Where Did All of the Totes Go? 
A Study in Supply Chain Design

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ABSTRACT

Corporations are increasingly looking at ways to incorporate environmental sustainability initiatives into their businesses to lower operating costs and improve the value of their brands for customers that expect higher social responsibility from corporations. These environmental initiatives, often called “win-win” for their dual effect on long-term shareholder value, are easy to identify but often hard to incorporate into existing operations. One such initiative in the retail industry involves delivering products to customers in reusable plastic cartons, rather than corrugated cardboard. One of the largest challenges when designing and implementing this type of supply chain system is developing a reverse logistics strategy that ensures carton return by the consumers, whom the corporation must convince to participate in closing the logistics loop.

This thesis analyzes a pilot program conducted by a consumer products company, referred to as the Sponsor, where reusable plastic cartons were used to deliver orders to one of their corporate customers. Process mapping, qualitative interviews, and data analysis were utilized to understand factors contributing to the unacceptably high rate of carton attrition. Using the results of this analysis, two new design tracks are proposed for the delivery of the Sponsor’s products at MIT. One design relies on the current operating systems and structures to minimize investment by the Sponsor, while the other design is aimed at maximizing effort to optimize the system. The proposed programs consider both operational practicalities in the logistical design and communication and incentive efforts that are needed to drive consumer behavior to maximize carton return and lower attrition rates. We believe the recommended implementation of the maximized effort design will result in lower carton attrition, which will provide the necessary proof of concept for the Sponsor to roll the program out to additional customers.

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Table of Contents

ABSTRACT ................................................................................................................................. 3

1. INTRODUCTION .................................................................................................................... 9

2. LITERATURE REVIEW ......................................................................................................... 11
   2.1 CORPORATE MOTIVATION FOR SUSTAINABILITY INITIATIVES .................................. 12
   2.2 SUSTAINABLE SUPPLY CHAINS .................................................................................. 12
   2.3 REUSABLE CONTAINERS IN CLOSED LOOP SUPPLY CHAINS .................................. 13
   2.4 INCENTIVES AND THEIR INFLUENCE ON HUMAN BEHAVIOR .................................. 14
       2.4.1 Deterministic Drivers of Environmental Consciousness Among Consumers ........... 15
       2.4.2 Factors Promoting Recycling Among Consumers .................................................. 17

3. METHODOLOGY .................................................................................................................. 20
   3.1 BACKGROUND ON TOTE SUSTAINABILITY CALCULATIONS .................................. 20
   3.2 PILOT PROGRAM PROCESS MAPPING ........................................................................ 21
   3.3 PILOT PROGRAM INTERVIEWS .................................................................................... 21
   3.4 PILOT PROGRAM DATA ANALYSIS METHODOLOGY ............................................... 22
   3.5 SYSTEM DYNAMICS MODELING OF THE PILOT PROGRAM ......................................... 23
   3.6 MIT LOGISTICS PROCESS METHODOLOGY ................................................................. 23

4. PILOT PROGRAM ANALYSIS .................................................................................................. 24
   4.1 PILOT PROGRAM BACKGROUND ............................................................................... 24
       4.1.1 Operational Design and Structure in the Pilot Program ......................................... 25
       4.1.2 Communication Strategies in the Pilot Program .................................................... 29
       4.1.3 Implementation ...................................................................................................... 30
   4.2 UNIVERSITY A DATA ANALYSIS ............................................................................... 30
       4.2.1 Customer Segmentation .......................................................................................... 32
       4.2.1.1 Customer Segmentation by Percentage Tote Loss ........................................... 33
       4.2.1.2 Customer Segmentation by Order Volume ....................................................... 36
   4.3 SYSTEM DYNAMICS MODEL FOR PILOT PROGRAM ATTRITION RATE ...................... 40

5. DESIGNING A NEW PROGRAM ............................................................................................. 45
   5.1 BACKGROUND FOR DESIGNING A NEW PROGRAM .................................................. 45
       5.1.1 Comparing University A to MIT ............................................................................ 46
   5.2 MIT CUSTOMER ORDERING PATTERNS .................................................................... 48
   5.3 DESIGNING A REUSABLE TOTE PROGRAM FOR MIT .................................................. 51
       5.3.1 Operational Process Gaps to Address .................................................................... 52
       5.3.2 Communication Gaps to Address .......................................................................... 53
   5.4 MIT PROGRAM DESIGN OPTIONS ............................................................................... 54
       5.4.1 Designing For Current Structures & Systems (CSS) .............................................. 57
           5.4.1.1 Collaboration - CSS ....................................................................................... 57
           5.4.1.2 Operational Consistency - CSS ................................................................. 57
           5.4.1.3 IT Systems - CSS ......................................................................................... 62
           5.4.1.4 Communication - CSS ................................................................................ 62
           5.4.1.5 Incentives - CSS ......................................................................................... 65
           5.4.1.6 Experiment Design - CSS ......................................................................... 68
       5.4.2 Recommended Design (RD) .................................................................................. 69
5.4.2.1 Collaboration - RD..................................................................................................... 69
5.4.2.2 Operational Consistency - RD................................................................................... 69
5.4.2.3 IT Systems - RD ......................................................................................................... 71
5.4.2.4 Communication - RD .............................................................................................. 72
5.4.2.5 Incentives – RD ........................................................................................................ 74
5.4.2.6 Experiment Design – RD.......................................................................................... 74
5.4.3 MIT Design Recommendations Summary....................................................................... 75

6. CONCLUSIONS ..................................................................................................................... 77
   6.1 SUMMARY OF FINDINGS.................................................................................................... 78
   6.2 RECOMMENDATIONS FOR SCALE UP ........................................................................ 79

7. BIBLIOGRAPHY.................................................................................................................... 82
List of Figures

Figure 1: Operational Flow of a Tote Order Through the System .............................................................. 27
Figure 2: Gross Tote Loss per Month and Attrition Rate per Month .......................................................... 32
Figure 3: Customers by Percentage Tote Loss ......................................................................................... 33
Figure 4: Order Volume by Customer Percentage Tote Loss ..................................................................... 34
Figure 5: Tote Loss by Customer Percentage Tote Loss ............................................................................ 35
Figure 6: Customers, Totes Delivered and Totes Lost as a Percentage of Total, Segmented by Percentage Tote Loss .................................................................................................................. 36
Figure 7: Customers by Orders per Customer ........................................................................................... 37
Figure 8: Totes Delivered by Orders per Customer .................................................................................... 38
Figure 9: Totes Lost by Orders per Customer ............................................................................................ 39
Figure 10: Percentage Tote Loss by Orders per Customer ......................................................................... 40
Figure 11: Factors Influencing Tote Return and Tote Loss ........................................................................ 41
Figure 12: Customers by Average Days Between Orders ............................................................................. 43
Figure 13: Percentage Tote Loss by Days Between Orders .......................................................................... 44
Figure 14: Campus Map of MIT with Main Loading Dock Locations ......................................................... 48
Figure 15: Average Number of Orders Per Building by Campus Zone ..................................................... 49
Figure 16: Customers by Orders per Customer .......................................................................................... 50
Figure 17: Customers by Average Days Between Orders ............................................................................ 51
Figure 18: MIT Order Volume By Month .................................................................................................. 65
Figure 19: Cost-Benefit Analysis of the Pilot Program at University A ....................................................... 76
Figure 20: Projected Cost-Benefit of the Program at MIT ........................................................................... 77
Figure 21: Potential Evolution of Sponsor Success for Reusable Tote Program Scale Up ............................. 81
List of Tables

Table 1: University A Tote Loss ................................................................................................................... 31
Table 2: Comparison of Selected Data of University A and MIT ................................................................. 46
Table 3: Ordering Patterns at MIT by Campus Section ............................................................................. 49
Table 4: Estimate of Tote Purchase and Cardboard Savings for MIT Program ........................................... 55
Table 5: Expected Sponsor Savings/Costs .................................................................................................... 56
Table 6: Tote Pick Up Locations Options at MIT ....................................................................................... 59
Table 7: Pick Up Time Options for Empty Totes ...................................................................................... 61
Table 8: MIT Strategic Communication Plan ............................................................................................ 63
Table 9: Negative Incentives Options for the Reusable Tote Program at MIT ............................................ 66
Table 10: Positive Incentives Options for the Reusable Tote Program at MIT .............................................. 67
Table 11: Drop Off Locations in the Recommended Design ......................................................................... 70
Table 12: Proposed Communication Prompts When Customers Place an Order ...................................... 72
1. **INTRODUCTION**

In the past several decades, environmental sustainability has come to the forefront of public awareness, touching virtually every aspect of society, including the business world. Organizations recognize that their growth comes with increased costs of doing business, particularly in terms of energy costs. The rising cost of oil has had an outsized impact on business operating costs, including energy used in manufacturing, fuel used in transportation, and materials used in packaging. Thus, infusing environmental sustainability initiatives into business practices has become a critical factor to ensure the longevity and long-term profits of corporations. In addition, companies are pursuing sustainability initiatives not only because they could lower overall costs but also because customers are increasingly searching for sustainable products. Being at the forefront of sustainability could serve as a competitive advantage for companies: they can lower their operating costs, be less vulnerable to price shocks in the energy market, and secure relationships with customers who are often willing to pay a premium for sustainable practices and create shareholder value.

The sponsor company of this thesis project (referred to herein as the Sponsor) is a retail company that delivers consumable goods to both corporate and individual customers. The Sponsor has already incorporated sustainability initiatives into its corporate strategy and is continually looking for ways to innovate and advance its sustainability in all aspects of its business. Part of this initiative includes exploring how to deploy reusable packaging (now referred to as totes) to replace the standard disposable corrugated cardboard used to ship orders to its corporate customers. Corporate customers will return the totes to the Sponsor for reuse, cutting down on the packaging cost and environmental waste of one-time use corrugated cardboard. In addition, sustainability initiatives such as reusable tote programs could increase customer retention in the long term because sustainability is something its’ customers value. The Sponsor believes this idea is viable with its corporate customers, whose deliveries per location are dense enough to allow for drivers to pick up
the totes while on their existing delivery routes. The Sponsor is not currently contemplating extending the use of reusable packaging to individual end consumers because the distribution network to these customers is too spread out.

The Sponsor has actively explored how to expand their use of sustainable packaging for its customers. In Ng and Chow’s 2010 thesis titled “Environmental, Operational and Financial Sustainability of Packaging Methods in Delivery Businesses,” the authors explored what was the most sustainable innovation in packaging for the Sponsor. It was concluded that reusable plastic totes were most suitable for the company’s goals. However, they also concluded that a reusable tote program would only be financially sustainable if the number of cartons not returned, otherwise known as the attrition rate, was less than 5%, and environmentally sustainable with an attrition rate of less than 20%. Ng and Chow encouraged collaboration, communication and incentives to keep attrition rates among users of reusable totes customers as low as possible (Ng & Chow, 2010).

The Sponsor has identified two measures of success for implementing a reusable tote program: (1) the cost of the totes and (2) their impact on the environment versus corrugated cardboard boxes. An initial pilot conducted at a university beginning in late 2009 resulted in an attrition rate (the rate at which reusable totes are not returned to the Sponsor) that was too high for the program to be viable. In other words, the investment in totes, inclusive of replacing lost totes, was greater than what the investment in cardboard would have been. Furthermore, if the unrecovered totes ended up being thrown out into a landfill, the totes are more harmful to the environment than cardboard boxes, which would have been recycled under the university’s waste management program.

This thesis attempts to understand the factors that can be adjusted to improve the attrition rate observed in the pilot program, how to design the logistics system for ease of tote return for both the Sponsor’s operations and customer convenience, and how to incent customers to return
the totes in a way that is both environmentally and financially sustainable. We analyze the MIT campus as a testing ground for a new pilot program, designed with these goals in mind. If there is a significant enough improvement in the success metrics for the MIT experiment, the Sponsor will roll out the returnable tote system to other corporate customers. Therefore, identifying factors from the pilot program that will make the MIT design, and its subsequent implementation, successful will have an impact on the scale up of this type of sustainable packaging for the Sponsor and its customers.

To understand the drivers behind tote loss we used data on ordering patterns and tote loss as well as qualitative interviews with stakeholders from the pilot program. We then compared the Sponsor's operating logistics system and the customer ordering patterns at the pilot program to those at MIT, to understand how similar a reusable tote program at MIT would be to the pilot program. The thesis concludes with operational and communication recommendations for the design of the MIT tote program and nationwide scale up.

