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Proposal Title: A Multi-Faceted Approach to Minimize Waste from Rutgers Dining Services

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Food-related waste is a massive problem in the United States, accounting for $40 billion lost from commercial service operations alone. Additionally, environmental implications extend far upstream and downstream as well. Despite recent initiatives to reduce student produced food waste, Rutgers dining services is still a major contributor to this problem. This proposal therefore takes a multi-pronged waste reduction approach to minimize Rutgers' dining services footprint in this area. In part I, it is shown that installing pre-consumer food waste tracking technology in kitchens can result in over 438,000 pounds of food saved each year. This corresponds to $333,216 in savings, or 3.74 million kilowatt-hours and 5.1 million pounds of CO_2 reduced. In part II, it is shown that a small change in take-out packaging practices can produce a substantial change in the environment to save 350,000 pounds of CO_2 emissions and 80,000 kilowatt-hours of energy. For a mere $230, a combined 3.6 million units of Rutgers' styrofoam cups and containers and plastic bags is saved from landfills each year. In total, the two parts together combine for a total annual savings of $332,986, 5.45 million pounds of CO_2 emissions, and 3.82 million kilowatt-hours of energy.

Introduction

Food waste is a massive problem in the United States. According to the U.S. Environmental Protection Agency, waste from food service operations amounts to $30-40 billion lost each year. [1] But implications extend far beyond monetary effects in the commercial sphere. Upstream, large quantities of freshwater, artificial fertilizers, pesticides, and other fossil fuels are wasted in the production of food never eaten. Energy expended in their transportation, processing, packaging, storage, and preparation is all for naught. [2] Downstream, food waste comprises the single largest component of municipal waste reaching landfills and incinerators, accounting for over 4% of the U.S. oil consumption with over 34 million tons discarded in 2010 alone [1]. Here, it decomposes into methane, a gas over twenty times more potent than CO_2. [2]

In an effort to reduce Rutgers' contribution to this problem, the university has taken two initiatives to decrease food waste by students. This past year, Rutgers implemented a tray-less dining policy, which has the psychological effect of inducing students to take and waste less food with each meal. Beyond this, food that is wasted is pulverized, removing over 80% excess volume, and provided to a local pig farmer named Steve Pinter. Because Pinter farms is less than 15 miles away, the cost of transport and the resulting environmental impact is significantly reduced in comparison to landfill disposal. [3] However, it is the opinion of the authors of this proposal that still not nearly enough is done to reduce the impact of food waste on the environment. While these two initiatives are steps in the right direction, there are still several proverbial low-hanging fruit that remain unpicked in combating this serious issue.

This paper thus takes a multi-pronged approach to accomplish the goal of reducing food-related waste by Rutgers University dining services. In the first part of this paper, a method is described for substantially reducing pre-consumer food waste, or waste due to inefficiency in food preparation and utilization by dining hall employees. This is accompanied by projections of hefty financial and environmental savings, as well as specific considerations for successful implementation. In this second part of this paper, a strategy for drastically minimizing take-out waste by using more sustainable food packaging practices is outlined. Additional eco-friendly tips and ideas are also included at the end of the paper, further allowing dining services to decrease their environmental footprint by an appreciable margin.

Part I: Automated Tracking to Reduce Pre-Consumer Waste

As mentioned in the introduction, Rutgers has already taken steps to decrease student food waste and its environmental consequences. This includes the introduction of tray-less dining to discourage excess food portions, as well as reallocation of food waste to feed animals at a local farm. Despite this, however, zero actionable steps have been taken to reduce food wasted inside the kitchen. In other words, reducing pre-consumer waste is an entirely unexploited opportunity to serve the university's environmental goals.

