference for value, or quality products for a low price.

![Marketshare of Distribution Channels 2008](image)

**Figure 4. Source: Home Textiles Today**

In order to offer the prices consumers are demanding, many companies have looked to reducing costs. However, it is important to note that with consumers looking for value in this economy, reducing product quality is not acceptable. Designers are adding additional value by increasing the size of the pillow, adding embellishments, or changing the fabric to find inexpensive ways to
offer more at the same price (Corral, 2008, p. 9). In order to continue to be successful manufacturers must find a way to cut expenses without sacrificing the product’s integrity.

An emerging consumer trend in the household linens, bedroom, bath, and table textiles industry reflects the fact that consumers are becoming more comfortable buying products on-line. Direct to consumer sales grew 18.2% in 2007 (Rowen, 2009, p. 42). On-line sales present another opportunity to reduce packaging requirements and streamline shipping processes from suppliers direct to consumers.

4.2 Macy’s

Macy’s Merchandising Group (MMG), a division of Macy’s Inc., develops private label goods sold exclusively in Macy’s stores. Brands are produced to appeal to a wide range of consumers and include names like Alfani, Charter Club, Tasso Alba, Greendog, Epic Threads, First Impressions, Tools of the Trade, and others. As merchandised under the slogan, “Exclusively at Macy’s,” these brands offer higher margins and exclusivity for the company. Upper management’s strategy has emphasized the production of private label brands, which represents 19 percent of total sales or about $4.3 billion a year at retail (Macy’s Merchandising Group, 2008, p. 1). Private label development creates the opportunity for MMG to increase revenue.
4.3 Transportation Trends

In the past decade, communication technology, sophisticated supply chain techniques, and access to low cost labor and transportation made off-shore production appealing to many companies. As a seemingly easy cost-cutting measure, in practice, globalization has shown to have both benefits and drawbacks. For example, companies involved with overseas manufacturing have encountered issues regarding the complicated nature of an extended supply chain, longer lead times for production, increased inventory, and many hidden costs. These challenges combined with volatile fuel prices have caused companies to question whether foreign production is still beneficial to the bottom line. “This new environment is creating serious consequences for companies that import and export goods. Even companies that simply consume indirect or MRO [Maintenance, Repair, and Operations] materials are affected, as are retailers and other direct-to-consumer entities. In many respects, fuel cost is now the ‘universal influencer’ of business strategy and activity” (Gosier, 2008, p. 41). The continually changing external environment is calling the global supply chain model into question.

For example, price volatility has affected companies relying on goods coming from overseas. According to a study by the CIBC World Markets, the price of Pacific-purchased metric ton bunker fuel (fuel oil used on ships) nearly doubled from $296.16 in January 2007 to $582.82 in March 2008 (Gosier, 2008, p. 41). Furthermore, the price of an average forty-foot equivalent unit (FEU) container from Shanghai to the U.S. East Coast more than doubled from 2000 to
2008, rising from $3,000 to $8,000 (Rohter, 2008, p. 1). Any additional expense in transportation can significantly impact margins. “The 96-percent fuel-cost increase and the 266-percent cumulative effect of general rate increases, capacity recalibration, and ocean carrier pricing strategies are undoubtedly making a significant impact on the overall LCCS [low cost country sourcing] equation” (Gosier, 2008, p. 41). Rising transportation costs are eroding the margin gains achieved by outsourcing production. In order for many companies to continue their current strategy and remain profitable, transportation expenses must be reduced.

Another issue facing companies is the unpredictability of fuel prices. Transportation costs have been extremely volatile in the past few years. In fact, “It's expected that volatility will continue as every global action (terrorism, currency change, environmental, etc.) generates a price reaction. Where transportation cost was once assumed to be fully recoverable and an accepted advantage, the new reality suggests that fuel pricing will remain unstable” (Gosier, 2008, p. 41). Companies importing goods would benefit from relying less on unpredictable transportation costs. “Skill of execution and adeptness in these volatile markets will provide a competitive advantage that can drive sales and profitability. Logistics leaders will thrive with the new opportunities to manage Risk vs. Reward and find creative ways to manage the continued complexity in a global logistics environment” (Gosier, 2008, p. 42). Less reliance on fuel and transportation costs will assist companies in protecting their margins, directly impacting the bottom line.
4.4 Sustainability

Firms are increasingly adopting sustainability as a key component for future business. Governments, investors, insurers, non-governmental organizations (NGOs) and consumers are driving this change. “Whether or not one believes that global warming is a threat to the planet, it’s clear that consumers, in tandem with governments and even investors, expect businesses to become more environmentally conscious” (Robinson, 2002, p. 1). Whether it is because of reputation or potential cost-savings, environmental impact is increasingly becoming a component in decision making.

The 2002 World Summit on Sustainable Development in Johannesburg created the following definition for sustainability: “[A] collective responsibility to advance and strengthen the interdependent and mutually reinforcing pillars of sustainable development—economic development, social development, and environmental protection—at local, national, regional and global levels” (UN Department of Economic and Social Affairs, 2004, p. 1). Corporations have added another layer to this definition. According to Balvinder Kalsi, President and CEO of DuPont India: “Sustainable growth is creating shareholder and societal value while reducing our environmental footprint across the value chains that we operate in” (Kashik, 2008, p. 3). The dimension of shareholder value complicates decision making for companies. Projects that benefit the environment, such as installing solar panels to utilize renewable energy, are still not economically justifiable in the short term and do not provide shareholder return. This type of thinking often inhibits sustainable practices by companies.
Increasingly, firms have been able to successfully align business interests with environmental initiatives in order to satisfy its stakeholders. Additionally, businesses are beginning to link sustainable practices to future profitability or long-term viability. “The challenge that people around the world face today is simple: to continue living in a way that does not jeopardize future generations. That means ensuring that global warming does not accelerate, natural resources, including water, are not depleted, and the divide between the rich and poor is not deepened” (Kaushik, 2008, p. 2). It is vital that firms begin thinking in a sustainable way in order to retain their reputation among consumers, comply with government regulations, and continue to rely on ecosystem services.

The integration of environmental philosophy into business practices cannot be an isolated initiative. It requires dedication from upper management to become a core value within the company. A common strategy to integrate green principles into business practices is through process improvement, or lean philosophies. “By definition, lean proponents are taking actions to drive waste out of the manufacturing processes. And for companies aiming to shrink their impact on the environment, generating less waste and better waste management strategies are sure fire ways to help meet that goal” (Jusko, 2008, p. 41). Companies are increasingly using lean principles to reduce waste: 58 percent of companies are already implementing waste/packaging minimization, with 33 percent planning to implement these programs (Robinson, 2008, p. 1). Finding ways to innovate to reduce or minimize waste will lead to cost savings as well as lessening a company’s carbon footprint.
4.5 Transportation and the Environment

Emissions

Global warming and climate change has become a central issue in the world today. According to the Intergovernmental Panel for Climate Change (IPCC), global warming is anthropogenic: “Increased production of CO\textsubscript{2} by human sources has caused total GHG emissions to exceed natural absorption rates, resulting in increased atmospheric concentrations. Since the beginning of the industrial revolution, atmospheric concentrations of CO\textsubscript{2} have increased by nearly 30 percent, CH\textsubscript{4} concentrations have more than doubled, and N\textsubscript{2}O concentrations have risen by approximately 15 percent” (EPA, 2005, p. 3). Damages as a result of human activity are widely thought to be irreversible. Therefore, it is vital to reduce future emissions to mitigate future negative impacts to the environment.