2. LITERATURE REVIEW

The bodies of literature concerning supply chain design and sustainability in business are both vast and growing. In light of the fact that this thesis will focus on the successful interaction between companies and consumers in achieving sustainability, this literature review will focus on four main areas: (1) why and how companies are incorporating sustainability into their supply chains and overall corporate strategies, (2) examples of existing reusable container programs, (3) how incentives drive human behavior and (4) what factors shape environmentally conscious consumer behavior and how to engage consumers to actively participate in sustainability initiatives.
2.1 Corporate Motivation for Sustainability Initiatives

The motivation for introducing the concept of sustainability in corporate operations is largely based on the desire to create shareholder value. According to a McKinsey & Company survey of close to 2,000 corporate executives, the majority (76%) pursue sustainability initiatives to create shareholder value. The top three reasons for value creation are enhancing the company's brand and reputation, aligning with the company's business goals, and improving the company's operational efficiencies by lowering costs (McKinsey, 2010). Corporations are increasingly reporting their sustainability initiatives to the public to help with brand reputation. According to a PricewaterhouseCoopers LLC study of 602 global companies, 81% now provide corporate social responsibility information on their websites (PricewaterhouseCoopers, 2010). Corporations are also thinking about how sustainability can improve their competitive advantage. Porter and Kramer argue that companies need to "operate in ways that secure long-term economic performance by avoiding short-term behavior that is socially detrimental or environmentally wasteful" (Porter & Kramer, 2006). These authors cite examples of DuPont saving $2 billion through energy-saving initiatives since 1990 or McDonald's redesigning its food wraps to reduce waste by 30% (Porter & Kramer, 2006). As more companies understand how implementing sustainability initiatives, they can concurrently reduce costs and promote their brands, sustainability initiatives will become an integral part of strategy and business operations.

2.2 Sustainable Supply Chains

When companies look to introduce sustainability initiatives into their supply chains, they often look to closing the supply chain loop as the most obvious way to improve environmental impact (Quariguasi et al., 2010). However, as Quariguasi et al. point out, closing the supply chain loop can mean many things: increasing transportation efficiency by increasing truckload utilization or finding alternative uses for back-haul routes, encouraging end-of-use recycling, remanufacturing
using recycled materials, and finally using reusable packaging. Depending on the company’s supply chain, these alternatives can have varying effects on the environmental impact of the company’s activities. These authors therefore propose a model to assess the lifecycle of the product in the supply chain and conclude that reuse and remanufacturing usually have much more environmental benefits than other sustainability initiatives. However, they also concur that few models exist that truly evaluate the environmental impact of changes in the supply chain. Given the difficulty of assessing environmental impacts of closed supply chain efforts, and the motivations of brand impact and cost savings shared by many companies in the pursuit of sustainability, at this juncture it is appropriate for the Sponsor to rely on the financial impact of the totes and customer satisfaction of its reusable tote program as measures of success.

2.3 Reusable Containers in Closed Loop Supply Chains

Much has been researched and written about closed loops and reverse logistics in supply chain management. The Council of Logistics Management defines reverse supply chain as “the process of planning, implementing and controlling the efficient, cost-effective flow of raw materials, in-process inventory, finished goods and related information from the point of consumption to the point of origin for the purpose of recapturing value or proper disposal” (Nukala & Gupta, 2006). Manufacturing companies have used reusable containers in closed-loop systems with their long-term suppliers for many years to aid in just in time inventory and to reduce packaging waste. More recently, retail companies have adopted reusable containers to ship goods from suppliers and warehouses to their store locations (Saphire, 1994). Saphire lists the many environmental and economic benefits that can arise from the use of reusable containers in these industries, including waste prevention, resource conservation, reduced costs of packaging materials, disposal, and even handling and storage. He also notes that there are certain conditions that make reusable container use beneficial: short distribution distances, frequent deliveries, small number of parties and dedicated
distribution vehicles. All of these characteristics can be used to describe many of the Sponsor’s corporate customers, which is why they are appropriate candidates for reusable tote programs.

It makes sense, then, that employing reusable containers for delivery to the end consumer is a relatively new concept, since there are few instances where a company that delivers directly to consumers has both a dense grouping of consumers who also receive frequent deliveries. Therefore, little research exists on the subject. Our review focuses on articles concerned with the use of reusable containers to end-users. Duhaime et al. provide a study of reusable containers sent to large customers by the Canada Post (Duhaime et al., 2001). The Canada Post often experienced a shortage of reusable containers within its system, and as with the Sponsor, there were several reasons posited. However, the authors found that the main problems with container shortages were geographic imbalance, characterized by containers sitting unused in low demand areas while customers clamored for more containers in high demand areas, and delay, when it took too long for the empty containers to become relocated back to the high demand areas. While these reasons for shortage are not exactly similar to what the Sponsor has seen in the pilot program, it does provide insight into potential pitfalls to monitor in future programs.

2.4 Incentives and Their Influence on Human Behavior

A closed-loop supply chain dependent on end-consumer involvement is somewhat prone to risk due to the unpredictability of human behavior. The fundamental reasons why human beings act and make the decisions they do have long been a fascination of researchers. The ability to predict how and why someone will act in a specific context has multiple drivers. This discussion will be limited to the way in which incentives can influence human behavior.

An incentive is some sort of driver, whether in the form of reward or punishment, which induces a person to act (Mankiw, 2007). Incentives can be categorized in several different ways, but they must be positive or negative in nature. Therefore, positive and negative incentives are mutually
exclusive of each other. For example, positive monetary incentives include prizes or discounts, whereas late fees or taxes would be categorized as negative monetary incentives. Examples of positive and negative psychological incentives are ones that cause good feelings about oneself and ones that produce feelings of shame and embarrassment, respectively.

Incentives have long been used to influence consumer behavior, mainly to address what motivates a consumer to buy a particular product. The answer to that question can differ depending on the researcher's field of study. Economists study the effects of monetary incentives, while psychologists look at how morality or guilt can motivate people, and social scientists focus on how external environmental factors influence consumer habits. The following discussion attempts to take into account all of these perspectives, focusing mostly on moral, psychological, and social avenues to understand the factors that drive consumer behavior. Furthermore, it is important to note that the literature we have chosen focuses on different theories pertaining to how and why consumers make environmentally conscious decisions.

2.4.1 Deterministic Drivers of Environmental Consciousness Among Consumers

There are several different intrinsic motivational theories used to describe why consumers choose environmentally conscious or environmentally friendly products. The predominating theory, based on a number of empirical studies, is that the connections between morality and environmental attitudes are strictly altruistic in nature. People who derive personal satisfaction from doing the right thing and believe that they are contributing to the larger good by recycling are more likely to recycle (Alcalde, et al. 2005). For example, in a study exploring linkages between consumer choices and morality, researchers found consumers were more likely to buy products with sustainable packaging when environmentalism was viewed as a moral value and it took precedent over other decision factors (Thogersen, 1999). Thogersen expands upon the idea of perceived consumer effectiveness. This measure "captures the person’s perception of his or her ability to do something about a social
problem and that its influence on behavior is mediated by personal norms” (Thogersen, 1999). He stresses that environmentally conscious consumer choices are more likely to be made when consumers perceive that their choices will have a positive environmental impact.

Thogersen stresses that the confluence of these two factors: perceived valued connections between a consumer’s choices and various environmental problems, in conjunction with the absence or diminished influence of other factors, will facilitate a personal norm to choose products with environmentally friendly packaged products. He suggests promoting practices that can increase the intrinsic motivation of consumers will work best to influence environmentally conscious consumption behavior. This effort will be important information when trying to understand how consumers view reusing plastic cartons. Reusable packaging could be perceived by these consumers to have a magnified environmental impact due to its potential for multiple uses.

Furthermore, other studies have shown that people who tend to care more about environmental issues possess values that promote the interests of others and the natural world, also known as self-transcendent values. In contrast, others are more likely to pursue more individualistic goals, rather than those of the greater good. This second group of people is known to hold self-enhancing values. Because people with self-transcendent values are more likely to adopt environmentally conscious behaviors without any prompting from outside forces, some researchers have argued that environmental messaging needs to target people acting in their own self-interest to have a greater impact. Thus, environmental messaging must be tailored to influence people in a way that is more relatable, tangible, and reflective of self-enhancing values (Schultz & Zelezny, 2003). Messages that are action-oriented and align with self-interest are optimal. For example, programs that encourage recycling through the use of positive monetary or economic incentives will cultivate the desired consumer behavior.
Stephen Kaplan offers a different perspective on how to explain environmentally responsible behavior in human beings. He begins by debunking the myth that environmental consciousness is born out of only altruistic motivations. He believes this model is overly simplistic, limiting, and often stresses the use of guilt or sacrifice to incent people to change their behavior. People often view self-interest and altruism as mutually exclusive, but in reality some sort of self-interest and thinking that there will be an external benefit motivates a large deal of altruism. He argues that people do not like to feel helpless or disoriented, but rather explore their surroundings, acquire information at their own pace and participate in the world around them (Kaplan, 2000). Thus, he proposes a method that is consistent with the way in which people receive new information and how it relates to motivation (Kaplan, 2000). He creates a new model that highlights motivation through quality of life enhancement components and argues that the way in which humans process information may lead to better outcomes when it comes to promoting environmentally responsible behavior.

Using this new model of human behavior, Kaplan suggests finding a way to motivate people to be environmentally responsible that “reduces their sense of helplessness and, at the same time, is sensitive to their needs and inclinations” (Kaplan, 2000). Defining activities that promote a confluence of self-interest and altruism are more likely to be satisfying and sustainable to people, as opposed to pitting the two concepts against each other. Recognizing that there might be more than one solution to an issue, promoters of environmentally beneficial behavior have a better chance of succeeding. Thus, it is more effective to give people a wide array of options that they can then choose from, rather than telling people the one thing they can do.

2.4.2 Factors Promoting Recycling Among Consumers

With a deeper understanding of what motivates consumers to adopt environmentally friendly behavior, we now focus on the academic literature that explains why customers return reusable packaging. Literature directly relating to how to incent consumers to return reusable packaging is
still an emerging field, so we have adopted consumer involvement in recycling programs as the closest alternative available to evaluate. Specifically, the review focuses on (1) the use of incentives and information to transform consumers into recyclers and (2) any other factors that could influence recyclers.

In a study by Easwar Iyer and Rajiv Kashyap, the authors explore how incentives and information dissemination can increase participation in community recycling programs. Specifically, they focused on how to get more people to recycle more frequently in a way that ensures the desired recycling behavior is sustained over time. Their main conclusion is that while incentives will motivate people to adopt a new behavior, it is sustained, targeted messaging that contributes to people adopting and maintaining new behaviors towards recycling (Iyer & Kashyap, 2007).

These authors make an important distinction when explaining the role of information in recycling programs: there is information as communication and information as knowledge. Information as communication is highly dependent on the combination of its content, outlet, and format, whereas information as knowledge has the ability to transform people’s behaviors. For example, when using information as knowledge, one study found that when employing written and verbal information packets about recycling programs, participation rates increased by six percent (Iyer & Kashyap, 2007).

Results from their study included several conclusions. First, interventions are essential because recycling practices have not yet been widely embedded and normalized into customers’ normal behavior and will be needed until recycling behavior is second nature to the consumer. The frequency of recycling message interventions is also extremely important because continual reminders will increase the desired behavior. Second, offering incentives has “an immediate and dramatic effect” on increasing recycling behaviors in the short term (Iyer & Kashyap, 2007). More important, however, “disseminating information that increases consumers’ knowledge has a more
lasting effect on recycling output than offering incentives” (Iyer & Kashyap, 2007). They hypothesize it is because while incentives are temporary, education through information influences a consumer’s core values and beliefs, which are more fundamental drivers of consumer behavior. So while both methods are effective, informational programs have longer-lasting effects than incentive structures.

Other studies confirm the use of information and the importance of prompting people to recycle as key ways to influence recycling behaviors. In a study by Hopper and Nielson, regular intervals and prompting of information increased household recycling levels by 20% (Hopper & Nielson, 1991). Thus, they argue, prompting and information strategies will increase desired recycling behaviors.

Beyond information influences, a study of 18 cities in Taiwan and Japan by Kuo and Perrings delved further into what drives recycling besides the factors of each city’s specific policies in place, such as penalties, mandatory recycling, use of specific containers, etc. The most significant factor was the time cost of recycling. They defined time cost as “a measure of the time elapsed between waste generation and disposal” and concluded that “the most effective measures reduce the marginal cost of favored disposal options or raise the marginal cost of unfavored options, either directly or through the disposal and recycling collection protocols that affect the time cost of those options” (Kuo & Perrings, 2010).