It is estimated that as much as 10% of food purchased in high-volume operations is wasted before ever reaching the customer's plate. [4] This is due to a variety of factors. For instance, several culinary workers create excess trim waste when cutting fresh meat, fruit, and vegetables. Additionally, it is difficult to develop 100% accurate forecasts due to ever-changing customer segments. The resulting overproduction and over-purchasing of food causes spoilage and expiration. [2] Regardless of the reason for the waste, however, it is obvious that such a massive operation as Rutgers dining services needs to take active measures in minimizing pre-consumer waste to the greatest extent possible.

So what could be the best solution to this problem? In a proposal the authors of this paper submitted two years ago, high resolution visual feedback was suggested to incentivize energy conservation habits in students and produce a projected half-million dollars in savings yearly. With its success, it was expected that a similar approach could be applied to the habits of dining hall employees to incentivize a reduction in food wastefulness. More specifically, comprehensive computer tracking of the food discarding habits of the kitchen staff is selected as the ideal solution to this issue, as software and hardware enables real-time and long-term ease of functionality the traditional pencil-and-clipboard method can't compare to. The expectation is that with precise and individualized data of wastefulness, the dining staff can target intervention practices to significantly reduce food waste. As the maxim goes, you can only manage what you measure.

With the solution approach identified, the next step was to describe the finer logistics of this food tracking procedure. Ultimately, it was concluded that rather than outsourcing the project as a senior design thesis to students in the computer science department, as was initially intended, it would be preferable to simply use the commercial service offered by a company named LeanPath. Not only were their product features exhaustive, but the added benefit of cooperation with a veteran company in the food waste management industry would be much preferred to the time cost associated with the university learning the finer points itself. In addition, the calculated projected returns far outweighed the the cost of the product offer. What follows below is therefore a detailed description of the LeanPath product, with most of the figures used in calculations coming directly from their case studies of similar dining operations.

LeanPath is the industry's first and leading fully automated food waste tracking system. It comprises all the tools needed to make monitoring food waste effective, including a weighing scale and a touch screen terminal display. This system is placed strategically en route to the garbage station in the production area, following the natural path kitchen or servery food waste follows as it is being discarded. This area is accompanied by prominent red stop sign stickers to remind employees to weigh the waste before disposal.

To analyze the tracker's features, it is helpful to walk through its use from a staff member's perspective. After determining that a specific item is unfit for serving, the staffer would head into the disposal area and place the food on the scale. On the touch screen terminal, the staffer then chooses his or her name from a list to record individualized data. Next, the employee would select from a menu the specific food being thrown out, with inedible foods such as egg shells and bones being excluded from the listing. After this, the staffer is then to log the reason for disposal. Options include the food item being burned, contaminated, or dropped, as well as waste due to equipment failure or preparation. Finally, the tracker device snaps a photo of the item, weighs it, and the software estimates the monetary loss from the disposal.

It is important to mention here that in order to encourage employees to partake in this procedure, managers would inform them that no one would be disciplined for logging waste deemed to be excessive. Rather, top weighers would be recognized and rewarded for their active participation. Also, a very important aspect of the software is the resolution of data it can display. After each individual logging, yearly projections of financial and environmental impact for this wasted food item are prominently displayed to incentivize staff members to avoid such wasteful practices in the future. When the tracker is not in use, it displays key data such as food waste reduction trends over time, top food items wasted in recent days, and the most frequent weighers on staff. More comprehensive data is available to the managers of the kitchen along with real-time notifications, allowing them to stay ahead of food saving opportunities.

Based on the above, it is obvious that continuous employee feedback provided by the software makes the kitchen staff more cognizant of their wasteful habits. This in itself is a psychological incentive to cut back on unnecessary waste, and also encourages such changes as carefulness to avoid dropping or burning food due to the financial and environmental impact it would cause. Ultimately, this allows more food to make its way to the serving plate, and enables the dining hall to purchase less ingredients to maintain the same student dining experience.

