Department of Biosystems and Agricultural Engineering
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BIGGBY® COFFEE Environmental Assessment: Data Analysis and Visualizations

BE 487 - Spring 2022
Biosystems Design Projects

Project under Non-Disclosure Agreement

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Client: BIGGBY® COFFEE Faculty Advisor: Dr. Christopher Saffron

Background

BIGGBY® COFFEE began with one location in East Lansing, MI in 1995. Bob Fish and Michael McFall decided to franchise the business in 1996 based on the core values of have fun, drink great coffee, and love people. There are four different store models: modular drive-thru only, lobby and drive-thru, lobby, and kiosk, with 240+ locations. BIGGBY® is working to make sustainability and environmental protection core values of their business.

All carbon footprint values were used to create the data visualizations. The car and semi-truck carbon footprint values were used to provide a familiar comparison.

Table 1: Carbon footprint values

Item	Carbon Footprint
Dairy Milk[1]	0.09
Coffee[2]	0.96
Plastic Type 1[3]	0.06
HDPE Milk Plastic[4]	0.10
Cardboard[5]	0.06
Non-Recycled Cups[6]	0.14
Recycled Cups[6]	0.08
Average Car[7]	10,141.00
Average Semi-Truck[8]	44,450.00

Units: lb. of CO_2 eq per (fl) oz
Units for car and semi-truck: lb. of CO_2 per year

Objectives

1. Create an easy-to-use system to accurately track the consumption of inputs and waste production data with little employee interaction.
2. Analyze the recorded data to find key store-level inefficiencies.
3. Create data visualizations based on waste production and inefficiencies for management understanding and informed decision making.
4. Recommend standards within the franchise operations manual in the sustainability section.

Constraints

- The data-tracking system must be understandable by a 12th grade reading level.
- The data-tracking system must be created from one store model and, with minimal adjustment, be applied to all store models (kiosk, drive-thru and lobby, drive-thru only, lobby only).
- All suggestions must be based on store level data and operations.

Design Parameters

The data-collection program took several different functions of daily franchise operations to convey their carbon footprint.

Items Used in Data-Tracking System
- Cardboard
- Coffee
- Cups
- Flavoring Syrups and their containers
- Milk and their containers

Data Visualization Software
Microsoft Power BI

Recipe Data
- All recipe information from the BIGGBY® Flavor Rules Flipbook.
  - Most recipes have variations: hot, iced, frozen, and crème.
- Details amount of water, ice, and espresso, if applicable.
- Number of pumps of specified syrups in each size for each drink.

Receipt Data
Receipt reprints were collected for a store of each model for the year of 2021. Data from receipts was analyzed to calculate ingredient use. Figure 1 provides an example of one receipt.

Limitations
- The official BIGGBY® recipe catalog does not include all drinks.
  - 32 oz options, cold brew, sweet foam, seasonal, brewed coffee.
- No official milk measurement in drinks.
- Different receipt and recipe names
  - Figure 1 shows a 20 oz Caramel Marvel. The recipe would show a 20 oz Hot Caramel Marvel Latte.

```
BIGGBY COFFEE\nThanks for joining us!

        300 W Grand River Ave
          East Lansing, MI

Barista: NAME                01/28/2022
Order #: 209                   07:52 AM

D20 Caramel Marvel                $5.69
D20 Caramel Marvel                $5.69
- Buy One Give One               -$5.69

Subtotal                          $5.69
Tax                               $0.34

Total                             $6.03

Tip                               $0.00
Discover ####                     $6.03
Change                            $0.00

  Tell us how your visit was!\n866.
  444.3909 or\nfeedback@biggby.com.
```

Figure 1: Receipt example.

Program Design

General Functions

The data processing program is written in Python and can produce summary reports that cover the ingredient usage recorded in a sample of receipts. Receipt data is downloaded from the BIGGBY® point-of-sale (POS) system in the form of a csv file.

The program is designed to generate a summary report of the total receipt data collected by one franchise over an entire year.

The program first reads raw receipt data from the collection of csv files in an input folder. Ordered items and modifications are then filtered and extracted from the raw data. They are organized into “Item” and “Order” objects.