This section has explored the motivation for corporations’ interest in implementing sustainable initiatives, the essential elements needed to design a sustainable reverse loop supply chain with consumer involvement, and how a deeper understanding the fundamental determinants of consumer behavior is important when consumers are a vital link in the supply chain. The subsequent sections of this thesis will explore how these key factors can be synthesized to design a successful sustainable closed loop supply chain involving reusable packaging using the relevant literature.
3. **Methodology**

In order to gain further proof of concept for using reusable packing to deliver products, we needed to understand the design, implementation, and current state of the program at the university chosen by the Sponsor for implementation of a pilot (referred to herein as University A). The pilot at University A is not currently financially sustainable because the Sponsor has observed that the attrition rate of totes is above the acceptable level established by Ng and Chow’s work (Ng & Chow 2010). The initial analysis focused on quantifying the rate of tote loss versus expectations and identifying the most likely operational and consumer behavior reasons for tote loss. We then moved to compare the Sponsor’s logistical process at University A to the process at MIT, in order to design a new reusable tote program at MIT that applied the lessons learned from our initial analysis in a way that was most appropriate to the Sponsor’s logistical process at MIT.

3.1 **Background on Tote Sustainability Calculations**

The totes in the pilot program were meant to withstand up to 100 uses, implying a 1% attrition rate. From a sustainability perspective, it had been determined from Ng and Chow’s work that a tote needed to be utilized for 5 trips to be environmentally sustainable. This translates into a 20% attrition rate. However, in order for the program to be financially sustainable for the Sponsor, Ng and Chow determined a tote needed to be utilized for 20 trips in order for the upfront cost of the returnable tote to be paid off in corrugated box savings. This translates into a 5% attrition rate, also known as the target rate. For the purposes of our analysis, any tote loss in excess of 5% will be considered unsustainable.
3.2 Pilot Program Process Mapping

In order to understand the logistical design of the pilot program system, we followed totes over a two-day period from packing at the fulfillment center to delivery to consumers. We observed how ordered items were picked and packed into totes at the sole fulfillment center that served University A and how this process differed from the rest of the fulfillment center’s picking and packing process. We then observed the services provided at the third party logistics company that supplied the delivery drivers to Sponsor. As the packed totes arrived, they were sorted by the different locations of University A and loaded onto trucks for delivery to customers. Finally, we followed two delivery drivers on their routes delivering to University A’s main campus. The results of this process mapping are found in Figure 1 in Section 4.

3.3 Pilot Program Interviews

We also conducted qualitative interviews with various stakeholders involved in the pilot initialization period. We interviewed Sponsor employees at the fulfillment center where the totes are packed and shipped, the sales executive in charge of University A’s account, and a logistics executive who was involved in the operational design of the pilot program. In all, we interviewed eight people who had direct knowledge of the program’s operations since inception. We had two primary objectives in conducting our interviews: (1) understanding how the program was designed and implemented in its initial phase and (2) developing hypotheses for why the tote attrition rate was exceeding the target rate. Since we did not want to color the opinions of our interviewees, we conducted very informal interview sessions using open-ended questions, rather than using a set questionnaire. We asked each interviewee what his/her role was in the pilot’s formation, what s/he thought was going well, what needed improvement, and why s/he thought the totes were being lost. We asked the same questions of the delivery drivers of the third party logistics provider who delivers
the orders to University A on behalf of the Sponsor. Since these employees have frequent contact with the university customers, we also asked them what the customers thought of the program. We did not conduct any direct interviews with university customers, but observed them accepting deliveries and returning totes.

### 3.4 Pilot Program Data Analysis Methodology

Our data analysis of the pilot program focused on three factors: first, determining the actual level of tote loss during the pilot program, second, testing the hypotheses for tote loss factors we gathered during the interview process, and, finally, segmenting customers in order to make links from customer characteristics and behavior to tote loss.

We began our data analysis with data given to us by the Sponsor on tote return and loss over a nine-month period, from October 30, 2009, when the pilot was initiated, to July 31, 2010. The pilot program was initialized with 1,000 totes. The Sponsor data tracked each tote’s trips over its useful life, noting when it was damaged and taken out of use. The Sponsor defined a lost tote as one that had not been returned in 90 days. We calculated the average trips that each tote took before being lost, as well as the standard deviation and data distribution, which confirmed that the tote loss rate was above the acceptable rate.

We then sought to identify any patterns in the data using customer segmentation. We collected data from the Sponsor on all orders that were packed in totes over the life of the pilot program at University A, which also contained information about the customer and if the tote was lost. We compared the number of totes lost by each customer to the total orders of each customer. We segmented customers into groups of low to high tote loss rate and compared the average order volume of these groups. We then segmented customers by order volume and compared the average tote loss rate of these groups. We also calculated the average time between deliveries per customer.
to understand the amount of time that empty totes were sitting at the customer location and compared this data to the tote loss rate for these customers.

3.5 System Dynamics Modeling of the Pilot Program

As a final step in our review of the pilot program, we reviewed what we had learned from the interview and data analysis process and created a system dynamics diagram that laid out the forces that influenced tote return rates. System dynamics models are used to "learn about dynamic complexity, understand sources of policy resistance, and design more effective policies" (Sterman, 2000). We used a system dynamics approach to understand the tote loss rates because the data we gathered from the interviews and customer segmentation analyses was complex and at times, contradictory. Because a system dynamics model can effectively capture multiple and competing forces that can affect outcomes, it was the most appropriate type of model to understand tote loss. We focused on the forces that influenced tote pickup and loss rates so that we would be able to design a new pilot program for MIT that could manipulate these forces in order to improve tote return.

3.6 MIT Logistics Process Methodology

As the final step in our methodology, we analyzed the supply chain process that the Sponsor uses at MIT as compared to University A. We interviewed four people within MIT’s Procurement department, three account managers at the Sponsor company who handle MIT’s account, and the logistics executive at the Sponsor company who designed the delivery routes for MIT. We also followed the Sponsor’s delivery drivers for a day of deliveries on MIT’s campus to understand the different process they used versus the process used at University A to deliver orders.

We also looked at the density of orders on MIT’s campus to discern if there were any differences to the order density we observed at University A. We then analyzed the patterns of
orders that MIT consumers made to the Sponsor so that we could compare them to University A’s consumers. Because MIT does not have a reusable tote program in place yet, the only metrics on which MIT and University A’s consumers can be compared are (1) number of orders and (2) time between orders. We were, however, able to compare the different logistics systems used to deliver orders and make recommendations based on the experience at University A. Using this information and the knowledge gathered in our process mapping and data analysis of University A and our literature review, we enumerated the different options for the MIT program’s possible designs and made two recommendations for the pilot program to the Sponsor: (1) designed for ease of implementation with the current structures and systems and (2) a recommended design that would require more integration with current structures, but yield more benefits from lower attrition rates.

4. **Pilot Program Analysis**

This section will detail how and why the Sponsor and University A formed a partnership to start a reusable tote program on the campus of University A. It will give an overview of the logistics system in place to deliver products in totes and the communication strategies employed to ensure consumers were aware of their crucial role in the program. The section will then analyze the success of the program’s first nine months through customer attrition rates and ordering patterns. Lastly, we will model tote attrition rate through a system dynamics approach to explore the various factors affecting tote return. The analysis will serve as a baseline to design a new reusable tote program at MIT, which will follow in Section 5.

4.1 Pilot Program Background

Colleges and universities across the country have been pioneers in environmental sustainability initiatives. One major university’s interest in becoming more sustainable led to the
launch of a campus-wide sustainability project. University A committed itself to be more sustainable throughout all aspects of its operations, including reaching out to implement supporting programs with its suppliers when possible.

University A’s stakeholders knew that the Sponsor was a leader in sustainability initiatives. Upon launch of their sustainability initiative, University A soon started discussions with the Sponsor to evaluate the feasibility of implementing a sustainable packaging program. The idea was to fulfill the University A’s orders from the Sponsor using a tote that was plastic, corrugated, and collapsible, rather than corrugated cardboard. The orders would be delivered to customers on campus and the totes would eventually be picked up by the delivery drivers and returned to the Sponsor’s fulfillment center for reuse. The proposed system would not only reduce the volume of cardboard that had to be used and recycled, but also increase awareness of sustainability among the general population at University A. The program, if successful, would lower the Sponsor’s cost of packaging materials and improve its reputation as a sustainable leader in its industry.

The Sponsor was eager to work with University A and treated this endeavor as a pilot program to test environmental and financial feasibility. If it were successful, it would add weight to the argument that such changes could be made to its other customers’ delivery and packaging options, and eventually scaled up nationally. Both University A and the Sponsor believed the proposal was a viable undertaking and implementation began relatively quickly.

4.1.1 Operational Design and Structure in the Pilot Program

In order to begin as soon as possible, the reusable carton program was configured to utilize existing programming, customer service, and logistics structures. This intent meant that the design of the reverse logistics loop to return the totes would have to be built on the shoulders of existing operating structures. Consequently, the reverse logistics loop system design was not as comprehensive as it could have been. In addition, the program had to work within the existing
supplier contract with the university, which called for desktop delivery, no minimum order size, and overnight delivery service. These parameters all exist to maximize the number of customer orders and number of delivery locations served, which made implementation more complicated. While our literature review revealed that reusable packaging programs worked well with few, concentrated customers and frequent deliveries, the contractual constraints hindered the system's ability to optimize tote return (Saphire, 1994).

The Sponsor's fulfillment center handled orders for multiple customers, but once the program commenced, University A's orders were segmented for reusable tote packaging. The tote's dimensions were large enough to accommodate orders with multiple line items. If the order's contents were too big for one tote, multiple totes could be used to fulfill the order as necessary. However, each tote would be used for only one order and multiple orders would not share a tote. The totes were not sealed, but rather used overlapping flaps for simple assembly or breakdown for customers and the Sponsor staff. In addition, no filler packaging, also known as dunnage, was used to pack the orders in order to reduce packaging materials and increase sustainability through materials reduction. Not all of the University's orders were packed in totes, however. Some large items, known as bulk items, already came in a cardboard box suitable for shipping. Other orders were small enough to fit into a paper envelope, and were shipped that way to improve transportation efficiency.

A detailed overview of the life cycle of a tote through the entire system - from being fulfilled in the fulfillment center, to delivery at the customer's location, to its empty trip back to the fulfillment center - is shown in Figure 1.
As seen in Figure 1, the orders would be filled and packed at the Sponsor’s fulfillment center, then loaded onto a line haul truck and delivered to the third party logistics (3PL) company overnight. The 3PL would then deliver the orders to customers among the various university locations. The Sponsor stayed committed to their overnight desktop delivery service, meaning when a customer placed an order, s/he would receive it at his/her workstation the next day. With over 1,000 delivery locations throughout the university’s various campuses, this was a large undertaking.

Also shown in Figure 1 are the various ways in which the customer could return the empty tote to the Sponsor. The customer could choose to unpack the delivery and give the tote back to the delivery driver right away. If that was not possible, the delivery driver could pick up the empty tote when s/he made the next delivery to the customer. However, unless the customer placed orders frequently, this meant that an empty tote could sit with the customer indefinitely. Once the tote was
returned to the delivery driver, the tote would be returned to the 3PL warehouse, where it was put on the line haul truck and returned to the Sponsor’s fulfillment center the next night.

The Sponsor maintained an extensive customer management system (CMS) that tracked orders throughout their journey. However, this system could not be easily modified to add tote tracking for the pilot program. Therefore, the Sponsor decided to implement a manual tote tracking system for the program with the assistance of a Microsoft Access database. Each tote was assigned a tote ID. When an order was fulfilled using a tote, the order ID was first scanned through the existing CMS. Then, the order ID and tote ID would be scanned and linked together with this secondary system before the tote was loaded onto the line haul out of the fulfillment center. This secondary system was only implemented at the fulfillment center; so subsequent tracking of the tote was done by tracking the order ID through the existing process of the CMS. The order ID was then scanned in to the 3PL when it was being unloaded from the truck. The next day the order ID would be scanned at the customer location upon delivery.

This step-by-step tracking process was lost on the reverse logistics loop because historically there was no need for reverse logistics tracking in the CMS. The only time the tote ID would be scanned after it left the fulfillment center was when it once again reached the fulfillment center on its return trip. As an added layer of complexity, the tote ID would only be scanned back into the fulfillment center when it was being filled with the next order. Therefore, essentially the tote would be scanned in from one order and immediately scanned to go back out with another order in the same day. This delay in scanning upon return to the fulfillment center meant that there would be totes available to use in the fulfillment center, but the database information would display that the totes were still at the customer location.
4.1.2 Communication Strategies in the Pilot Program

For the program to be successful, customers had to not only be aware of its existence, but also be willing and committed to returning the totes to the Sponsor. Several communication strategies were employed before the start of the reusable tote program to ensure customers were informed of the upcoming change. A website connected to University A’s intranet was created to explain the details of the program and included a frequently asked questions section and other pertinent information customers might need. Marketing pieces were created and sent out via email to all university employees that could place an order with the Sponsor, and subsequently posted on University A’s procurement and ordering intranet site. Every customer would see an announcement about the new program when s/he logged into the university’s intranet procurement site. Furthermore, once an end user chose a “ship to location” for delivery, a message on the ordering website appeared reminding the user of the tote program.