The environmental impact of the transportation industry as a whole is 13% of the total green house gas emissions globally, as shown in the Figure 5. “Transportation petroleum use grew by 23 percent from 1990 to 2003 and accounted for 93 percent of the increase in total U.S. petroleum consumption over this period” (EPA, 2005, p. 4). Furthermore, there has been little progress in the area of alternative fuels: “The U.S. transportation sector derived all but 1 percent of its energy from fossil fuels in 2003” (EPA, 2005, p. 4). Decreasing fuel usage is essential for not only reducing the reliance on gas pricing, but also reducing the negative effects on the environment.
Figure 5. In 2004, transportation accounted for 13% of total greenhouse gas emissions globally. *Source: IPCC*

Specifically, airplane emissions account for 13 percent of the transportation sector’s CO₂ emissions, as depicted in Figure 6 (IPCC, 2001, p. 1). Airplane emissions include carbon dioxide, water vapor, carbon monoxide, hydrocarbons, particles, oxides of nitrogen, and sulfur compounds (ICAO, 2007, p. 106). “Aircraft emit gases and particles directly into the upper troposphere and lower stratosphere where they have an impact on atmospheric composition. These gases and particles alter the concentration of atmospheric greenhouse gases…and may increase cirrus cloudiness—all of which contribute to climate change” (IPCC, 2001, p. 1). It is estimated that CO₂ emissions as a result of aviation transportation amounted to 600 million tons in 2005 (ICAO, 2007, p. 105).
Demand

Demand for air transportation is out-pacing improvements in fuel efficiency, resulting in a negative net impact on the environment. This trend is expected to intensify in the future. In the past 10 years, demand has increased 4.5 percent year over year, compared to future demand, which is estimated at 5 percent per year through 2015 (Ross, 2008, p. 3). “Improvements in the energy efficiency of the aviation system have failed to keep pace with industry growth, resulting in a net increase in global emissions…Therefore, not only will the overall impact of aircraft emissions increase, but also the importance relative to the total climate impact” (Ross, 2008, p. 3).
5. Research Methodology

5.1 Methods Used

Environmentalism has taken center stage among policy makers, corporations, and the public. For consumers, it has become increasingly important that the places they shop employ green practices. Therefore, in order to retain their reputation and customer base, corporations have made environmental policy a component of decision making.

This study was a result of the green trend. In order to improve its environmental image, Macy’s challenged its interns to create a sustainable proposal. The project also had to positively impact the bottom line by reducing expenses or increasing sales.

During the 10 week internship, my intern group focused on packaging as a means to reduce costs and eliminate wasteful product. Analysis for the proposal was completed utilizing lean principles, often employed in environmental and supply chain fields. Lean principles focus on eliminating waste in a process. These tenants are effective in reducing costs and improving the environment by streamlining processes and eliminating unnecessary material. These principles provided the framework for this proposal.

5.2 Original Research Explanation

It is important to note that research for this project is largely primary. Secondary sources are used to support the claims made. The following discussion details my process in obtaining primary research for the purposes of this thesis.
The foundation for my research began in my semester abroad in Hong Kong. I began gathering the information and know-how necessary to understand the fundamentals of transportation. In the course of my internship at a freight forwarder, Cohesion Freight Ltd., I learned about the flow of goods from China to areas all around the world. I visited airports and ocean ports in several areas in Hong Kong and Shenzen. This included transportation trends, costing, and strategy. Figure 7 shows pictures taken during my internship of various modes of transportation.

![Image of transportation modes](image1.png)

**Figure 7.** Modes of Transportation in Hong Kong

Immediately after my return from China, I began my internship with Macy’s Inc.’s design and development department. During the production process of soft goods, samples of each product are sent air freight from overseas manufacturers around the world to the New York City headquarters. Sample shipping amounts to a significant cost, directly affecting the bottom line as an operating expense. It is part of the hidden costs of moving operations overseas, which may not have been considered by the design and logistics departments. The technique of life cycle assessment, which is a common tool in supply chain, considers the entire production process in decisions, instead of merely the pricing of a particular component, in this case, labor.
Noticing the inefficiencies in transportation and packaging of these samples, it seemed like a clear choice for my group’s green, cost saving project. Working with my team, composed of five interns from different disciplines, I was able to contribute my knowledge of freight billing and supply chain background. The group developed a plan to use vacuum sealing as a way for the corporation to save on transportation costs.

With a conceptual idea, the group set out to create a proposal to present to upper management. We began meeting with employees in the shipping, customs, supply chain, home, finance, and overseas departments to gain more insight and obtain feedback on the idea. We obtained data from these employees such as number of packages shipped per year, total freight transportation expense, dimensions of comforters, average daily shipment size, and others.

The group found very little already written on the subject; therefore much of our research is original. Our field work included contacting numerous vacuum sealing vendors and finding a business that would send us samples to perform tests of actual product. Storage Kaddy, a vacuum sealing bag vendor, offered to support our research efforts. We conducted our tests using several comforters, pillows, and throws produced by Macy's. We recorded before and after dimensions of both vacuum sealed and unsealed goods to calculate the difference in volume of the two groups.

The next piece of information we required was shipping rates from areas throughout the world. This was secured internally from large freight carriers that
Macy’s employed to transport their product. Using these rates as well as the dimensions in our in-house tests, we were able to calculate freight savings.

Our assignment required that we create a business proposal that saved money and was environmentally friendly. Therefore, we sought out information about sustainability to quantify the impact this procedural change would have on the environment.

We synthesized the information we gathered over a ten week period to create a presentation to the Vice President of Bedding and Vice President of Logistics at Macy’s Merchandising Group (MMG). The summation of costs incurred for logistics and product development as a unit had not been considered before. This report offered management a new way of considering how their off-shore productions policies impacted the environment as well as the bottom line.

Our presentation was well received and was accepted for implementation.

There were significant obstacles to the completion of this project. First, the proposal required a large scope of data obtained from many different employees. It was a cross functional venture, involving customs, shipping, finance, sustainability, overseas offices, and the home department as well as outside vendors. As a group, we met with more than twenty-four people multiple times both inside and outside the company over the ten weeks of our internship.

The bureaucracy of a large corporation presented its own challenges. We had difficulty securing data internally, even though we were approved to complete the project. The time-line also presented obstacles, as the ten weeks provided limited time in which to secure data and put together a full business proposal.
Additionally, some of the data we were seeking such as total cost of sample shipping, had never previously been examined.

On the other hand, a large company can work in a researcher’s favor. In obtaining numbers and quotes, the buying power of a large corporation prompted external companies to cooperate with our research efforts. As a researcher, it was much more difficult to obtain real quotes from logistic vendors.

Using this data for my thesis proved to be difficult because much of it was proprietary and could not be reported. Therefore, research for this analysis was conducted outside of Macy’s. I extended the scope of the project to include additional research on environmental issues. The thesis also explores the potential impact of procedural changes at the store level, which was only briefly mentioned in our original proposal. The data used was collected from contacts at freight carriers and corrugated suppliers. Lastly, I conducted interviews and obtained further data through contacts at other major retailers such as Sears, JC Penney, and IKEA, to supplement the information in the original proposal.

6. Research

In response to the problem identified, my group investigated the use of vacuum sealing of samples for high cube, low weight products, namely products in the home category such as comforters, throws, and pillows. First popularized for storage in small closets and traveling with limited space in a suitcase, this technique reduces the volume of products in a sealed bag with the use of an everyday vacuum cleaner. According to in-house tests performed at Macy’s, this
technique can reduce the dimensions of products up to 78 percent, a way to significantly reduce the volume of shipments.