The largest positive changes resulting from the adoption of this tracking system, however, are management-level decisions driven by LeanPath's high resolution data. These decisions generally fall into two varieties. The first is to avoid over-ordering foods that simply end up spoiling or expiring. For instance, Busch dining hall can simply order and make less pizza if it finds an excess waste trend in that food category. By analyzing patterns of food waste, chefs can review amounts of specific foods disposed at specific time intervals, such as over an hourly, daily, or even seasonal basis. By projecting forecasts and making ingredient ordering decisions accordingly, there is a direct positive effect on the financial bottom line. The second data-driven decision that can be made by managers is a marginal repurposing of food that would otherwise go to waste. Chefs can solicit ideas from staff members in pre-shift employee meetings, and determine creative ways to combine leftover foods into other entrees. For instance, leftover potato products can be inserted into soups or other foods to enhance their flavor and thickness. Similarly, leftover coffee could be frozen and reused in an ice coffee beverage. Overall, this produces less food waste to be disposed of, which in turn drives down cost for transportation of food-waste to farms.

Part I Cost Analysis

The cost structure of implementing LeanPath software into the dining hall infrastructure includes the LeanPath monthly price, training, logging time, and time spent analyzing of data collected. The largest package would be necessary to handle the 4,000,000+ meals served per year at Rutgers University. [5] The LeanPath 360 Ultimate costs $749/month and includes a Tracker 2.0 Unit, tracking customization, advanced reporting with custom reports, custom waste alerts, data review sessions, proactive coaching support, weekly waste summary emails, and more. [4] To ensure the success of the program, employees must be trained to operate the LeanPath software. The software is straightforward and user-friendly, only taking about an hour to train an employee. Using a benchmark from a previous case study, it takes an average of 4 minutes per day for an employee to operate LeanPath software. [2] Taking an average wage of $10 for 395 employees [5] and 111 days worked per year (5,000,000 meals served per year/45,000 meals served per day = 111 days food is served), [6] a meager annual opportunity cost of $4,871.67 is calculated as employees will now spend extra time operating the software that could have been used towards work. Finally, employee discussions on how to improve food utilization will occur during frequent pre-shift meetings as to avoid additional opportunity costs.

Part I Savings Analysis

The first step to calculate the potential savings from LeanPath software is to determine the food waste production by Rutgers University, and this was obtained from data in 2007 when Rutgers University Dining Services signed a contract with Steve Pinter of Pinter farms to haul away food waste at a rate of $30 per ton.[3] On a daily basis, Rutgers produces 10 tons of food waste that gets hauled to feed farm animals. To calculate the estimated savings of implementing LeanPath software, which only reduces pre-consumer waste, measurements from a study completed by Merrow [1] et al. were used to estimate the fraction of food waste that was coming from pre-consumer operations. In one dining hall, the percent of prep waste from total waste was 16.5%, while it was 14.5% in another dining hall. An average estimate of 15% is taken and applied to Rutgers' daily 10 tons of waste for 1.5 tons of pre-consumer waste. A modest estimate of pre-consumer food waste reduction from LeanPath software of 40%, which is 7% lower than a similar LeanPath case study[2] and 10% lower than average,[4] would yield 1,200 pounds of food waste eliminated per day. By simply not purchasing the ingredients that constitute these 1,200 pounds of daily food waste, a significant amount of money can be saved. 1,200 pounds over 365 days sums to 438,000 pounds of food per year. Although it is true that the dining hall does not operate 365 days per year, the reported numbers are based on a 365 day average. The reported $100,000 spent per year on hauling food waste away converts to approximately 3,500 tons of food per year, which is 10 tons of food waste per day for 350 days--entirely accurate with Steve Pinter hauling away 10 tons of food waste per day. To figure out the savings from not purchasing 438,000 pounds of generic food each year, an estimate of the breakdown of food composition as well as the wholesale market price averages of these different kinds of foods is needed. Merrow's study found the breakdown of post-consumer waste to be 66.381% carbohydrates and leftovers, 19.517% animal products, and 14.102% organic materials. In a study at Bates College,[7] the Dining Services had a split of 75.76% carbohydrates and organic materials and 24.24% meat products in pre-consumer waste, verifying that the numbers are similar enough to be a viable estimate for food waste in a typical dining hall whether pre- or post-consumer. Using average wholesale prices of $1.30 for protein and $0.63 for vegetables and carbohydrates, [8-10] this amounts to a total savings of $347,074.70 for 438,000 pounds of food. This directly translates into potential savings for Rutgers by mitigating the costs of excess food resources. The opportunity cost for the monthly fee and time investment of LeanPath is approximately $13,589. As a result, this leaves a net saving of $333,216, or 3.74 million kilowatt-hours saved, and 5.1 million pounds of CO_2 reduced. [11-12] These savings do not include the additional savings from increased fuel efficiency of the farm truck due to fewer trips for waste disposal being needed.