Beyond the flyers and web advertisements and reminders, the Sponsor utilized their delivery drivers as well. As the face of the company, the delivery drivers already had established relationships with customers, especially those who ordered frequently, and would be able to spread the word about the new program. The drivers even brought a prototype of the plastic tote to customers before the program started to explain the program and importance of returning them.

The last detailed communication was on the tote itself. It was designed to have visible signage to remind customers that the tote was property of the Sponsor. The messages “Unpack and Give Back” and “After you unpack this tote please return it to your Delivery Driver as soon as possible” were visible on the top of the box when customers would open it. In addition, the side of each tote had an environmental message intended to motivate customers to return the totes stating, “Each reusable tote we use eliminates the need for more than 100 corrugated boxes.”
messaging would serve as a final reminder to customers that the tote was not disposable and must be sent back to the Sponsor.

4.1.3 Implementation

The pilot went live in late October 2009 with 1,000 totes in operation, with approximately 20-75 totes being shipped to the university per day. As the program progressed, however, fewer totes than expected were being returned to the fulfillment center. It had been predetermined that each tote needed to complete 20 trips through the system in order for it to be financially sustainable for the Sponsor. At the rate at which the totes were being lost, with some months losing more than 10% of the total amount of available totes, this was clearly not happening. The following section will highlight key metrics and performance indicators for the first nine months of the pilot program.

4.2 University A Data Analysis

As discussed above, the primary focus of the thesis is to improve tote attrition rates for future programs. As such, the actual tote attrition rates needed to be measured to determine the base level of the pilot program. For our purposes, tote loss will be defined a tote that has not been returned to the fulfillment center within 90 days of its delivery to the customer. Table 1 summarizes these findings.
We calculated the total tote loss over the first nine months of the program. During that same time period, the totes made a total of 8,301 trips to University A’s customers. Of the 1,000 totes purchased for the program, 655 were lost in those nine months, implying an average attrition rate of 8% per month. Attrition rate is calculated by dividing the totes lost in one month by the number of totes that were delivered to customers that month. This attrition rate exceeds the target rate of less than 5%. The totes made an average 8.7 trips before becoming lost, with a standard deviation of 5.4 trips, far short of the 20 trips needed for program sustainability. Of the original 1,000 totes, 73 were lost due to damage, a rate of less than 1%. The damaged totes made an average of 8 trips before becoming damaged, but the totes were expected to last for 50 to 100 trips. Given the low damage rate, however, we can assume that these damaged totes were outliers in either design, or perhaps extraordinarily used.

Qualitative interview results suggest that the majority of totes were lost at the beginning of the program due to poor introductory communication. Figure 2 shows the gross numbers of totes lost for the first nine months of the pilot program, as well as the attrition rate of totes per month.
The data show that attrition rate has not gone down over time, suggesting different factors than those hypothesized by interviewees, who believed tote loss was highest at the beginning of the program and then tapered off. The decrease in the number of totes lost in May through July 2010 can be attributed to lower order volume in those months due to seasonality.

![Figure 2: Gross Tote Loss per Month and Attrition Rate per Month](image)

Tote loss is defined as a tote that has not been returned to the fulfillment center within 90 days of its delivery to the customer. Attrition rate is calculated by dividing the totes lost in one month by the number of totes that were delivered to customers that month.

4.2.1 Customer Segmentation

Since tote loss did not decrease over time, other factors that were present through the duration of the pilot program must have affected tote loss. We sought to identify these factors through customer segmentation, as it was hypothesized that the frequency of interaction with the delivery driver had an effect on tote loss rates. It was noted during the shadowing of delivery drivers at University A that they often had a personal relationship with frequent customers, and were more likely to pick up empty totes from these customers. In the following customer segmentation
analysis, we will graphically illustrate customers, totes delivered, totes lost, and percentage totes lost. For ease of reading, we will always display customers as blue, totes delivered as orange, totes lost as green and percentage of totes lost as turquoise. The first segmentation analysis conducted was to segment customers by the totes that they had lost as a percentage of total totes they had received.

### 4.2.1.1 Customer Segmentation by Percentage Tote Loss

Figure 3 shows that the vast majority of customers (67%) had never lost a tote, 12% had lost up to 10% of their totes, 8% had lost between 11% and 20% of their totes, and 13% of customers had lost more than 20% of their totes.

![Figure 3: Customers by Percentage Tote Loss](image)

**Figure 3: Customers by Percentage Tote Loss**

Customers are defined as the person who placed the order on the Sponsor website. Percentage tote loss is defined as number of totes lost by the customer divided by the number of totes that were delivered to that customer.

Order volume, defined as the number of totes delivered, followed roughly the same patterns when segmented by customer percentage tote loss. The majority of totes delivered were to customers who did not lose any of their totes (42%). A similar number (36%) of totes delivered went to customers who lost 10% or fewer of their totes. However, only 12% of the orders were
delivered to customers who lost between 11% and 20% of their totes, and the remaining 10% of deliveries went to customers who had lost more than 20% of their totes. Figure 4 illustrates these results.

**Figure 4: Order Volume by Customer Percentage Tote Loss**
Order volume is defined as number of totes delivered. Percentage tote loss is defined as number of totes lost by the customer divided by the number of totes that were delivered to that customer.

Finally, looking at the number of totes lost by these customer categories, it can be seen that 55% of the totes lost in the program were by customers who lost over 20% of the totes they were delivered. The remaining 45% of the missing totes were delivered to customers who lost between 1% and 20% of the totes that were delivered to them. Figure 5 summarizes these findings.
Putting all of these data together, the customers can be segmented as follows:

- The significant majority of customers, who are in compliance with the program, and represent 42% of all orders,
- Those who lose between 1% and 20% of their totes and are relatively high-volume consumers, and
- Those who lose more than 20% and are lower volume consumers.

Figure 6 illustrates this segmentation.
Figure 6: Customers, Totes Delivered and Totes Lost as a Percentage of Total, Segmented by Percentage Tote Loss

It can be concluded from this segmentation, then, that there are two types of customers to which the Sponsor should focus its outreach. There is a small group of repeat offenders who can be targeted relatively easily, and it can be hypothesized that they are losing their totes due to the infrequency of their contact with the delivery drivers, due to their low order volume. The other, larger group, which needs to be addressed, is the relatively frequent orders who are losing up to 20% of their totes. These customers order frequently enough to be aware of the process and to have contact with the delivery drivers. The reason for their tote loss may be due to the lack of regular communication and incentives that research has been found to sustain continued recycling behavior (Iyer & Kashyap 2007).

4.2.1.2 Customer Segmentation by Order Volume

We sought to understand the relationship between tote loss and order volume further by segmenting the customers by their relative order volumes. There was a relatively even distribution of low and medium volume consumers and a few high volume consumers. When segmented by
order volume, the highest category of customers was those who ordered just 2 to 4 times during the study period (31%). The next highest number of customers was in the 11 to 25 times category, or roughly one to three times per month (22%). A surprising 19% of the customers had only ordered once during the study period. There were a small number of extremely high volume consumers who received orders of more than 50 during the study period, or at least five per month. Figure 7 summarizes these figures.

![Bar graph showing customers by orders per customer](image.png)

**Figure 7: Customers by Orders per Customer**

Looking at the number of totes delivered, or order volume, by this customer segmentation, it follows that the heaviest volume categories lie in the middle. Deliveries to customers who ordered between 11 and 50 times during the study period accounted for 59% of the total order volume. The high volume orders (above 50 times) accounted for 18% of the volume, while those who ordered fewer than 11 times accounted for the remaining 23% of the volume. Figure 8 shows this distribution.
Figure 8: Totes Delivered by Orders per Customer

Totes lost by these customers followed the same distribution as order volume. The majority of totes were lost by the customers who had ordered between 11 and 50 times (53%). The highest volume consumers (those who ordered over 50 times) lost 15% of the missing totes, while the remaining lower volume consumers accounted for the remaining 32% of totes lost. Figure 9 illustrates this distribution.
Interestingly, when looking at percentage of totes lost by this customer segmentation, several patterns emerged. Customers who had ordered with relative frequency - 11 to 25 times, 26 to 50 times, and 51 to 100 times - were at or below the average percentage tote loss, at 6%, 8% and 4%, respectively. The customers who had only ordered once also only lost 7% of their totes. In contrast, the very highest volume consumers lost 13% of their totes. These findings were surprising because it had been assumed regular contact with delivery drivers was a key factor in determining tote loss percentage. The other relatively low-volume consumers were also problem customers. The customers who had ordered between 2 and 4 times lost 14% of their totes, and those who had ordered 5 to 10 times lost on average 10%. Only customers who had ordered between 51 and 100 times during the study period had an average attrition rate below the target rate. Figure 10 summarizes these findings.
Clearly there were many different reasons for tote loss when segmenting customers by the frequency of their orders. It can be concluded, then, that a successful program needs to incorporate different communication strategies to reach these different customer segments. As will be explained in the next section by the system dynamics model, customers who order very frequently need to be incented to stick with the program, while customers who order relatively infrequently need alternatives so that their empty totes do not sit at their desks waiting for pickup for too long.

4.3 System Dynamics Model for Pilot Program Attrition Rate

Given the qualitative and quantitative data gathered and the sometimes conflicting conclusions they seemed to convey, a system dynamics theory was utilized to help explain the factors behind tote loss. As Figure 11 summarizes below, there are several factors affecting tote loss rate and influencing customer behavior.

Figure 10: Percentage Tote Loss by Orders per Customer
We believe that the relationship between the delivery rate and the so-called “average time to
discard” has had the biggest impact on the high attrition of totes at University A. Delivery rate is
the rate at which new totes are brought to the customer. It is a function of how frequently the
customer orders from the Sponsor. New order delivery is the primary way that the customer
interacts with the Sponsor, which also drives the pickup rate, which is the rate at which the delivery
driver picks up old totes from the customer. The connection between delivery rate and pickup rate
creates a reinforcing feedback loop (denoted with an R - “Order Frequency” in Figure 11): the more
frequently a customer receives new totes, the more the customer interacts with the delivery driver.
This interaction positively affects both the convenience of returning totes to the Sponsor, as well as
the customer’s awareness of the program. These are the two primary factors positively affecting
pickup rates, thus creating the reinforcing loop that sends totes back through the system. If the customer is delivered to frequently, then the customer is likely to lose fewer totes, since the convenience of seeing the delivery driver frequently, as well as the delivery driver’s verbal reminders to return totes, will influence the pickup rate positively. However, if the delivery rate is too slow, then the customer does not see the pickup transaction as convenient, or s/he may forget about the totes that need to be returned. This is where the relationship between delivery rate and average time to discard plays a role. Totes that have been delivered to customers but awaiting pickup are sitting in the stock “At Customer Locations.” These totes can alternately be picked up upon next interaction with the delivery driver or lost. The customer’s time to discard is the point at which the customer no longer wishes to have the empty tote sitting in his/her office area, awaiting pickup. This time varies by person and was not measured in the pilot program. We believe that if the tote sits at the customer location longer than the customer’s time to discard, due to infrequent deliveries, then the customer will eventually throw out the tote or repurpose it. We also believe that average time to discard is the factor overpowering frequent driver interaction for the highest volume customers, causing their high attrition rates. We believe that due to the greater number of totes that they receive due to their high order volume, they have a lower time to discard than the other customers. In essence, they suffer from program fatigue, and therefore place less value on each tote sitting at their locations. Increased communication to these customers can remind them why it is important to return totes in the program. Incentives, which were not a part of the program at University A, can also decrease the loss rate for these customers by decreasing the relative value of the tote’s other uses (such as throwing them away).

There are also three balancing loops present in the system (denoted with a B). The number of totes in the stock “Available for Delivery” affects the delivery rate: the more totes in that stock, the more that can be delivered. In the case of the pilot program, no new totes have been purchased
to replace the totes that have been lost. So, as fewer totes are available for delivery, more orders will be delivered in cardboard instead of totes, since they are not available at the fulfillment center, making the program unsustainable. When the program is scaled up, the Sponsor will purchase new totes to replace lost ones, so this feedback loop will not have importance on a larger scale. Similarly, the more totes sitting “At Customer Locations” influences the rate at which those totes are either picked up or lost. These are balancing loops because the greater the quantity of the stock, the greater the rate at which the stock can then be depleted, which then lowers the quantity of the stock.

Given the crucial relationship between time between tote deliveries and the hypothetical average time it would take for the customer to discard the tote, we analyzed the average days between tote orders per customer. Figure 12 shows the distribution of customers by their average days between orders. University A’s customers had an average of 16 days between orders, with a standard deviation of 11 days and a median of 14 days. This analysis excludes those customers who only ordered once from the program.