Vacuum sealing reduces expenses because of the billing structure of air shipments. When traveling by air, products are billed on the greater of two weights, actual weight or dimensional weight. Actual weight refers to how much the product weighs in pounds or kilograms. Dimensional weight is the length, width, and height multiplied together and divided by a dimensional factor (DIM) of 366 (though negotiable, this is a standard number across the transportation industry). In order to reduce the cost of shipping products, therefore, there are two main strategies: reducing the actual weight or the cubic volume of the shipment. As a result of dimensional weight billing described above, low weight and high cube products such as comforters are very expensive to air ship. According to David Kennedy, President and CEO of Perfect Fit, "a large percentage of our product is air and it's very expensive to import a product that's bulky" (Marks, 2008, p. 1). The dimensional weight can be up to five times the actual weight for these products, resulting in expensive rates. However, if the dimensions of each product could be reduced, it would decrease dimensional weight and result in lower shipping costs. Figure 8 shows the results of vacuum sealing.

Figure 8. Pillow Unsealed (left) and Sealed (middle, right)
6.1 Initial Investment

The limited number of samples in the home department makes implementation relatively simple and inexpensive. The initial investment to implement vacuum sealing would be low compared to the potential cost savings. Vacuum sealing on a small scale utilizes a hand vacuum to seal shipments, costing an average of $45-50. Bags required for an entire season of home sample shipments amounts to 150 bags, costing $450 ($3.00 per bag) according to a quote from Storage Kaddy, a vacuum sealing bag vendor (Personal communication, July 2008). These bags can be reused up to 100 times, making the cost $0.03 per use. Table 1 shows the initial investment by category.

<table>
<thead>
<tr>
<th>Item</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vacuum</td>
<td>$50</td>
</tr>
<tr>
<td>150 Bags</td>
<td>$450</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>$500</strong></td>
</tr>
</tbody>
</table>

Table 1: Initial Investment

6.2 Cost savings

The cost-savings from this proposal are substantial, as depicted in Table 2. It shows the original size (length (L), width (W), and height (H)) and the volume in cubic inches of the unsealed product based on in-house tests. The column of “Cubic In (Sealed)” shows the dimensions after the product has been vacuum sealed. An average volume reduction of 78% was used. The volume was then divided by a dim factor of 366, as described above, to find the dimensional weight sealed and unsealed. Finally, based on air freight rates provided by Mohawk
Global Logistics from Hong Kong to New York City, the freight for both the sealed and unsealed products was calculated (Marc Packard, personal communication, February 16, 2009). The difference of transportation costs for sealed and unsealed products was used to indicate the final savings per unit. See Table 2 for a summary of the results of this analysis. These charts are also replicated in Appendix 1.

Table 2: Transportation Savings per Unit (Air)

<table>
<thead>
<tr>
<th></th>
<th>L</th>
<th>W</th>
<th>H</th>
<th>Cubic In (Unsealed)</th>
<th>Dim Weight (Unsealed) (Kg)</th>
<th>Cost (Unsealed)</th>
<th>Cubic In (Sealed)</th>
<th>Dim Weight (Sealed) (Kg)</th>
<th>Cost (Sealed)</th>
<th>Savings</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Comforters:</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Twin</td>
<td>64</td>
<td>86</td>
<td>1.5</td>
<td>8,256</td>
<td>22.55737705</td>
<td>$70.60</td>
<td>1,816.32</td>
<td>4.962622951</td>
<td>$15.53</td>
<td>$55.07</td>
</tr>
<tr>
<td>Full/Queen</td>
<td>86</td>
<td>86</td>
<td>1.5</td>
<td>11,094</td>
<td>30.31147541</td>
<td>$94.87</td>
<td>2,440.68</td>
<td>6.66852459</td>
<td>$20.87</td>
<td>$74.00</td>
</tr>
<tr>
<td>King</td>
<td>86</td>
<td>102</td>
<td>1.5</td>
<td>13,158</td>
<td>35.95081967</td>
<td>$112.53</td>
<td>2,894.76</td>
<td>7.909180328</td>
<td>$24.76</td>
<td>$87.77</td>
</tr>
</tbody>
</table>

This analysis was performed based on the dimensions of an IKEA comforter.

<table>
<thead>
<tr>
<th></th>
<th>L</th>
<th>W</th>
<th>H</th>
<th>Cubic In (Unsealed)</th>
<th>Dim Weight (Unsealed) (Kg)</th>
<th>Cost (Unsealed)</th>
<th>Cubic In (Sealed)</th>
<th>Dim Weight (Sealed) (Kg)</th>
<th>Cost (Sealed)</th>
<th>Savings</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Pillows:</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gosa Karna</td>
<td>24</td>
<td>13</td>
<td>3.5</td>
<td>1,092</td>
<td>2.983606557</td>
<td>$9.34</td>
<td>240.24</td>
<td>0.656393443</td>
<td>$2.05</td>
<td>$7.28</td>
</tr>
<tr>
<td>Stockholm</td>
<td>22</td>
<td>22</td>
<td>3.5</td>
<td>1,694</td>
<td>4.628415301</td>
<td>$14.49</td>
<td>372.68</td>
<td>1.018251366</td>
<td>$3.19</td>
<td>$11.30</td>
</tr>
<tr>
<td>Inner</td>
<td>28</td>
<td>28</td>
<td>3.5</td>
<td>2,744</td>
<td>7.49726776</td>
<td>$23.47</td>
<td>603.68</td>
<td>1.649398907</td>
<td>$5.16</td>
<td>$18.30</td>
</tr>
</tbody>
</table>

This analysis was performed based on the dimensions of several styles of IKEA decorative pillows.

<table>
<thead>
<tr>
<th></th>
<th>L</th>
<th>W</th>
<th>H</th>
<th>Cubic In (Unsealed)</th>
<th>Dim Weight (Unsealed) (Kg)</th>
<th>Cost (Unsealed)</th>
<th>Cubic In (Sealed)</th>
<th>Dim Weight (Sealed) (Kg)</th>
<th>Cost (Sealed)</th>
<th>Savings</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Throws:</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ofelia</td>
<td>67</td>
<td>51</td>
<td>0.25</td>
<td>854</td>
<td>2.334016393</td>
<td>$7.31</td>
<td>187.94</td>
<td>0.513483607</td>
<td>$1.61</td>
<td>$5.70</td>
</tr>
<tr>
<td>Full</td>
<td>80</td>
<td>96</td>
<td>0.25</td>
<td>1,920</td>
<td>5.245901639</td>
<td>$16.42</td>
<td>422.40</td>
<td>1.154098361</td>
<td>$3.61</td>
<td>$12.81</td>
</tr>
</tbody>
</table>

This analysis was performed based on the dimensions of throws from IKEA (Ofelia) and L.L.Bean (Full).

Please Note: Calculations assume a 78% volume reduction using vacuum sealing, a result of in-house testing. Shipping rates were based on quotes from Mohawk Global Logistics (Marc Packard, personal communication, February 16, 2009).

6.3 Annualized Savings
Table 4 shows annualized transportation savings from this proposal. The number of items shipped yearly is based on an estimation of styles of a fixed number of private label brands. It is assumed that five samples of each style are shipped per season for two seasons per year. Estimations are conservative, only accounting for products that have made it to market and discounting the styles that did not complete the full product development cycle. Please see Table 3 for a breakdown of styles by brand and type and Table 4 for annual transportation savings.