Part II: Sustainable Packaging Alternatives for Take-out Meals

Just as reducing pre-consumer waste is an excellent approach to reducing excess food-related waste, a second opportunity for innovation can be found in minimizing food packaging waste. To date, no measures have been taken to reduce the environmental impact of packaging for take-out meals. Although, take-out remains a massively popular option for meal swipes, little consideration has been given to the sheer amount of un-recyclable waste it produces from the plastic bags and styrofoam cups and containers used to hold the food and drinks. Because neither of these waste types are biodegradable, this causes serious environmental issues; over 3.57 million tons of plastic bags were discarded in 2008, [13] and nearly 1,369 tons of Styrofoam find their way into landfills daily. [14] Obviously, Rutgers dining services needs to reduce its contribution to these figures as much as possible to promote an eco-friendly environment.

This paper therefore proposes the idea of completely eliminating the use of plastic bags and styrofoam cups in addition to replacing styrofoam containers with biodegradable paper containers for takeout meals. The elimination of plastic bags and styrofoam cups is the most effective preventative measure that can be taken to reduce the quantity of waste heading to landfills. Plastic bags inherently increase the amount of waste when students fill up their bags with excess supplies that always end up in the garbage, such as extra napkins, utensils, fruits, and condiments. While some students may complain that no bags will result in spilling food and making a mess, this problem is somewhat backwards because the real issue is fitting a semi-rigid container into a free-flowing plastic bag that almost always causes the tilting of the container and spilling any sauce or food. Spills will be much less frequent when balanced by the hands alone, and if students opt to bring their own canvas bags they will be more conscious to keep their bags clean. To counteract the loss of styrofoam cups, all students with meal plans will be provided either aluminum, stainless steel, or BPA-free plastic bottles, so that they can get refills on drinks. The cost of these bottles is covered by an increase in the cost of their meal plans by a meager $5, while also allowing them unlimited refills.

Part II Cost Analysis

To calculate the number of takeout meals per year, Rauf et. al [15] interviewed Livingston Dining Services Manager David Osmun who estimated 4,000 takeout swipes occur during peak hours from 8pm to midnight. Breakfast and lunch takeout do not serve food in containers, so the 4,000 estimate is accurate for the purpose of these calculations. The cost of styrofoam containers is approximately $72.45 per thousand 9" hinged containers [16] resulting in a cost of $52,164 per year for 2 semesters of 15 weeks each and serving takeout 6 days per week (no takeout is served on Saturday). The cost of switching to more environmentally friendly plastic containers would be $461.70 per thousand 9" hinged containers, [17] or $332,424 per year. This proposal, however, recommends switching to biodegradable paper containers that would cost $174.37 per thousand 9" hinged containers [18] or $125,546.40, which is $206,877.60 cheaper than plastic containers. In total, it costs Rutgers $73,382.40 to make the switch from styrofoam to biodegradable food containers.