Figure 12: Customers by Average Days Between Orders
Day is defined as a business day.
The Sponsor cannot affect the average days between orders, since this is driven by the customer’s demand. In fact, fewer days between orders would increase the Sponsor’s overall costs, because more deliveries would be made, requiring more trucks and delivery drivers to handle the increased volume. However, if the days between orders are greater than the average time to discard, then there is a greater chance of the tote being lost, which increases the cost of a reusable tote program. This conclusion can be seen in Figure 13, which shows the customer’s average tote loss percentage by the average days between orders. However, similar to the data shown in Figure 10: Percentage Tote Loss by Orders per Customer, there are two segments of customers whose attrition rates are above average: those who order very frequently and those who order very infrequently. As we recommended above, we will address these two segments in our design recommendations with both communication and logistics design strategies.

![Figure 13: Percentage Tote Loss by Days Between Orders](image)

The Sponsor can however, influence the pickup rate and loss rate through other factors, as demonstrated in Figure 11: Factors Influencing Tote Return and Tote Loss. First, awareness can be
influenced by the Sponsor’s communication strategy. Communications can supplement delivery driver interaction to boost frequency of interaction with the consumer. Increased communication increases word of mouth (“WOM”) among customers, which increases awareness, thereby magnifying the communication efforts. Second, convenience can be influenced by the program design. If the consumer does not want the tote to sit at his/her location until the next pickup, options can be designed for scheduled pickup or central drop-off points. Finally, incentives can be introduced. Incentives will increase the pickup rate for all users by making the tote less attractive for other uses, since the incentive will create a value for the tote when it is picked up, which may be greater than the value of the tote to the customer when it is used as something else. As described above, we believe a combination of incentives and increased communication will drive sustained compliance with the program for frequent users.

To summarize, the factors affecting tote pickup rate and loss rate that are under the Sponsor’s control are awareness, convenience and incentives. We will discuss specific recommendations for these factors in Section 5 and 6 as we make recommendations for the design of a new pilot program at MIT and recommendations for scale up.

5. **DESIGNING A NEW PROGRAM**

5.1 **Background for Designing a New Program**

The Massachusetts Institute of Technology (MIT) is an institution of higher education known for innovation, environmental consciousness, and pioneering the development and use of new technologies. In July 2010, the Institute contracted the Sponsor to be one of their vendors. In negotiations, the Sponsor explained its work in developing a sustainable packaging pilot program at University A, and the challenges it was facing there. MIT’s interest in sustainability led to an agreement to use the MIT campus as a test lab to further experiment with the sustainability of a
reusable tote program. Like the pilot program at University A, this partnership would provide benefits to both parties: MIT would continue to maintain its reputation as a leader in sustainability initiatives and the Sponsor would add weight to their proof of concept for developing a scalable reusable carton program.

5.1.1 Comparing University A to MIT

Differences arise in the operational environments for a reusable tote program when comparing University A to MIT.

Table 2 compares and contrasts their operational configurations.

<table>
<thead>
<tr>
<th>Table 2: Comparison of Selected Data of University A and MIT</th>
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<tbody>
<tr>
<td><strong>University Metrics</strong></td>
</tr>
<tr>
<td>Students</td>
</tr>
<tr>
<td>Student-Faculty Ratio</td>
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<tr>
<td>Campus Size</td>
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<tr>
<td><strong>Sponsor Operating Metrics</strong></td>
</tr>
<tr>
<td>Service Level</td>
</tr>
<tr>
<td>Customers Receiving Orders During Study Period</td>
</tr>
<tr>
<td>Approximate Annual Orders (Totes and Bulk Orders)</td>
</tr>
<tr>
<td>Dedicated Delivery Drivers</td>
</tr>
</tbody>
</table>

Although University A is over three times as large as MIT in terms of student population, MIT has a lower student-to-faculty ratio, due to MIT’s heavy emphasis on research. MIT’s campus is also larger by area than University A’s main campus, where the bulk of the Sponsor’s orders are delivered. So, when comparing the order patterns between the two universities, MIT has almost three times the number of active customers (customers who have placed an order with the Sponsor...
at least once during the study period) and a slightly smaller number of estimated annual orders. The number of MIT orders that will be packed in totes remains to be determined for the MIT program, but the ratio of tote orders to other orders at University A is approximately 1:3. Other orders include bulk items, which come in their own box, and those orders fulfilled by third parties for the Sponsor. Despite their differences, operational implementation will be similar because there are few levers to pull in terms of tweaking operational process and customer-service levels. Without major structural changes to the operational network in terms of tracking or dedicated delivery drivers, the design of the reverse logistics portion of the supply chain will be relatively similar. Arguably the most important difference is that the Sponsor has the opportunity to optimally design MIT's program through addressing the pilot program's implementation issues and using the lessons learned to improve tote return rates.

Figure 14 details a bird's eye view of MIT's campus. Currently the Sponsor makes deliveries at the loading docks at Building 32 and Building E19. From there, the delivery driver continues on a perimeter route of campus and makes deliveries. Meanwhile, a part-time employee takes a walking route to make deliveries to the inside buildings of the campus using a delivery cart. For the most part, the Sponsor's delivery routes are much more densely packed at MIT than University A, with multiple deliveries per building and buildings located very closely with one another. In contrast, the delivery drivers at University A often only had a few deliveries per building and needed to drive to each building location.
As mentioned earlier, the Sponsor is committed to maintaining a high level of customer service by ensuring desktop delivery. This service level and the factors discussed above will be considered when designing the reverse loop of the supply chain. The next section will discuss the analysis done to further understand the ordering patterns, density, and typical customer characteristics.

5.2 MIT Customer Ordering Patterns

As mentioned above, MIT's campus is larger than University A's main campus. MIT's campus can be roughly divided between the main campus and the East, North and West sections. However, the bulk of the orders are delivered to buildings on the main and East campuses, which are densely located, and contain many offices per building.
Table 3 details the number of orders that were delivered to MIT by the Sponsor by campus section during the eight-month study period and Figure 15 illustrates the specific campus sections and the average number of orders per building over the eight-month study period.

<table>
<thead>
<tr>
<th>Table 3: Ordering Patterns at MIT by Campus Section</th>
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<tbody>
<tr>
<td>Number of Buildings</td>
</tr>
<tr>
<td>Orders</td>
</tr>
<tr>
<td>Average Orders per Building</td>
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<tr>
<td>Average Monthly Orders per Building</td>
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</tbody>
</table>

Figure 15: Average Number of Orders Per Building by Campus Zone

The duration of the study periods of University A and MIT were roughly the same. University A’s pilot program has been running for over a year, but we contained our analysis to the
period from the beginning of the pilot (end of October 2009) to the end of July 2010, which is roughly nine months. MIT has been ordering from the Sponsor since July, so the study period is eight-months long. Thus, the two sets of data can be compared with respect to customer segmentation by frequency of orders and days between orders.

As compared to University A, MIT has close to three times the number of customers who have ordered from the Sponsor at least once. Since the total annual order volume is similar between the two universities, it can be concluded that the order volume per customer at MIT will be lower than at University A. As shown in Figure 16, the vast majority of MIT’s customers have ordered less than four times. It can be concluded from this data that delivery driver interaction will be less frequent per customer on MIT’s campus than on University A’s.

![Figure 16: Customers by Orders per Customer](image)

Days between orders follows roughly the same pattern at MIT as at University A. MIT’s customers had an average of 17 days between orders, with a standard deviation of 12 days and a median of 14 days. This is slightly higher than University A’s ordering pattern, so the Sponsor should be concerned that the waiting time between orders will be greater than the customer is
willing to hold the tote. Again, this analysis excludes those customers who only ordered once from
the program. Figure 17 illustrates the distribution of customers by their average days between
orders.

![Figure 17: Customers by Average Days Between Orders](image)

**Figure 17: Customers by Average Days Between Orders**

Day is defined as a business day.

The data above can be summarized in that in comparison to University A, MIT has more
customers, who are more densely packed, but have a similar amount of time between orders. The
Sponsor should keep these facts in mind when designing the MIT pilot, as described below.

### 5.3 Designing a Reusable Tote Program for MIT

As shown through the detailed analysis of the pilot program at University A, there is no
definitive root cause (or causes) to explain why the attrition rate of totes was so high month after
month. As shown in

Table 2: Comparison of Selected Data of University A and MIT and Section 5.2 MIT Customer
Ordering Patterns, the operational comparisons between University A and MIT are not different
enough to warrant major reverse logistics design shifts. Yet there are ways in which the Sponsor can
facilitate an improved program design for MIT by addressing gaps in design from the University A pilot. The MIT pilot has a higher chance of financial sustainability if the Sponsor addresses the following issues, which can be broken down into process and communication gaps.

5.3.1 Operational Process Gaps to Address

During a walk-through of the tote cycle process, several process issues that could be corrected were identified. The Sponsor could improve tote utilization by reducing packing errors at the fulfillment center. Some of the bulk orders were being categorized as tote orders, which skewed the actual number of orders being packed in the totes. On the other hand, the Sponsor should have also ensured orders small enough to fit in envelopes did not get packed into totes. Not only do customers tend to dislike when a small order comes in excessive packaging, but this change would improve the environmental impact of the tote program because fewer totes would have been sent, which would decrease the chances of tote loss and lower the overall impact the Sponsor’s transportation has on the environment. Both the bulk orders and packing small orders in envelopes were fixed relatively easily by adjusting the Sponsor’s CMS.

Tracking the totes’ location, especially during the reverse loop, was not as strong as it could and should be. Presently the only time a tote’s presence is known in the reverse loop is when it is scanned back into the fulfillment center. The Sponsor was missing opportunities to scan the tote once the delivery driver had picked it up from the customer at the pick-up location, the 3PL’s warehouse, and line haul points. Furthermore, the tote was only scanned into the fulfillment center on the same day it goes back out with a new order, meaning, it could potentially be sitting in the warehouse for days before it is considered returned. This result was skewing the number of days a tote is out with a customer. Scanning the totes in when they are returned to the fulfillment center would result in more accurate tracking and cycle time for the program. However, the Sponsor must
consider the additional labor time that may be involved in increased scanning in the reverse logistics loop. We believe the system benefits of tracking will outweigh the financial cost of implementation.

Presently the drivers are sometimes going back along their delivery route to pick up empty totes from customers if there is time after making all of the current day’s deliveries. This extremely variable pickup system not only increases tote cycle time, but also contributes to the increase in delivery driver time and mileage, which decreases route efficiency. There needs to be more use of the email address provided by the 3PL that customers can use to arrange a pick up for an empty tote. Increasing customer awareness of this option could increase the tote return rate and reduce the need for delivery drivers spending time on tote-finding missions. A standardized e-mail protocol and tote collection expectations should be designed and widely communicated to MIT campus customers for better tote collection rates.

5.3.2 Communication Gaps to Address

Improvements in the way customers receive communication about the reusable tote program could yield better results in the desired customer behavior. As seen in the academic literature on sustaining positive changes in consumers’ recycling behavior, the Sponsor needs to use continued, targeted, and ongoing messaging to its customers regarding the reusable tote program (Iyer & Kashyap 2007). This is especially important for customers who are not placing orders frequently, for those who have held onto totes for a long period of time and for those who order so often that they may be suffering from program fatigue. Engaging the customers in creative and continuing ways will increase the chance of totes being returned.

Overall communication strategies can be culled from Figure 11: Factors Influencing Tote Return and Tote Loss. The “WOM” (Word of Mouth) reinforcing loop shows that if the Sponsor can correctly saturate its customers with information about the reusable tote program, overall awareness of the program will increase on campus through word of mouth, which will increase the
rate of tote return. Hence, the Sponsor should invest in multiple channels of communication to spread awareness of the program including, but not limited to promotional flyers, emails, prompts in the intranet ordering system, and dedicated contact points for customers.

As shown in the analysis conducted from University A, segmentation of customers by their ordering patterns also has the potential to help the Sponsor improve their tote return rates. As seen in Figure 6: Customers, Totes Delivered and Totes Lost as a Percentage of Total, Segmented by Percentage Tote Loss, customers ordering at high volumes lost between 1% and 20% of their totes and will need frequent reminders to return totes. The assumption is that because they are high-volume consumers they will most likely have totes in their possession at any given time. We have also assumed that their average time to discard is lower than a lower volume consumer because they are more likely to have multiple totes sitting in their offices, which may become more of a nuisance to them over time. The analysis from University A also shows that the longer a tote sits with a customer, the more likely it is to become lost. Thus, frequent reminders will prompt them to schedule a pick up with a delivery driver. In contrast, the customers who order infrequently and lost more than 20% of the totes delivered to them need upfront education and targeted communication to return a tote. For first time customers, for example, delivery drivers can encourage customers to unpack the order immediately to return the tote at the time of delivery. Otherwise, the delivery driver can deliver some sort of messaging around returning the tote by scheduling a pick up.