Table 3: Samples Sent per Year

<table>
<thead>
<tr>
<th>Brand</th>
<th>Comforter</th>
<th>Pillow</th>
<th>Throw</th>
</tr>
</thead>
<tbody>
<tr>
<td>Charter Club</td>
<td>13</td>
<td>6</td>
<td>2</td>
</tr>
<tr>
<td>Hotel Collection</td>
<td>20</td>
<td>25</td>
<td>3</td>
</tr>
<tr>
<td>Martha Stewart</td>
<td>10</td>
<td>5</td>
<td>3</td>
</tr>
<tr>
<td>Style &amp; Co</td>
<td>9</td>
<td>2</td>
<td>-</td>
</tr>
<tr>
<td><strong>Total Styles</strong></td>
<td><strong>52</strong></td>
<td><strong>38</strong></td>
<td><strong>8</strong></td>
</tr>
<tr>
<td><strong>Total Samples (x8)</strong></td>
<td><strong>416</strong></td>
<td><strong>304</strong></td>
<td><strong>64</strong></td>
</tr>
</tbody>
</table>

Table 4: Annual Transportation Savings (Air):

Comforters:

<table>
<thead>
<tr>
<th>Size</th>
<th>Cost Per Unit (Unsealed)</th>
<th>Cost Per Unit (Sealed)</th>
<th>Savings Per Unit</th>
<th>Annual Cost (Unsealed)</th>
<th>Annual Cost (Sealed)</th>
<th>Annual Savings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Full/Queen</td>
<td>$ 94.87</td>
<td>$20.87</td>
<td>$74.00</td>
<td>$39,467.97</td>
<td>$8,682.95</td>
<td>$30,785.01</td>
</tr>
</tbody>
</table>

The Full/Queen size was used because this is often the size of a sample.

Pillows:

<table>
<thead>
<tr>
<th>Brand</th>
<th>Cost Per Unit (Unsealed)</th>
<th>Cost Per Unit (Sealed)</th>
<th>Savings Per Unit</th>
<th>Annual Cost (Unsealed)</th>
<th>Annual Cost (Sealed)</th>
<th>Annual Savings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ikea Stockholm</td>
<td>$ 14.49</td>
<td>$ 3.19</td>
<td>$11.30</td>
<td>$4,404.03</td>
<td>$968.89</td>
<td>$3,435.14</td>
</tr>
</tbody>
</table>

The IKEA Stockholm pillow was used as an approximate size of a decorative pillow sample.
Throws:

<table>
<thead>
<tr>
<th></th>
<th>Cost Per Unit (Unsealed)</th>
<th>Cost Per Unit (Sealed)</th>
<th>Savings Per Unit</th>
<th>Annual Cost (Unsealed)</th>
<th>Annual Cost (Sealed)</th>
<th>Annual Savings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Full</td>
<td>$16.42</td>
<td>$3.61</td>
<td>$12.81</td>
<td>$1,050.86</td>
<td>$231.19</td>
<td>$819.67</td>
</tr>
</tbody>
</table>

The Full throw was used as an approximate size of a blanket sample.

**Total Freight Savings:** Annualized freight savings equate to $35,039.82 per year. However, this does not include savings from plastic and corrugated cardboard, which are discussed later.

6.4 Reverse Logistics

For sample freight, reverse logistics would be simple with the dedication of key employees. When packages are opened with vacuum sealing products, the bags would be collected and consolidated in the mail room. Depending on the number of vacuum sealed bags and usage rate, bags will be returned to corresponding overseas offices periodically throughout the year along with daily shipments. The bags can be sent back to the overseas offices to be reused, following this cycle for up to 100 trips. Although this will be an additional freight cost of $94 annually, it will be largely insignificant due to the number of bags and the cost savings they produce.
7. Current State

Macy’s is currently implementing this project on the sample level. The following is a quote from Michael Singer, a logistics employee from Macy’s Merchandising Group:

“We have run a number of test shipments on comforters and we are very pleased with the results. We are looking to roll out the process on all similar type sample shipments during fiscal 2009 starting in February. Based on our test shipments savings on freight have been running about 50%. For now this will be for just comforters and similar items since this is where the cost savings is significant” (M. Singer, personal communication, 2009).

Macy’s has not yet considered implementing this plan on the store level for all products. There are several obstacles that were raised by upper management. Based on further research for this thesis, the following is analysis that addresses these challenges and shows the potential for this plan on the store level.

8. Potential Implications

Vacuum sealing can also be applied to other product categories, such as apparel. Outerwear, specifically winter coats and large sweaters, would be a likely candidate for this type of packaging strategy during the design and development process.
Direct shipping from the supplier to the customer for online orders is mentioned earlier as an increasingly popular way to save costs. In this case, the supplier would be responsible for drop shipping directly to the consumer, cutting out the role of the retailer. For suppliers, vacuum sealing is a strategy to reduce shipping costs without the concerns of in-store logistics. The same concept applies to retailers on-line shipping procedures as well, because in-store presentation is not a concern.

Although analysis for this project was done on the sample level, it has significant potential for in-store product, as stated above. The margins per item are much lower because the items are shipped by ocean which is less expensive; however the volume is significantly higher.

The following chart shows the potential savings per unit for comforters, pillows and throws based on ocean shipping rates from Hong Kong to New York City. The length (L), width (W), and height (H), of each product is multiplied together to find the total dimensions. This number is divided by a dimensional (DIM) factor of 166 to find dimensional weight. This number is negotiable, but is assumed to be 166 for this study. Cubic feet and cubic meters are also calculated from the total dimensions to determine the number of products that will fit in a standard 20’ shipping container. Calculations are based on a volume reduction of 78% for comforters, 51% for pillows, and 67% for throws. Quotes from Mohawk Global Logistics on mini land-bridge (MLB) from Hong Kong to New York, were also used (Marc Packard, personal communication, February 16, 2009). Finally, this number was divided by the number of products per container to find the
freight savings per unit. Table 5 summarizes the results, which can also be found in Appendix 2.

Table 5: Transportation Savings per Unit (Ocean)

<table>
<thead>
<tr>
<th>Comforter</th>
<th>L (in)</th>
<th>W</th>
<th>H</th>
<th>Cubic In</th>
<th>Cubic Ft</th>
<th>Cubic M</th>
<th>Dim Weight (Lbs)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Twin</td>
<td>64</td>
<td>86</td>
<td>1.5</td>
<td>8,256</td>
<td>4.7777778</td>
<td>0.1352942</td>
<td>49.73</td>
</tr>
<tr>
<td>Full/Queen</td>
<td>86</td>
<td>86</td>
<td>1.5</td>
<td>11,094</td>
<td>6.4201389</td>
<td>0.1818015</td>
<td>66.83</td>
</tr>
<tr>
<td>King</td>
<td>86</td>
<td>102</td>
<td>1.5</td>
<td>13,158</td>
<td>7.6145833</td>
<td>0.2156251</td>
<td>79.27</td>
</tr>
</tbody>
</table>

<p>| | | | | | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>unsealed</td>
<td>245</td>
<td>comforters in a container</td>
<td>$12.06</td>
<td>cost per comforter unsealed</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>sealed</td>
<td>1,115</td>
<td>comforters in a container</td>
<td>$2.65</td>
<td>cost per comforter sealed</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

\[ 4.55 \times \text{the amount can fit} \quad \text{savings per comforter} \quad \text{9.41} \]

<table>
<thead>
<tr>
<th>Pillow</th>
<th>L (in)</th>
<th>W</th>
<th>H</th>
<th>Cubic In</th>
<th>Cubic Ft</th>
<th>Cubic M</th>
<th>Dim Weight (Lbs)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gosa Karna</td>
<td>24</td>
<td>13</td>
<td>3.5</td>
<td>1,092</td>
<td>0.6319444</td>
<td>0.017895</td>
<td>6.58</td>
</tr>
<tr>
<td>Ikea Stockholm</td>
<td>22</td>
<td>22</td>
<td>3.5</td>
<td>1,694</td>
<td>0.9803241</td>
<td>0.0277602</td>
<td>10.20</td>
</tr>
<tr>
<td>Inner</td>
<td>28</td>
<td>28</td>
<td>3.5</td>
<td>2,744</td>
<td>1.587963</td>
<td>0.044967</td>
<td>16.53</td>
</tr>
</tbody>
</table>