After items are sorted by date into an ordered list, they are matched with their corresponding recipes using string comparison. This allows ingredient quantities to be assigned to item objects for use in calculations. The code allows for changes to ingredient quantities using recipe modifications.

```
16  class Item(object):
17      """
28
29      def __init__(self, item = None,date = None, name = "unknown",
30                   size = "#", mods = list(), recipe_name = None,
31                   recipe = None, modded_recipe = None):
32
33          # Define basic attributes
34          self.item = item
35          self.date = date
36          self.name = name
37          self.size = size
38          self.mods = mods
39          self.recipe_name = recipe_name
40          self.recipe = recipe
41          self.modded_recipe = modded_recipe
42
43          # Define item name and size
44          self.name_and_size()
45
46      def name_and_size(self):
94
95
96      def mod_apply(self, modded_recipe):
108
109
110     def __str__(self):
120
```

Figure 2: Item class definition code sample.

Program Outputs

Four sheets are written into a single output Excel file:

1. A list of all items read from receipt data their respective dates and modifications.
2. A summary of all ingredients used over time for each recipe-matched item.
3. A summary of all items and matched recipes to be used for manual error checking.
4. A list of all items which could not be matched with a recipe from the input recipe catalog.

Visualizations

The visualizations tell a story of the carbon footprint from BIGGBY® by transforming technical data into simple visuals. They will be a useful tool for the client to present to BIGGBY® executives, making it easier and faster to identify patterns and trends.

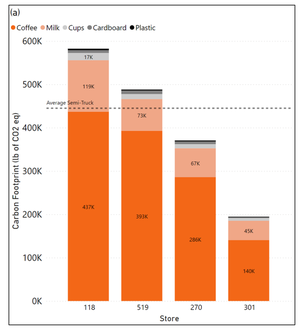

Figure 3: Combined carbon footprint of key materials used at four stores in 2021.

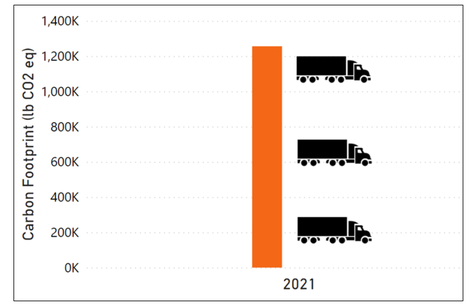

Figure 5: Combined carbon footprint of coffee at four stores in 2021.

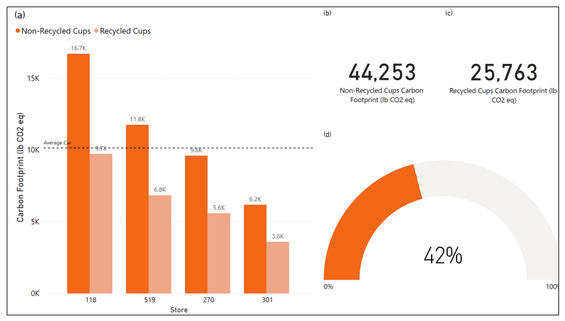

Figure 4: Carbon footprint of cups and emission reduction potential of plastic due to recycling cups for four stores in 2021.

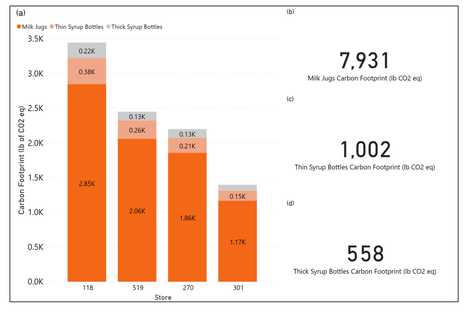

Figure 6: Combined carbon footprint of milk jugs, thick, and thin syrup bottles for four stores in 2021.

Together, the visualizations and company recommendations created based off them will direct company focus and strategy for improving business sustainability decisions. The aim was to create simple and easy to follow next steps for BIGGBY® to execute.

Recommendations

- Consultation from Consumers Energy.
- Require Energy Star appliances in new stores.
- Implement an in-store recycling system.
- Source coffee beans from sustainable farms.
- Develop a standardized method of quantifying recipe ingredients and recipe modifications.
- Add a sustainability section to the BIGGBY® website.
- Include all recipes, such as cold brew and seasonal, in recipe catalog.
  - Create a spreadsheet from recipe catalog.
- Improve accessibility of data in the POS system.
- Clearly and consistently define names and ingredient measurement units in POS system and recipe catalog.
- Update current program code to incorporate improvements to the POS system.

Select References

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