5.4 MIT Program Design Options

Ideally, the critical factors for success for a reusable tote program should have been identified from the analysis conducted with the pilot program at University A. Yet, with all of the qualitative and quantitative data we have amassed, the analysis is conjectural and more research will be needed going forward.
To begin, using the number of totes purchased for University A as a proxy, we can estimate the number of totes required at MIT. MIT will require slightly more totes, since MIT customers order on average two boxes per order, while University A’s customers average just over one per order. The cost per tote is still to be determined, depending on the number of totes ordered. The Sponsor can lower the cost per tote by ordering in bulk, but until the program is scaled up beyond small pilots, it does not make sense to do so. We have shown a range of price options in Table 4 to calculate the total cost of totes purchased for the program. The lowest price represents what the price could be if the Sponsor ordered in bulk, the medium price represents a typical 1,000 tote order without set-up costs and the high price represents a typical 1,000 tote order with an initial set-up cost. We have also shown the annual cardboard purchase savings the Sponsor can expect by replacing the MIT deliveries now made in cardboard boxes with totes.

Table 4: Estimate of Tote Purchase and Cardboard Savings for MIT Program

<table>
<thead>
<tr>
<th></th>
<th>Low</th>
<th>Medium</th>
<th>High</th>
</tr>
</thead>
<tbody>
<tr>
<td>Purchase price per tote</td>
<td>$ 6.00</td>
<td>$ 10.56</td>
<td>$ 17.06</td>
</tr>
<tr>
<td>Tote purchase cost</td>
<td>$ 7,416.14</td>
<td>$ 13,052.41</td>
<td>$ 21,086.57</td>
</tr>
<tr>
<td>Purchase price per cardboard box</td>
<td>$ 0.40</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Annualized MIT tote trips</td>
<td>13,680</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Annual cardboard box savings</td>
<td>$ 5,526.85</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Depending on the expected attrition rate at MIT, the Sponsor can expect a range of cardboard cost savings from this initial purchase, which exceeds the initial purchase price of the totes at attrition rates less than 4%. This target attrition rate differs from the analysis conducted on the previous pilot (Ng & Chow, 2010) due to the higher purchase price we assumed for the totes. Table 5 shows the expected Sponsor savings, or costs, by translating how long the initial totes purchased will last before having to be replaced and how that translates into cardboard purchase savings. The Sponsor can use this information, compared with the savings that MIT will realize in recycling less cardboard, which cannot be estimated at this time, to discuss collaboration and possible cost and savings sharing options. It is important to note that we did not include some costs, which the Sponsor may incur in the implementation of the pilot at MIT. For example, the Sponsor will have to set up a tote tracking system at the fulfillment center that serves MIT, the added time of the reverse logistics portion of the supply chain may necessitate more work for the existing delivery drivers serving MIT, and the Sponsor’s employees will have to dedicate more time to tracking and analyzing this additional pilot program.

| Monthly MIT tote trips | 1,140 |
| Expected Attrition | 1% | 2% | 3% | 4% | 5% | 6% | 7% | 8% | 9% | 10% |
| Totes lost per month | 11 | 23 | 34 | 46 | 57 | 68 | 80 | 91 | 103 | 114 |
| Months of tote initial tote life | 108 | 54 | 36 | 27 | 22 | 18 | 15 | 14 | 12 | 11 |
| Years of initial tote life | 9.0 | 4.5 | 3.0 | 2.3 | 1.8 | 1.5 | 1.3 | 1.1 | 1.0 | 0.9 |
| Total cardboard box savings | $49,935 | $24,968 | $16,645 | $12,484 | $9,987 | $8,323 | $7,134 | $6,242 | $5,548 | $4,994 |
| Tote purchase cost (medium) | $13,052 | $13,052 | $13,052 | $13,052 | $13,052 | $13,052 | $13,052 | $13,052 | $13,052 | $13,052 |
| Total Sponsor Savings | $36,883 | $11,915 | $3,593 | $ (569) | $ (3,065) | $ (4,730) | $ (5,919) | $ (6,810) | $ (7,504) | $ (8,059) |

There are many ways in which the Sponsor can design the new reusable tote program at MIT to improve different pieces of the program. The following section will design the program using two different scenarios: first, the scenario closest to the pilot at University A, which will involve the least amount of change and investment for both the Sponsor and MIT, and, second, a
scenario requiring more investment from both parties that would not only increase the probability of overall success of the program, but also increase the ability to replicate the program at other locations.

5.4.1 Designing For Current Structures & Systems (CSS)

This design recommendation is based on the current operational systems in place for the Sponsor’s delivery at MIT. Without requiring a large amount of investment, it builds upon the lessons learned at University A and assumes that operational and communication gaps mentioned in Sections 5.3.1 and 5.3.2 have been corrected or implemented.

5.4.1.1 Collaboration - CSS

The first and foremost consideration to the success of a reusable tote program is the customer’s commitment to the program. The Sponsor will need to prove it is not only sustainable environmentally, but also can save the customer money, most likely through a reduction in the amount of cardboard they will have to recycle. This effort will facilitate customer buy-in to the program. Furthermore, if the Sponsor can get the customer to use their own resources for the program, such as facilities and staff, the more likely there will be customer buy-in. Finally, depending on the customer location and the operational delivery structure of the Sponsor, contract terms might have to be renegotiated in order to maximize impact of the tote program. Once again, the customer’s willingness to be flexible will be a good indicator of their buy-in into the program.

5.4.1.2 Operational Consistency - CSS

Consistency in return options could be one of the most influential factors in getting customers to return totes. A flaw in University A’s program was initially only collecting empty totes from a customer when the next order was delivered. Yet the average University A customer did not receive another order until sixteen days later, which allowed ample time for the tote to be lost. In
addition, the added option to allow customers to schedule a pick-up was implemented ten months after the program started, and may have led to confusion in how to return the tote. The return options were poorly structured and lacked consistency and clear messaging for the customer. This inconsistency also put the Sponsor at a disadvantage for recouping the totes it sent out in a timely, orderly fashion. An email address to schedule a tote pick-up should be implemented and communicated to customers at the beginning at the pilot. Given that the delivery drivers observed totes that had been thrown into dumpsters, the messaging of tote return had not been communicated clearly enough to University A's customers.

Thus, it is important that the options must all be available there from the outset and should be consistently communicated to the customer. The additional effort it takes to set up and communicate the new option to customers will not match the additional totes returned at some point. Adding more options once the program has started is strongly discouraged because at some point there are diminishing returns to the number of ways customers can return a tote. Table 6 outlines the potential location options for customer tote return on campus at MIT, along with brief comments and a traffic light symbol representing each option's feasibility given the constraints of the current system.
Table 6: Tote Pick Up Locations Options at MIT

<table>
<thead>
<tr>
<th>Location</th>
<th>Feasibility</th>
</tr>
</thead>
<tbody>
<tr>
<td>Desktop</td>
<td>Increased workload for the Sponsor</td>
</tr>
<tr>
<td>Department office supply area</td>
<td>MIT cooperation; theft potential; space constraints</td>
</tr>
<tr>
<td>Central location in buildings</td>
<td>MIT cooperation; space constraints; increased workload for customer</td>
</tr>
<tr>
<td>Central location on campus (or areas of campus)</td>
<td>Increased workload for customer</td>
</tr>
</tbody>
</table>

The colored circles represent the feasibility of each option given the current constraints of the system, similar to a traffic light.

Having the delivery drivers pick up empty totes at the desktop delivery level will put the least amount of burden and responsibility on the customer. It is also the easiest way for delivery drivers since they will be delivering full orders at that level as well. However, as shown in the results from University A’s pilot program analysis, with so much time between customer orders, there will be a delay in the time between totes delivery and the time they are picked up which leaves them vulnerable to loss. In addition, when observing the Sponsor’s deliveries on MIT’s campus under the existing system, many of the customers were not present at the time of delivery, so the delivery drivers may not have access to empty totes sitting in customer’s locked offices.

Another option in Table 6 is to utilize common spaces at a department level as a consolidation point for totes, such as an office supply closet. This approach would clear totes from individual customers’ desktop and make it easier for the delivery drivers to pick up multiple totes at one time. However, this option is subject to constraints including cooperation from MIT and each department, the availability of such a space in each department, and also a higher risk of shrinkage as
the totes would be in a common area and therefore be more likely to be perceived as common property of the department.

A variation on this option is to have a central point within buildings to drop off totes. This would decrease the amount of stops the delivery driver has to make to pick up totes, but would require more effort of the customer. As we have seen in the literature, the customer values his/her time and will be less willing to return the tote if s/he has to walk far to drop off a tote at a central location (Schultz & Zelenzy, 2003). In addition, there would have to be some way to secure the location and track that the customer actually drops off the tote, again due to the collective ownership of the totes within the central location. MIT cooperation and available space are also concerns with this option.

Finally, there could be one or several central drop off locations throughout campus, which would ease the burden of the delivery driver, but put more of the onus on the customer. Again, security and a tracking mechanism would need to be implemented to ensure tote return as well.

Table 7 looks at the timing of the collection of empty totes from an operational perspective. It is a compilation of possible ways in which the delivery driver can collect the empty totes, including brief comments and a traffic light symbol representing each option’s feasibility given the constraints of the current system.
Table 7: Pick Up Time Options for Empty Totes

<table>
<thead>
<tr>
<th>Location</th>
<th>Feasibility</th>
</tr>
</thead>
<tbody>
<tr>
<td>Same day – driver waits to unpack</td>
<td>• Increased workload for the Sponsor</td>
</tr>
<tr>
<td>Same day – driver returns in the afternoon</td>
<td>• Increased workload for the Sponsor; route inefficiency</td>
</tr>
<tr>
<td>On next delivery – time between orders varies</td>
<td>• Infrequent customers have high potential for loss; customer space constraints</td>
</tr>
<tr>
<td>Scheduled Pickup</td>
<td>• System integration necessary; increased workload for the Sponsor</td>
</tr>
<tr>
<td>Once a week – driver’s lightest day</td>
<td>• Increased workload for the Sponsor; customer space constraints</td>
</tr>
<tr>
<td>Once a week – designated day without new shipments</td>
<td>• Customer service suffers; route inefficiency</td>
</tr>
</tbody>
</table>

The colored circles represent the feasibility of each option given the current constraints of the system, similar to a traffic light.

The easiest way to ensure tote return is to have the order unpacked upon delivery, but there are several flaws in this option. First, this will slow down the delivery drivers in making deliveries if s/he has to wait for every customer to unpack his/her order. On days where order volume is heavy, this could mean that not all deliveries get made. Furthermore, this strategy assumes that the customer will be there to unpack the order, which might not be true. Even if the delivery driver comes back later in the day to pick up the tote, that puts more of the burden on them, increases route inefficiency, and there is still no way to know if the customer will be there.

Another set of options revolves around having a designated pick-up day. It could be the day with the least orders, which would leave additional time to collect totes, and would guarantee that an empty tote would sit at a customer location for no more than five days. Alternatively, the Sponsor could dedicate a full day solely to picking up totes, but that would be at the expense of deliveries,
customer service, and require a change in contract, since orders received by the Sponsor on Friday would not be delivered until Tuesday, which violates the next business day clause in the contract. Either option is contingent on available space at the customer location and efficient route planning. It would decrease the time between “waste generation and disposal” and the importance of timely pick up as noted by Kuo and Perrings in the Literature Review (Kuo & Perrings 2010). However, given the volume of orders and customer contract in the current system, this approach may not be feasible to undertake at MIT.

5.4.1.3 IT Systems - CSS

The system integration is a crucial link for tote success, but not utilized in the current system because of the financial investment required. As seen in Table 5: Expected Sponsor Savings/Costs there are little savings available for investment when conducting a small pilot program due to the high costs of the initial tote purchase. The Sponsor will most likely continue to use its CMS to track orders and manually track the totes using an Access database. It also means that there will be little or no tote tracking in the reverse logistics loops of the supply chain.

5.4.1.4 Communication - CSS

The importance of consistent, regular communication with customers during a program where customers play a huge role in the logistics system cannot be stressed enough. As seen in the literature reviewed earlier in this thesis, the role of information as knowledge, rather than information as communication is crucial. The same methodology can be applied for the return of totes. Messaging such as “You need to return this tote as part of an environmental sustainability initiative” is more effective than messages that simply state, “Please return this tote.” The more that messaging can be categorized as” information as knowledge,” the more likely it will influence a person’s core beliefs and facilitate a change in desired behavior. The importance of prompting people to recycle is also a vital way to influence and increase recycling behaviors. Furthermore, the
frequency of messaging interventions is also important, as continual reminders will normalize behavior.