<p>| | | | | | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>unsealed</td>
<td>1,196</td>
<td>pillows in a container</td>
<td>$2.48</td>
<td>cost per pillow unsealed</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>sealed</td>
<td>2,917</td>
<td>pillows in a container</td>
<td>$1.01</td>
<td>cost per pillow sealed</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

\[ 2.44 \times \text{as many pillows} \quad \text{savings per pillow} \quad \text{1.46} \]

<table>
<thead>
<tr>
<th>Throw</th>
<th>L (in)</th>
<th>W</th>
<th>H</th>
<th>Cubic In</th>
<th>Cubic Ft</th>
<th>Cubic M</th>
<th>Dim Weight (Lbs)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ofelia</td>
<td>67</td>
<td>51</td>
<td>0.25</td>
<td>854</td>
<td>0.4943576</td>
<td>0.0139989</td>
<td>5.15</td>
</tr>
<tr>
<td>LLBean</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Full</td>
<td>80</td>
<td>96</td>
<td>0.25</td>
<td>1,920</td>
<td>1.1111111</td>
<td>0.0314638</td>
<td>11.57</td>
</tr>
</tbody>
</table>

<p>| | | | | | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>unsealed</td>
<td>2,372</td>
<td>pillows in a container</td>
<td>$1.25</td>
<td>cost per throw unsealed</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>sealed</td>
<td>7,187</td>
<td>pillows in a container</td>
<td>$0.41</td>
<td>cost per throw sealed</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

\[ 3.03 \times \text{as many throws} \quad \text{savings per throw} \quad \text{0.84} \]

Note: Mini landbridge (MLB) from Hong Kong to NYC is $2,960.00 (Marc Packard, personal communication, February 16, 2009). Additionally, a 20 ft container = 33.2 cubic m according to APL (APL Limited, 2009).
8.1 Annualized Savings

Several assumptions were made when estimating annualized savings from this proposal. The price comforter sold at Macy’s was averaged based on retail prices of its products. The average is approximately $472 at retail. It is an estimate, and does not account for potential markdowns or including all products. According to *Home Textiles Today*, comforters contributed $491 million to sales in 2008 (Rowen, 2009, p. 42). This does not include bedding sets. Under these assumptions, 1.04 million comforters were sold in 2008. Savings per comforter was calculated to be $9.41; therefore, the estimated annualized savings is $9.79 million for comforters sold independently (not part of a bedding set).

Similar analysis was performed for throws. Included in this category were sales for quilts, coverlets, bedspreads, and duvet covers. The average price for a throw was calculated to be $221, resulting in 2.7 million units sold. With freight savings per unit of $0.84, the resulting annual freight savings of $2.3 million.

Please see Table 6 for a summary of these savings.

Freight savings for pillows was not calculated because sales for this data were unavailable.

Table 6: Annualized Transportation Savings (Ocean)

<table>
<thead>
<tr>
<th>Product</th>
<th>Total Sales (2008)</th>
<th>Average Retail Price</th>
<th>Total Units Sold (2008)</th>
<th>Freight Savings (per Unit)</th>
<th>Total Freight Savings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Comforters</td>
<td>$ 491,280,000</td>
<td>$ 472.00</td>
<td>1,040,847</td>
<td>$ 9.41</td>
<td>$ 9,794,374.58</td>
</tr>
<tr>
<td>Throws</td>
<td>$ 603,420,000</td>
<td>$ 221.00</td>
<td>2,730,407</td>
<td>$ 0.84</td>
<td>$ 2,293,542.08</td>
</tr>
</tbody>
</table>

9. Additional Savings

9.1 Corrugated
Vacuum sealing provides additional savings by eliminating process waste. For a box size 22” x 22” x 22”, double wall, 2.75 weight, with glue joints, and FOB dock, the cost is $2.675, according to a quote from Smurfit-Stone Container (Personal communication, March 2009). This is a typical size box for a shipment, able to hold approximately three queen-sized comforters. For every 100 boxes used, for example, it costs a company approximately $267.50. However, if the volume of comforters could be reduced by 78%, only 22 boxes would be needed to transport the same number of comforters, amounting to $58.85 for a savings of $208.65. Savings become even more significant with larger volumes of product.

9.2 Plastic

Plastic bags are used to protect each sample from damage during transport, such as water or chemicals. This creates an enormous amount of waste that is often not reused, but merely disposed of. Vacuum sealing bags, on the other hand, can be re-used up to 100 times and have a life span of up to five years. They also protect the integrity of the product from damage from transport. This will eliminate the unnecessary expenses of purchasing one time use plastic bags.

9.3 Storage

On a large scale, other savings potential derives from the saved storage space on the retail floor and backroom. This will improve measures such as sales per square foot, because more merchandise can be fit into a smaller area. Michael Sagan, a sourcing manager at IKEA, stated that vacuum sealing has saved “an incredible amount of floor space” (Personal Communication, March 11, 2009). It
would also reduce clutter and allow for wider aisles, improving the customer experience.

9.4 Challenges

Interviews with Macy’s and Sears introduced several significant obstacles to this proposal. The discussion below addresses these objections based on further research.

**Product Integrity:** Many vacuum sealing manufacturers claim that bags do not cause wrinkles. However, in-house tests showed that products in vacuum bags for several weeks did show slight creases when unsealed. In the case of samples being used for product presentation to buyers, product is steamed regardless of the way it is shipped. For other products shipped to the design and tech departments, wrinkles are not a concern. Therefore, shipping samples using vacuum sealing bags would not impact operations.

For finished products at a store, wrinkles caused by vacuum sealing present a larger obstacle. Due to the large volume of products stocked, steaming product before putting it out on the floor would likely negate any freight savings. This is an unlikely solution, especially because additional packaging would be necessary for floor display.

Another option would be selling the product vacuum sealed to the final consumer. Sealed products would reduce the required floor space significantly in
addition to savings on shipping costs. The obstacle presented with this strategy is
the customer reaction to slight wrinkles in the product after bringing it home. One
cycle through the dryer would most likely fix any issues, but it may cause
customer dissatisfaction. However, as stated previously, IKEA has not found this
to be a large issue with its in-store vacuum sealed product, although they reported
a limited number of customer complaints (Sagan, personal communication, March
11, 2009). This is largely due to the clear in-store and product signage that
communicates the rationale for the strategy to customers (Sagan, personal
communication, March 11, 2009). Customers aware of the cost savings and green
principles involved with this strategy are much more likely to be receptive to this
new concept.

**Recycling:** One of the key components of this proposal on the sample
level is the reusability of the bags. They can be sent back to overseas offices for
up to 100 trips. Selling comforters vacuum sealed in store, however, would create
more challenges. If the customer were to buy the comforters in the bags
themselves, reverse logistics becomes infinitely more complicated when dealing
with multiple store locations. Without being able to recycle them, the bags
become additional waste. A possible solution to this problem is having a bag
recycle area in each store for customers to return their used packaging.

**Customer Reaction:** Concerns are also raised about the way the comforter
would be presented on the floor if the product were sold vacuum sealed.
Customers may react negatively to buying a flat comforter, as opposed to one that
was fluffy. More testing would have to be completed. However, for low
involvement purchase like mattress pads and standard pillows, it is likely that this would have minimal effect on customer perception. IKEA did not report any impact to sales in bedding as a result of vacuum sealing with the addition of point of sale signage and care instructions (Sagan, personal communication, March 11, 2009).