Part II Savings Analysis

To demonstrate how to offset the costs of switching from styrofoam to biodegradable containers, the savings from removing plastic bags and styrofoam cups are presented. Considering now that bags and cups are handed out during breakfast and lunch, this increases the number of takeout meals used in calculations to an estimated 8,000 swipes per day, or 1,440,000 swipes per year (6 days per week, 30 weeks per year). At a cost of $15.29 per thousand bags, [19] this comes out to $22,017.60 annual savings from removing plastic bags. Switching to biodegradable bags would cost $25.66 per thousand bags, [20] or $36,950 per year, which is not an economical decision for Rutgers. Styrofoam cups cost $35.51 per thousand cups, [21] or $51,134.40 annually. Removing styrofoam cups and plastic bags, Rutgers has the potential to save $73,152.00--nearly offsetting the cost of switching from styrofoam to biodegradable containers to a mere $230.40. This is a meager cost for Rutgers to pay to prevent 720,000 styrofoam containers and 1.44 million styrofoam cups and plastic bags from reaching landfills each year, reducing 350,000 pounds of carbon emissions and 810,000 kilowatt-hours of energy from producing these materials. [11-12]

Considerations and Suggestions

As an added consideration, additional practices can be employed to enhance the effectiveness of these methods to further induce eco-awareness and prevent wastefulness in the student population. For one, the TV monitors placed prominently in dining halls can be programmed to display savings from the pre-consumer waste reduction strategy in part I. This encourages students to follow suit and minimize their own post-consumer food waste. Additionally, stickers can be placed on the biodegradable take-out containers mentioned in part II to further encourage environmentally-conscious habits.

There are other measures that can reduce the university dining services' environmental footprint. One example is to target the paper waste from napkins in the dining hall. Currently, napkins are distributed in a basket with no limit on how many can be dispensed and used. This leads to students using excessive amounts of napkins and even bringing them home by the handful. To remedy this issue, single napkin dispensers can be used, similar to the ones in Henry's Diner on Livingston Campus. This will forcefully limit the number of napkins students can grab in a handful while also providing space to advocate environmental awareness. In a study by Montazeri, [22] it was found that even using dispensers that remind the user of being environmentally friendly will reduce the amount of napkins taken. In a study done at the Georgia Institute of Technology, [1] roughly 21,500 students were able to reduce paper waste by 40% or 70.61 trees per year. Scaling up to the size of Rutgers at 65,500 students, there is the potential to save approximately 215 trees per year. This is the equivalent of 26,000 to 52,000 pounds of paper or 2,150,000 to 4,300,000 sheets of paper. [23]

Furthermore, students are more inclined to portion themselves excess amounts when given the opportunity to self-serve their entrees. In Busch Dining Hall, for example, employees only allow each student one steak and they must line up again to receive more. However, there is no such regulation at Livingston Dining Hall and students are free to take as many steaks as they want.

Conclusion and Timeline for Implementation

With new energy innovations occurring on campus year after year, it may seem that there are no more low-hanging fruit left at Rutgers to instigate positive environmental change. But as this proposal demonstrates, several opportunities in terms of dining hall wastefulness still remain unexploited. In part I, it was shown that installing pre-consumer food waste tracking technology in kitchens can result in over 438,000 pounds of food saved each year. This corresponds to $333,216 in savings, or 3.74 million kilowatt-hours and 5.1 million pounds of CO_2 reduced. In part II, it was shown that a small change in take-out packaging practices could produce a substantial change in the environment to save 350,000 pounds of CO_2 emissions and 80,000 kilowatt-hours of energy. For a mere $230, a combined 3.6 million units of Rutgers' styrofoam cups and containers and plastic bags can be saved from landfills each year. In total, the two parts together combine for a total annual savings of $332,986, 5.45 million pounds of CO_2 emissions, and 3.82 million kilowatt-hours of energy. A suggested timeline for implementation to achieve this results in the 2015-2016 school year follows:

- *Early summer: Install LeanPath 360 Ultimate in all four dining hall kitchens (part I)*
- *Early summer: Order biodegradable containers and reusable bottles (part II)*
- *Late summer: Mandatory LeanPath training session for RU dining staff (part I)*
- *First week of fall semester: Give out reusable bottles with first take-out swipe (part II)*
- *Throughout semesters: Continuous review and application of waste data (part I)*

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