The first step in planning a reusable tote program should be a pre-implementation survey to MIT consumers in order to gauge their interest in such an endeavor. The survey could help reveal how willing customers are to participate in the program, which goes back to the earlier theme of collaboration. Questions surrounding consumers’ preferences on how to return a tote (desktop versus central pick up) could also glean some insight into how to design the return options for the totes. Most likely there will be some positive bias, as people tend to say they are more willing to engage in positive behavior on a survey than they will in reality, but it is still worth carrying out. As seen in the literature review, stakeholders that use a participatory community-based approach to increase environmentally friendly behavior usually have better outcomes (Kaplan, 2000). A positive side effect is this could also be considered the first marketing piece of the program. Table 8 is a summary of the critical phases of the communication strategy that must be implemented throughout the duration of the MIT program.

Table 8: MIT Strategic Communication Plan

<table>
<thead>
<tr>
<th>Program Phase</th>
<th>Strategy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Program Roll out</td>
<td>• Recruit MIT stakeholders (i.e. Green Ambassadors) for “media blitz” and ongoing program champions</td>
</tr>
<tr>
<td></td>
<td>• FAQ</td>
</tr>
<tr>
<td></td>
<td>• Email for inquiries</td>
</tr>
<tr>
<td>Regular Intervals</td>
<td>• Regular progress report to MIT</td>
</tr>
<tr>
<td></td>
<td>• Website and email reminders of program</td>
</tr>
<tr>
<td></td>
<td>• Consider campus-wide report</td>
</tr>
<tr>
<td>Repeat Offenders</td>
<td>• In person sales attention</td>
</tr>
</tbody>
</table>
As the program is unveiled, there should be an intranet page set up on MIT Procurement’s site, similar to what University A implemented. This page will have details of the program, contact information for customers, and frequently asked questions sections. The idea is to make information widely available in order to capture the attention of the widest audience possible. An email address or other IT integration option to schedule pickups is also imperative to capturing lost totes. This will allow consumers to return totes at their convenience and also allow another touch point with the Sponsor. The idea of an integrated communication system will be explored further in the Recommended Design section.

Beyond the traditional modes of communication, the Sponsor needs to take advantage of the distinctive university environment and the micro-communities that exist within it. Part of what makes the MIT community unique is the commitment and reputation surrounding sustainability initiatives. Recruiting interested groups on campus to spread awareness about the program would increase customer collaboration. One such overarching group is the “GreeningMIT” campaign that consists of a group of students, faculty, and staff that are trying to make MIT more sustainable and energy efficient through awareness campaigns, planning tools, and the use of volunteers known as the Green Ambassadors. The Green Ambassadors are a “network of change agents,” currently 173 strong that promote and model sustainable initiatives in their respective offices, labs, and dormitories (MIT Energy Initiative). The Sponsor should leverage the Green Ambassadors’ relationships throughout campus to promote the reusable tote program as another sustainable project at MIT. This approach will benefit both the Sponsor and the GreeningMIT group.

The Sponsor should also look at any seasonality or patterns in orders to better understand when MIT consumers are ordering in order to tailor their communication during peak times. An analysis of MIT’s orders from the 2009-2010 academic year is shown in Figure 18. This shows that there is some seasonality, with more orders in August and September, which is most likely due to the
start of a new school year. With this information the Sponsor can segment and target its different consumer bases with specific messaging in mind.

**Orders by Month**

![Orders by Month Chart](image)

**Figure 18: MIT Order Volume By Month**

5.4.1.5 **Incentives - CSS**

Using incentives to return the totes is another area in which small changes could yield large results in desired return behavior among customers. There were no incentives in the University A pilot program and, as mentioned in the Literature Review, incentives have been shown to have "an immediate and dramatic effect" on customer recycling behavior (Iyer & Kashyap, 2007). Such incentives could be a quick win opportunity for the Sponsor while it builds on its messages and longer terms goals for change in consumer behavior. A variety of incentive options are explored below, ranging from negative incentives (to discourage tote theft) to positive incentives (to encourage tote pickup). Collaboration between MIT and the Sponsor is paramount to choosing the right incentives, because the incentives have to align with the university culture. Furthermore,
tracking of the totes will be very important so that results can be clearly validated if fines are to be levied or prizes awarded.

Table 9: Negative Incentives Options for the Reusable Tote Program at MIT

<table>
<thead>
<tr>
<th>Negative Incentive</th>
<th>Feasibility</th>
</tr>
</thead>
<tbody>
<tr>
<td>Deposit on the Tote</td>
<td>Contract restructuring required, tracking required, appropriate deposit cost is unclear</td>
</tr>
<tr>
<td>Fines for Lost Totes</td>
<td>Contract restructuring required, tracking required</td>
</tr>
<tr>
<td>Publish “Shame” List of Worst Return rates</td>
<td>Tracking required, equity is questionable</td>
</tr>
</tbody>
</table>

The colored circles represent the feasibility of each option given the current constraints of the system, similar to a traffic light.

Table 9 lists potential negative incentives that can be used for the MIT pilot. The first two are monetary incentives that would require contract re-negotiations and better tracking than what is currently available with a CSS design. Putting a deposit on any order delivered in a tote or a fine for totes not returned may not work, depending on if consumers perceive that there is room in their budgets to incur these costs. In addition, the actual value of the deposit must be balanced in a way that does not incent consumers to feel as though they have already paid for the tote and thus should keep it. The final option is to publish a list of the worst offenders of tote loss either at an individual, departmental, or building level in order to essentially embarrass consumers into better behavior.

Contrary to the negative options, positive incentives can be used in conjunction with an emerging concept known as gamification. This theory explores how to apply “the basic elements that make games fun and engaging to things that typically aren’t considered a game”
Another website defines gamification as a, “dynamic and exciting industry that brings together game mechanics and marketing to create engagement and solve problems” (The Gamification Blog). Essentially it is applying a game design and game thinking to “engage users and solve problems” (NPR Staff, 2007). Examples include frequent flyer miles, credit card reward points, and virtual rewards such as badges on numerous smart phone applications, such as FourSquare. The theory is based on a number of trends in both business and technology throughout the last 25-30 years, but has recently gained traction due to the increasing presence of technology and complex problems facing society and businesses. According to one expert, using positive incentives derived from games such as rewards and pleasure can promote better behavior and help assist in problem solving (NPR Staff, 2007).

As more literature and examples surrounding this type of incentive emerge, we highly recommend that the Sponsor incorporate this concept in its reusable tote programs. In the meantime, some gamification theory can be seen in the potential positive incentives for MIT in Table 10.

<table>
<thead>
<tr>
<th>Positive Incentive</th>
<th>Feasibility</th>
</tr>
</thead>
<tbody>
<tr>
<td>Published List of Best Performers</td>
<td>Tracking required</td>
</tr>
<tr>
<td>Prizes for Best Return Rates</td>
<td>Tracking required</td>
</tr>
<tr>
<td>Discounts on Orders</td>
<td>Contract restructuring required</td>
</tr>
</tbody>
</table>

The colored circles represent the feasibility of each option given the current constraints of the system, similar to a traffic light.
Publishing an “honor” list of best performers whether at an individual, departmental, or building level could spark a healthy competition among customers to return totes. Even more tempting would be prizes for best return rates, awarded by either MIT or the Sponsor. Both options would require more tracking and more frequent data analysis than what is currently being collected. Finally, the Sponsor could restructure its contract with MIT to allow for discounted merchandise for customers or departments that meet a certain threshold return rate. While this would be of great benefit to the department and MIT, it would probably not be the most compelling option at an end user level, since they are using their departmental budgets, not their personal money, for the merchandise.

5.4.1.6 Experiment Design – CSS

The Sponsor and MIT have the option of dividing the campus into sections to pilot different operational, return, communication, and incentive strategies. Each experiment zone would serve as a microcosm of how well it would test campus-wide. Advantages of this segmentation would include the ability to isolate the multitude of factors and options discussed above and determine their influence in the program. However, this approach directly contradicts the earlier stated need for consistency for the customer. Each small experiment will require training customers and the Sponsor’s personnel to act within the boundaries of the program. If the long-term goal is to expand the best working experiments to the entire campus, it would require new training and buy-in from stakeholders when the best aspects of each pilot are spread to all areas of the campus. This could be confusing and detrimental to the program overall if the messaging is not consistent.

On the other hand, the Sponsor and MIT could also choose to implement a university wide experiment with the factors they consider to be the most important or dynamic. While this would limit the comparison that could be done only to University A, it might be a strategic way to gain customer trust and buy-in about the program; both of which are imperative to make the program
successful. Either option would be feasible within the current operational delivery system, but we would recommend the latter, to keep operational and customer communications and word of mouth simple and consistent.

5.4.2 Recommended Design (RD)

From the analysis and lessons culled from the pilot program at University A, there are certain modifications that could be made within the current system, as outlined above, which we believe will make the program run more effectively. However, if the Sponsor wants to see major change, we propose making significant adjustments in the operational and IT systems as well as introducing incentive structures. This approach will drive better tracking and, ultimately, performance for the program as well as make it easier to scale up to other customer locations.

5.4.2.1 Collaboration - RD

Collaboration is of the utmost importance when the Sponsor is contemplating a reusable tote program with a customer. The customer’s willingness to ensure all of its stakeholders are on board – from central procurement staff to operational staff to end users receiving orders – will improve the operability of the program. A discussion of sharing the costs and benefits of a reusable tote program between the parties will facilitate collaboration. For example, the Sponsor and the customer could share the costs of the initial investment in reusable totes at the outset of the program, and then share the cost savings of reduced cardboard purchasing (at Sponsor) and recycling (at customer). This will ensure alignment of interests. This theme will be expanded upon in the end of Section 5 and the conclusion of this thesis.

5.4.2.2 Operational Consistency - RD

As discussed above, the options available to customers must be rolled out simultaneously to have continuity for the customer communications. When designing the program for scale up, the
Sponsor should continue to utilize the desktop delivery space and the scheduled pick-ups as a primary tote collection zone. However, they should also work with MIT to add central collection bins within every building that receives a significant number of totes. This arrangement would be similar to the inter-department mailboxes that sit in the lobby of each building, where instead of sending envelopes, customers would drop their collapsed, empty totes. This would be beneficial for both the customers and the delivery drivers because the customers would not have to store a tote beyond their time to discard and the delivery driver would increase efficiency by only having to go to one central point in the building to pick up totes. If customer willingness to walk to the drop-off points is a point of concern, then the Sponsor can work with MIT to utilize MIT’s facilities staff to gather totes as part of their normal waste collection routine. These options are shown below in Table 11.

**Table 11: Drop Off Locations in the Recommended Design**

<table>
<thead>
<tr>
<th>Location</th>
<th>Feasibility</th>
</tr>
</thead>
<tbody>
<tr>
<td>Desktop</td>
<td>Increased workload for Staples</td>
</tr>
<tr>
<td>Central location in buildings</td>
<td>MIT cooperation; space constraints; increased workload for customer</td>
</tr>
</tbody>
</table>

The colored circles represent the feasibility of each option given the current constraints of the system, similar to a traffic light.

Another way that the Sponsor can improve their tote pick up rate is by increasing the number of dedicated staff on campus making deliveries and picking up empty totes. As seen in Table 2: Comparison of Selected Data of University A and MIT, with over 2,000 customers and only one and a half staff members dedicated to the campus, there is potential for totes to sit at customer locations for long periods of time. To truncate this time, the Sponsor could dedicate more staff members to the program or dedicate at least one person to only collect the empty totes. However, an additional delivery driver would cost over $40,000 per year, which is higher than even the greatest
savings the Sponsor can expect from the program, as shown in Table 5: Expected Sponsor Savings/Costs. Since the Sponsor currently has one full-time and one half-time delivery driver dedicated to MIT’s campus, the incremental cost could be lower than the expected savings if the half-time driver was increased to a full-time basis.

5.4.2.3 IT Systems - RD

As discussed earlier in key gaps influencing the program at University A, it is imperative to integrate the tote tracking within the customer management system. It would take a significant amount of investment on behalf of the Sponsor, but would most likely lead to higher return rates of the totes, since they would be able to be managed more effectively. This integration would also allow the Sponsor to scan empty totes at any point in the reverse logistic chain, allowing the Sponsor to know the location sooner. It would streamline the staff time needed to manually match totes with orders and would also allow for automatic communication notices to go out to customers who have not returned totes within a set number of days. This automatic notification system would also make it easier for the customer to schedule a pick up.