**Packaging (Bed in Bag):** Labeling considerations are also important, as a comforter normally packaged has a lot of room for packaging display, such as a cardboard insert. How would this be consolidated to fit in a vacuum sealed comforter? The argument there, of course, is that if materials are consolidated into a smaller insert, cardboard material can be saved.

**Cost of Implementation:** Depending on the cooperation of the supplier and a more detailed cost analysis, either hand vacuums or larger machinery could be used in this process. With labor being inexpensive, it may be more cost effective to invest in hand vacuums and use human capital for the process. Automation is another option, requiring a more significant investment in a machine that hermetically seals products at a rapid pace. Machines of this kind can cost between $10,000 and $78,000 according to prices at Lantech, a leader in manufacturing and packaging (Lantech, 2009, p. 1).

**IKEA:** Further information from IKEA indicates that the company uses compression packing in addition to vacuum sealing. Although vacuum sealing provides larger savings, problems occurred when the product became unsealed and would no longer fit into packaging on the sales floor. Sagan stated:

“In the start up our stores encountered many problems with stability on the shelves and in our warehouses when the vacuum seals were broken."
These seals could be broken due to rough handling in the warehouse & transport or by customers on our shop floors. This resulted in very small packages inflating and becoming very large. This of course impacted the durability and continuity of the display to our customers” (Sagan, personal communication, March 11, 2009).

The company moved towards compression packaging, which provides savings of only 30-65% compared to 50-70% savings using vacuum sealing (Sagan, personal communication, March 11, 2009). Compression sealing is a similar technique, but involves a rolling technique, where the air is pushed out of the packaging using pressure. The process is similar, utilizing the same concept of reducing the dimensions of a product to save on freight. Vacuum sealing is still the primary process for more stable products. IKEA uses volume reduction techniques, either vacuum sealing or compression packing, in the following categories: pillows, quilts, textiles, and foam mattresses (Sagan, personal communication, March 11, 2009). Because the process is completed at the manufacturing level, IKEA requires its suppliers to have vacuum sealing or compression packing capabilities (Sagan, personal communication, March 11, 2009).

10. Conclusion

Environmental sustainability is becoming an increasingly important part of a company’s decision-making process. Lean principles are the future for integrating green cost-saving initiatives. Unnecessary time, money, and materials must be removed in order to stream-line processes. Reusing materials, reducing the amount used, and recycling should be part of companies’ strategy for long-term viability.
Additionally, in the current economic climate these types of creative cost-saving solutions are necessary for remaining profitable. Increasing costs and decreasing prices are causing margin erosion for companies, requiring them to rethink their fundamental practices in order to stay in business.

Recognizing the viability of vacuum sealing on the sample level, Macy’s has worked to implement this process since the project was proposed. However, it has not been seriously considered on the store level for the reasons stated earlier, including product integrity and customer reaction. Representatives from Sears also expressed similar objections (D. Luczynski, personal communication, February 25, 2009). However, substantial research has shown that IKEA has been able to implement vacuum sealing on several of its products on the store level and it has been incredibly successful.

This analysis attempts to show that vacuum sealing techniques can be used for samples as well as in-store products to reduce costs. According to the research presented, the hypothesis was found to be correct. Significant transportation and material savings result from volume reduction of high cube, low weight products. Furthermore, innovation and dedication from cross-functional employees can overcome the challenges of applying this concept to the store level. It is this type of inventive cost-saving strategy that will separate successful companies from those who do not survive in the future.
Sources Cited and Consulted


2/27/2009 from:


http://www.llbean.com/webapp/wcs/stores/servlet/CategoryDisplay?categoryld=1157&catalogId=1&storeId=1&langId=-1&nav=gnro


# Appendix 1: Transportation Savings per Unit (Air)

## Comforters:

<table>
<thead>
<tr>
<th></th>
<th>L</th>
<th>W</th>
<th>H</th>
<th>Cubic In</th>
<th>Dim Weight (Unsealed) (Kg)</th>
<th>Cost (Unsealed)</th>
<th>Cubic In (Sealed)</th>
<th>Dim Weight (Sealed) (Kg)</th>
<th>Cost (Sealed)</th>
<th>Savings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Twin</td>
<td>64</td>
<td>86</td>
<td>1.5</td>
<td>8,256</td>
<td>22.5737705</td>
<td>$70.60</td>
<td>1,816.32</td>
<td>4.962622951</td>
<td>$15.53</td>
<td>$55.07</td>
</tr>
<tr>
<td>Full/Queen</td>
<td>86</td>
<td>86</td>
<td>1.5</td>
<td>11,094</td>
<td>30.31147541</td>
<td>$94.87</td>
<td>2,440.68</td>
<td>6.66852459</td>
<td>$20.87</td>
<td>$74.00</td>
</tr>
<tr>
<td>King</td>
<td>86</td>
<td>102</td>
<td>1.5</td>
<td>13,158</td>
<td>35.95081967</td>
<td>$112.53</td>
<td>2,894.76</td>
<td>7.909180328</td>
<td>$24.76</td>
<td>$87.77</td>
</tr>
</tbody>
</table>

This analysis was performed based on the dimensions of an IKEA comforter.

## Pillows:

<table>
<thead>
<tr>
<th></th>
<th>L</th>
<th>W</th>
<th>H</th>
<th>Cubic In</th>
<th>Dim Weight (Unsealed) (Kg)</th>
<th>Cost (Unsealed)</th>
<th>Cubic In (Sealed)</th>
<th>Dim Weight (Sealed) (Kg)</th>
<th>Cost (Sealed)</th>
<th>Savings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gosa Karna</td>
<td>24</td>
<td>13</td>
<td>3.5</td>
<td>1,092</td>
<td>2.983606557</td>
<td>$9.34</td>
<td>240.24</td>
<td>0.656393443</td>
<td>$2.05</td>
<td>$7.28</td>
</tr>
<tr>
<td>Stockholm</td>
<td>22</td>
<td>22</td>
<td>3.5</td>
<td>1,694</td>
<td>4.628415301</td>
<td>$14.49</td>
<td>372.68</td>
<td>1.018251366</td>
<td>$3.19</td>
<td>$11.30</td>
</tr>
<tr>
<td>Inner</td>
<td>28</td>
<td>28</td>
<td>3.5</td>
<td>2,744</td>
<td>7.49726776</td>
<td>$23.47</td>
<td>603.68</td>
<td>1.649398907</td>
<td>$5.16</td>
<td>$18.30</td>
</tr>
</tbody>
</table>

This analysis was performed based on the dimensions of several styles of IKEA decorative pillows.

## Throws:

<table>
<thead>
<tr>
<th></th>
<th>L</th>
<th>W</th>
<th>H</th>
<th>Cubic In</th>
<th>Dim Weight (Unsealed) (Kg)</th>
<th>Cost (Unsealed)</th>
<th>Cubic In (Sealed)</th>
<th>Dim Weight (Sealed) (Kg)</th>
<th>Cost (Sealed)</th>
<th>Savings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ofelia</td>
<td>67</td>
<td>51</td>
<td>0.25</td>
<td>854</td>
<td>2.334016393</td>
<td>$7.31</td>
<td>187.94</td>
<td>0.513483607</td>
<td>$1.61</td>
<td>$5.70</td>
</tr>
<tr>
<td>Full</td>
<td>80</td>
<td>96</td>
<td>0.25</td>
<td>1,920</td>
<td>5.245901639</td>
<td>$16.42</td>
<td>422.40</td>
<td>1.154098361</td>
<td>$3.61</td>
<td>$12.81</td>
</tr>
</tbody>
</table>

This analysis was performed based on the dimensions of throws from IKEA (Ofelia) and L.L.Bean (Full).

Please Note: Calculations assume a 78% volume reduction using vacuum sealing, a result of in-house testing. Shipping rates were based on quotes from Mohawk Global Logistics (Marc Packard, Personal communication, February 16, 2009).
Appendix 2: Transportation Savings per Unit (Ocean)

### Comforter

<table>
<thead>
<tr>
<th>IKEA</th>
<th>L (in)</th>
<th>W (in)</th>
<th>H (in)</th>
<th>Cubic In</th>
<th>Cubic Ft</th>
<th>Cubic M</th>
<th>Dim Weight (lbs)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Twin</td>
<td>64</td>
<td>86</td>
<td>1.5</td>
<td>8,256</td>
<td>4.77778</td>
<td>0.13529</td>
<td>49.73</td>
</tr>
<tr>
<td>Full/Queen</td>
<td>86</td>
<td>86</td>
<td>1.5</td>
<td>11,094</td>
<td>6.42014</td>
<td>0.1818</td>
<td>66.83</td>
</tr>
<tr>
<td>King</td>
<td>86</td>
<td>102</td>
<td>1.5</td>
<td>13,158</td>
<td>7.61458</td>
<td>0.21562</td>
<td>79.27</td>
</tr>
</tbody>
</table>

- unsealed: 245 comforters in a container
- sealed: 1,115 comforters in a container

\[ 4.55 \times \text{the amount can fit} \quad \text{$9.41$ savings per comforter} \]

### Pillow

<table>
<thead>
<tr>
<th>IKEA</th>
<th>L (in)</th>
<th>W (in)</th>
<th>H (in)</th>
<th>Cubic In</th>
<th>Cubic Ft</th>
<th>Cubic M</th>
<th>Dim Weight (lbs)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gosa Karna</td>
<td>24</td>
<td>13</td>
<td>3.5</td>
<td>1,092</td>
<td>0.632</td>
<td>0.0178</td>
<td>6.58</td>
</tr>
<tr>
<td>IKEA Stockholm</td>
<td>22</td>
<td>22</td>
<td>3.5</td>
<td>1,694</td>
<td>0.98032</td>
<td>0.02776</td>
<td>10.20</td>
</tr>
<tr>
<td>Inner</td>
<td>28</td>
<td>28</td>
<td>3.5</td>
<td>2,744</td>
<td>1.588</td>
<td>0.04497</td>
<td>16.53</td>
</tr>
</tbody>
</table>

- unsealed: 1,196 pillows in a container
- sealed: 2,917 pillows in a container

\[ 2.44 \times \text{as many pillows} \quad \text{$1.46$ savings per pillow} \]

### Throw

<table>
<thead>
<tr>
<th>IKEA</th>
<th>L (in)</th>
<th>W (in)</th>
<th>H (in)</th>
<th>Cubic In</th>
<th>Cubic Ft</th>
<th>Cubic M</th>
<th>Dim Weight (lbs)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ofelia</td>
<td>67</td>
<td>51</td>
<td>0.25</td>
<td>854</td>
<td>0.494357</td>
<td>0.01399</td>
<td>5.15</td>
</tr>
<tr>
<td>LLBean</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Full</td>
<td>80</td>
<td>96</td>
<td>0.25</td>
<td>1,920</td>
<td>1.111111</td>
<td>0.03146</td>
<td>11.57</td>
</tr>
</tbody>
</table>

- unsealed: 2,372 pillows in a container
- sealed: 7,187 pillows in a container

\[ 3.03 \times \text{as many throws} \quad \text{$0.84$ savings per throw} \]

Note: Mini land-bridge (MLB) from Hong Kong to NYC is $2,960.00 (Marc Packard, personal communication, February 16, 2009). Additionally, a 20 ft container = 33.2 cubic m according to APL (APL Limited, 2009).
Written Summary

This thesis was created from a project completed during an internship at Macy’s Merchandising Group (MMG), a division of Macy’s Inc. Working in product development I obtained knowledge about the design, development, and transportation processes of soft goods from initial conception to the finished product in-store. As part of a group of interns, I was challenged to create a cost-saving, green initiative for the company. Observing the vast amount of waste produced by daily shipments, my project team and I focused on minimizing packaging requirements. We created a proposal based on our research, obtaining information internally from key employees as well as externally from outside vendors. The proposal was well received by management and a pilot implementation project was created in Hong Kong. I was interested in further exploring how retail companies could make a difference in their carbon usage and at the same time favorably impact the bottom-line. I expanded my research and conducted interviews with a variety of retail establishments to further examine the issues involved in transportation waste reduction. This thesis is a summary of my research findings.

Objective

MMG designs and develops private label merchandise exclusive to Macy’s. During the production process, samples of the finished product are produced at overseas manufacturers all over the world, including Hong Kong, Egypt, Taiwan, and many other locations. Samples, which can include fabric
swatches or trims in addition to as many as five mock-ups of the entire item, are sent from the supplier to the closest Macy’s owned overseas office. They are then consolidated and sent daily to the New York City headquarters. As an essential step of the production process, samples are time-sensitive because final product must be on time to the stores. Therefore, all samples are sent via air freight because it provides shorter transit times than ocean freight. Once received, samples are reviewed by the design and technical departments. Any changes are communicated back to the overseas office and then to the manufacturer electronically. Figure 1 summarizes the flow of samples and information through the supply chain beginning with the overseas manufacturer, to the overseas offices, and finally to the New York headquarters.

The sample process described above is utilized to ensure the accurate and timely production of products. However, the flow of goods creates significant waste of corrugated (cardboard), plastic, and energy. Additionally, air travel
causes harmful effects to the environment. Excess waste is particularly prevalent in the home textiles department. Products developed in this department include comforters, pillows, and throws as well as other bedding items. Samples amount to a significant number of shipments each day. The challenge, therefore, is reducing waste in the sample shipment processes in a way that will save money and be sustainable.

Hypothesis Statement

Reducing the dimensions of home textiles can result in a significant reduction of transportation expense as well as reducing the environmental impact that shipping samples presently creates.

Research Methodology

Methods Used

During the 10 week internship, my intern group focused on packaging as a means to reduce costs and eliminate wasteful product. Research for the proposal was completed utilizing lean principles, often employed in environmental and supply chain fields. Lean principles focus on eliminating waste in a process. These tenants are effective in reducing costs and improving the environment by streamlining processes and eliminating unnecessary material. These principles provided the framework for this proposal.

Original Research Explanation

It is important to note that research for this project is largely primary. Secondary sources are used to support the claims made. The group found very
little research on the shipping strategy of vacuum sealing; therefore much of our work is original and required in-house analysis. Our field work included contacting numerous vacuum sealing vendors and finding a business that would send us samples to perform tests of actual product. Storage Kaddy, a vacuum sealing bag vendor, offered to support our research efforts. We conducted our tests using several comforters, pillows, and throws produced by Macy’s. We recorded before and after dimensions of both vacuum sealed and unsealed goods to calculate the difference in volume of the two groups.

We synthesized the information we gathered from a multitude of employees and outside vendors over a ten week period to create a presentation to the Vice President of Bedding and Vice President of Logistics at MMG. This report offered management a new way of considering how off-shore productions policy impacted the environment as well as the bottom line. Our presentation was well received and was accepted for implementation.

Data used in the proposal was proprietary and could not be reported here. Therefore, research for this analysis was conducted outside of Macy’s. I extended the scope of the project to include additional research on environmental issues. The thesis also explores the potential impact of procedural changes at the store level, which was only briefly mentioned in our original proposal. The data used was collected from freight carriers and corrugated suppliers. Lastly, I conducted interviews and obtained further data through contacts at other major retailers such as Sears, JC Penney and IKEA, to supplement the information in the original proposal.
Research

In response to the problem identified, my group proposed vacuum sealing of samples for high volume, low weight products, namely products in the home category such as comforters, throws, and pillows. First popularized for storage in small closets and traveling with limited space in a suitcase, this technique reduces the volume of products in a sealed bag with the use of an everyday vacuum cleaner. This technique can reduce the dimensions of products up to 78 percent, a way to significantly reduce the size of shipments (according to in house tests performed at Macy’s).