Another operational tracking improvement would be to integrate the tote ID into the order-tracking system for a one-time scan with the order. This would increase efficiency for the packer, who would only have to complete one scan instead of two per tote. However, this approach could only be implemented with substantial investment made to enhance the CMS, a prospect not feasible for such a small pilot project.

Finally, automated and integrated tote tracking would make implementing an incentive program easier for the Sponsor. If the consumer doubts the veracity of the Sponsor’s manual tracking of the tote location, then s/he will be less willing to accept the consequences of any negative incentives in place. Furthermore, if the consumers do not believe their positive behaviors
will be rewarded, due to the authenticity of the tracking system, they are less likely to be influenced by positive rewards.

5.4.2.4 Communication - RD

In addition to the strategic communication plan for MIT outlined above, an IT systems integration would allow the Sponsor to utilize tailored communication strategies for consumers at different points in the ordering and pick-up process through prompts in the online ordering system. As outlined in Table 12, the Sponsor could send the customer different messages, depending on the status of their tote as tracked by the system.

Table 12: Proposed Communication Prompts When Customers Place an Order

<table>
<thead>
<tr>
<th>Order Phase</th>
<th>Strategy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Day 0</td>
<td>Prompt user in the online ordering system that they will be receiving a tote and how they can return it</td>
</tr>
<tr>
<td>Day 1</td>
<td>Receive order and invoice with contact information to schedule a pick up for an empty tote</td>
</tr>
<tr>
<td>Day 30 &amp; 60</td>
<td>Automatic email sent for totes in field for 30 and 60+ days requesting scheduled pickup</td>
</tr>
<tr>
<td>Day 90</td>
<td>In person sales attention</td>
</tr>
<tr>
<td>Placing a New Order</td>
<td>Prompt in the ordering online system to ask if the tote from the last order has been returned</td>
</tr>
</tbody>
</table>

When the customer first places an order, the system should calculate whether the customer will be receiving a tote and prompt the customer about the program and options available to return the tote. When the customer receives the order the next day, the invoice should come with clear information on ways to return the tote, including the contact email to schedule a pick-up. As seen in
the pilot at University A, the program could be more successful by retrieving the tote from the
customer as soon as possible. Therefore, if the tote has not been returned 30 days after it was
received at the customer location, the customer should receive an email asking if s/he needs to
schedule a pick up. The same message should be sent at the 60 day mark. If that does not work, the
customer should receive in person sales attention from the Sponsor company representative on
campus, as recommended in the other design system. There should also be a mechanism in place for
the consumer at each point to acknowledge loss of the tote so that they do not receive further
prompts. A follow-up survey could be sent upon receipt of this acknowledgment to add to the
program’s body of knowledge on reasons for tote loss.

Furthermore, if the customer places a new order before the tote from his/her last order has
been retrieved, s/he will receive a prompt in the system asking if s/he needs to schedule a pick up.
This approach will target the group of high-volume consumers who are still losing totes (1%-20% in
University A’s pilot program). An alternative message to prompt the customer when an order is
placed is to always ask if there are any other totes to pick up, even if the customer does not have any
outstanding totes. Perhaps this communication would affect the self-motivated customers, who
could serve as collectors of totes within their department, thereby increasing the word of mouth of
the program.

Lastly, once the program has been in place for at least 90 days, the Sponsor should collect
more information on the customers who have lost totes and feedback on how to make the system
more user-friendly. This could yield some insights into how customers perceive the program, its
implementation, and their experience with it so far.
5.4.2.5 Incentives – RD

Using incentives to influence customer behavior is an approach the Sponsor must implement. It is highly recommended that the Sponsor only use positive incentives perhaps in conjunction with gamification theory to promote the wanted behavior from customers. One gamification expert believes an emerging model for user rewards known as SAPS – status, access, power, and stuff - is what people want in that specific order. “Status is a fantastic motivator for getting people to do stuff” (NPR Staff, 2011). This should be taken in mind when the Sponsor and MIT design incentive structures. First we must define what constitutes good behavior; in this case we will define it as the percentage of totes returned by the customer. So long as each customer who orders a tote maintains above a certain percentage of totes returned, they can receive a certain elevated status within the MIT community or be entered into a lottery for some sort of prize on a monthly basis. Given the results of the analysis from University A, the majority of customers never lost a tote, so the target return rate customers must meet should be significantly high enough in order to change the behavior of the smaller percentage of customers who are losing totes.

The use of incentives comes with a caveat. As discussed in the literature review, incentives are more effective in getting people to adopt a new behavior – in this case, returning the tote. The real game changer to make this new behavior sustainable is frequent, targeted messages to customers that increase their intrinsic attitude towards recycling. Making customers feel good about the fact that they are contributing to the greater good is essential for reusable totes to be returned and the program to be sustainable – both financially and environmentally.

5.4.2.6 Experiment Design – RD

As mentioned in the design for current systems and structures section, we also favor the campus wide experiment size for the recommended design, rather than segmenting the campus in
order to conduct a number of micro-experiments. Although some granularity will be lost, the larger experiment size will provide consistency for the Sponsor’s operations and customer messaging.

We believe that the recommended design pilot has a greater chance of success on MIT’s campus than what has been implemented and observed at University A. However, given the lack of conclusive data as to why the attrition rates were so high at University A, we recommend that a pilot at MIT be monitored in detail and for some period of time in order to add to the body of knowledge created by Ng and Chow’s work and this thesis. We would make sure that the data tracked by either the system or a person(s) dedicated to experiment observation are as robust as possible, including:

- Customer segmentation metrics, as analyzed in Section 4.2.1 Customer Segmentation;
- Reasons for tote return and loss, tracked through surveys of both compliant and non-compliant customers;
- Program awareness, tracked through surveys conducted at regular intervals during the pilot communication process;
- Communication effectiveness and user engagement, tracked through email open rates, click-through rates and intranet site visits.

Ideally, this tracking should start at the beginning of the program and continue indefinitely for optimal program success and knowledge building. Further research and tracking will be the Sponsor’s most strategic move in ensuring program success.

5.4.3 MIT Design Recommendations Summary

When looking at a cost-benefit matrix comparing the Sponsor to University A, it is clear to see that the Sponsor has incurred the majority of costs, due to minimal share value creation at this point. Figure 19 shows the relative costs and benefits to each party through the placement of each
factor on the matrix. In order to continue the pilot, the Sponsor and University A need to be converging in the center; by sharing the costs and savings in a more equitable manner. Ideally, they should share space in the upper right quadrant where each party accrues benefits from the program and value is created for both.

![Diagram](image)

**Figure 19: Cost-Benefit Analysis of the Pilot Program at University A**

Green font denotes a benefit to both Sponsor and University A. Red font denotes a cost to both Sponsor and University A. Orange font denotes a cost to one party and benefit to the other party.

In order to design a better pilot for both the Sponsor and MIT, the costs and benefits need to be more equitably disbursed. Figure 20 depicts the multitude of programmatic factors available to the Sponsor and MIT in designing the next program. We believe the Sponsor and MIT need to work towards sharing the costs and benefits through collaboration until the program becomes at least cost neutral, thus adding proof of concept to the reusable tote program. The more programmatic factors the Sponsor and MIT can choose that share costs and benefits, such as sharing the purchase costs of
the totes and creating incentives to maximize tote return, the more likely the program will be financially sustainable for both parties.

Figure 20: Projected Cost-Benefit of the Program at MIT
Green font denotes a benefit to both Sponsor and MIT. Red font denotes a cost to both Sponsor and MIT. Orange font denotes a cost to one party and benefit to the other party.

6. CONCLUSIONS

This thesis has examined how to design a sustainable logistics system when using reusable packaging to deliver products to customers. It has also addressed ways to engage and incentivize customers to return reusable totes, as customers are the key component of any reverse logistics operating system that involves the end user. Specifically, building on the knowledge of the academic literature and an initial pilot program that had been conducted, we identified several key factors essential to a reusable tote program's success. Ideally, using this information, the Sponsor will be able to scale up this program model to its other corporate customers across the country. This
section will focus on general conclusions that can be extracted from the analysis of the pilot program at University A and subsequent informed design of the program at MIT as well as recommendations to considered for a national scale up.

6.1 Summary of Findings

Like any other business proposal, sustainability initiatives must fit squarely within the overall strategy of the company. They must be profitable and make good business sense before they are feasible. Yet even after a particular sustainability initiative has been vetted, there is a tendency to rush its implementation, since these initiatives have been known to eventually bolster a company’s brand value and as a result, long-term shareholder value. This rushed effort can have negative effects on a company’s overall profitability and value proposition if consumers perceive the sustainability initiative as more “greenwashing” than actual change.

While the Sponsor has integrated sustainability into its core corporate strategy, the relatively rushed design and implementation of the pilot program at University A could be partially responsible for the high attrition rate of totes. Accordingly, a lesson culled from the pilot is that it is imperative to fully understand the operating environment when implementing sustainability initiatives because it is a strong indicator for success. For a reusable tote program, this means understanding how a company’s operations will be affected both positively and negatively when adding the reverse logistics loop to the supply chain.

The Sponsor must also implement monitoring and evaluation of its reusable tote programs. As seen in the University A pilot, there were many simple operational tweaks that could have been made earlier if they had been identified and observed earlier. In addition, because the data analysis in the pilot program at University A began after the program had been running for several months, the available data was limited and the analysis influenced by anecdotal hypotheses that had been
proffered for attrition rates. Going forward, the Sponsor should track as many variables as possible in the MIT pilot upon implementation to understand the multiple reasons for tote attrition.

Furthermore, customer collaboration is key. The Sponsor must have complete buy-in from the customer before executing a reusable tote program. This was not an issue with the administrations of University A or MIT, given their interest in sustainable initiatives, but the Sponsor should be prepared to explain how a reusable tote program is financially and environmentally beneficial to its customers. As described below in the Scale Up section, if the Sponsor cannot adequately make this case, the program’s success will be in jeopardy for both parties involved. In the case of a reusable tote program that involves the end user, the program must be designed to maximize ease of use for this end user, since end user compliance will determine the success of the program and these users are often not the direct beneficiaries of the financial and environmental benefits of a successful program. Therefore, the Sponsor and the customer must work in concert to ensure that each end user is properly educated and incentivized to align his/her interests with that of the program.

6.2 Recommendations for Scale Up

We believe that a university campus will be one of the most difficult environments for the Sponsor to implement a reusable tote program. Campuses tend to have very diverse locations that are, by their very nature, spread out. They have a large amount of outside traffic present, and they usually do not ascribe a high priority to maintaining costs or operating as profit centers. Corporations, on the other hand, are more willing to restrict employee behavior to control costs and have much more secure locations. We are confident that if the Sponsor can achieve satisfactory attrition rates on MIT’s campus, then they will have a platform for scale up nationwide.

Given the diverse nature of customers’ internal geographic configuration and varying ability to control their end users, it is essential the Sponsor identify specific corporate customers that are
poised for success for a reusable tote program. Some of their customers might not be willing or able to make this type of a program work and given the relatively low attrition rate that needs to be achieved to make the program successful, the Sponsor must make strategic choices for overall program success.

Secondly, it is essential to invest in IT systems integration for reusable tote programs. We believe better tote tracking will have a huge impact on the attrition rate of the totes and assist in the monitoring, evaluation and proactive customer communication of reusable tote programs.

Lastly, because consumers are the linchpins as the end user in the traditional supply chain and as the first link in the reverse logistics chain, the Sponsor needs to continue to research, learn, and use incentives for customers to return the totes. Consumer behavior is notoriously difficult to predict, but tweaking incentive structures could help reduce attrition rates.

Ultimately implementing a reusable tote program is about innovations in operations and how to shape consumer behavior to benefit the reverse logistics portion of the supply chain. The Sponsor must continue to be flexible as reusable tote programs continue to grow and evolve. As the Sponsor continues to roll out reusable tote programs and increase their working knowledge, ideally the cost-benefit ratio for the Sponsor and its' customers will move to the upper right quadrant where benefits will accrue to both parties, as seen in Figure 21.
The Customer

Figure 21: Potential Evolution of Sponsor Success for Reusable Tote Program Scale Up
Green font denotes a benefit to both Sponsor and its customers. Red font denotes a cost to both Sponsor and its customers. Orange font denotes a cost to one party and benefit to the other party.

In addition, as reusable tote programs are expanded to more of the Sponsor’s customers, the program will begin to obtain economics of scale benefits. These benefits, in the form of additional operational savings, greater environmental consciousness by consumers, and reduced carbon footprint, will increase the value proposition of the reusable tote programs. As success of the Sponsor’s program reaches a broader audience, shareholders will increasingly demand innovative sustainability initiatives be implemented at their companies, putting environmental sustainability at the forefront of business operating strategy.
7. BIBLIOGRAPHY