Vacuum sealing reduces air freight expense because of the way shipments are billed. When traveling by air, products are billed on the greater of two weights, actual weight or dimensional weight. Actual weight refers to how much the product weighs in pounds or kilograms, while dimensional weight is the length, width, and height multiplied together and divided by a dimensional factor (DIM) of 366 (though negotiable, this is a standard number across the transportation industry). In order to reduce the cost of shipping products, therefore, there are two main strategies: reducing the actual weight or the cubic volume of the shipment.

As a result of dimensional weight billing described above, low weight and high volume products such as comforters are very expensive to air ship. The
dimensional weight can be up to five times the actual weight for these products, resulting in expensive rates. When shipping low density products, such as fluffy items, the freight expense largely results from shipping air. However, if the dimensions of each product could be reduced, it would decrease dimensional weight and result in lower shipping costs. Figure 2 shows pictures of an unsealed and sealed pillow, demonstrating the potential volume reduction gained from vacuum sealing.

![Figure 2: Pillow Unsealed (left) and Sealed (middle, right)](image)

**Initial Investment**

Initial investment to implement vacuum sealing would be quite low. The small amount of samples and limited scope makes implementation relatively simple and inexpensive. Overseas offices can utilize a regular hand vacuum to seal shipments, costing an average of $45-50. Bags required for an entire season of home shipments amounts to 150 bags, costing $450 ($3.00 per bag, or $0.03 per use) according to a quote from Storage Kaddy (Personal communication, July 2008).

**Cost savings**
The cost-savings from this proposal are substantial, as depicted in the chart below. It shows the original size (length (L), width (W), and height (H)) and the volume in cubic inches of the unsealed product based on in-house tests. The column of “Cubic In (Sealed)” shows the dimensions after the product has been vacuum sealed. An average volume reduction of 78% was used for all products. The volume was then divided by a dimensional factor of 366, as described above, to find the dimensional weight sealed and unsealed. Finally, based on air freight rates provided by Mohawk Global Logistics from Hong Kong to New York City, the freight for both the sealed and unsealed product was calculated (Marc Packard, personal communication, February 16, 2009). The difference of these two numbers was used to indicate the final savings per unit. For comforters, savings were calculated to be between $55.01 and $87.77 per unit, depending on the size of the item. Freight savings for pillows were between $7.28 and $18.30 and throws between $5.70 and $12.21. These figures were calculated using actual product dimensions from IKEA and L.L.Bean.

Annualized freight savings equate to $35,039.83 per year. However, this does not include savings from plastic and corrugated, which are discussed later.

Reverse Logistics

For sample freight, reverse logistics would be simple with the dedication of key employees. When packages were opened with vacuum sealing products, the bags will be collected and consolidated in the mail room. The bags can then be reused, following this cycle for up to 100 trips. Although this will be an additional
freight cost of $94 annually, it will be largely insignificant due to the number of bags and the cost savings they produce.

**Current State**

Macy’s is currently implementing this project on the sample level. The following is a quote from Michael Singer, a logistics employee from Macy’s Merchandising Group:

“We have run a number of test shipments on comforters and we are very pleased with the results. We are looking to roll out the process on all similar type sample shipments during fiscal 2009 starting in February. Based on our test shipments savings on freight have been running about 50%. For now this will be for just comforters and similar items since this is where the cost savings is significant” (M. Singer, personal communication, 2009).

**Potential Implications**

Vacuum sealing can also be applied to other product categories, such as apparel. Outerwear, specifically winter coats and large sweaters, would be a likely candidate for this type of packaging strategy during the development process. Although analysis for this project was done on the sample level, it has significant potential for in-store product, as stated above. The margins per item are much lower because the items are shipped by ocean which is less expensive; however the volume is significantly higher.

Potential savings per unit for comforters, pillows and throws are $9.41, $1.84, and $0.84 respectively. These numbers are based on ocean shipping rates from Hong Kong to New York City.

**Annualized Savings**
Table 1 is a summary of the annual savings provided by vacuum sealing in-store product. Freight savings for pillows was not calculated because sales were unavailable.

### Table 1: Annualized Transportation Savings (Ocean):

<table>
<thead>
<tr>
<th>Product</th>
<th>Total Sales (2008)</th>
<th>Average Retail Price</th>
<th>Total Units Sold (2008)</th>
<th>Freight Savings (per Unit)</th>
<th>Total Freight Savings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Comforters</td>
<td>$491,280,000</td>
<td>$472.00</td>
<td>1,040,847</td>
<td>$9.41</td>
<td>$9,794,374.58</td>
</tr>
<tr>
<td>Throws</td>
<td>$603,420,000</td>
<td>$221.00</td>
<td>2,730,407</td>
<td>$0.84</td>
<td>$2,293,542.08</td>
</tr>
</tbody>
</table>

Vacuum sealing provides additional savings, besides freight, by eliminating excess waste. For every 100 cardboard boxes used, for example, it costs a company approximately $267.50 (Smurfit Stone Container, personal communication, March 2009). However, if the volume of products could be reduced by 78%, only 22 boxes would be needed to transport the same number of comforters, amounting to $58.85 for a savings of $208.65. Savings become even more significant with larger volumes of product.

Plastic bags are used to protect each sample from damage during transport, such as water or chemicals. This creates an enormous amount of waste that is often not reused. Vacuum sealing bags, on the other hand, can be re-used up to 100 times and has a life span of up to five years. It also protects the integrity of the product from damage from transport. This will eliminate a significant amount of waste in the process, as well as unnecessary expenses of purchasing plastic.

Other savings potential derives from the saved storage space on the retail floor and backroom. This will improve measures such as sales per square foot, because more merchandise can be fit into a smaller area. It would also reduce clutter and wider aisles, improving the customer experience.
Challenges

There are significant obstacles that retailers such as Macy’s, Sears, and JCPenney have raised in personal interviews. This includes the retention of product integrity, customer reaction, reverse logistics, and packaging. These are all addressed further in the thesis.

Conclusion

Environmental sustainability is becoming an increasingly important part of a company’s decision-making. Lean principles are the future for integrating green cost saving initiatives. Unnecessary time, money, and materials must be removed in order to stream-line processes. Reusing materials, reducing the amount used, and recycling should be part of companies’ strategy for long-term viability.

Additionally, in the current economic climate these types of creative cost-saving solutions are necessary for remaining profitable. Increasing costs and decreasing prices are causing margin erosion for companies, requiring them to rethink their fundamental practices in order to stay in business.

Recognizing the viability of vacuum sealing on the sample level, Macy’s has worked to implement this process since the project was proposed. However, it has not been seriously considered on the store level for the reasons stated earlier, including product integrity and customer reaction. Representatives from Sears also expressed objections (D. Luczynski, personal communication, February 25, 2009). However, substantial research has shown that IKEA has been able to
successfully implement vacuum sealing on several of its products on the store level and it has been incredibly successful.

This analysis attempts to show that vacuum sealing techniques are viable in other retail business models. According to the research presented in the thesis, it can be concluded that significant transportation and material savings result from volume reduction of high cube, low weight products. Furthermore, innovation and dedication from cross-functional employees can overcome the challenges of applying this concept to the store level. It is this type of inventive cost-saving strategy that will separate successful companies from those who do not survive the economic downturn.