**The Perfect Batch**

*Cookie Monster Approved*

Lean Operations Management – Final Report

Florida Polytechnic University

Spring 2022

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[04/22/2022]

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# Introduction

A wise blue Muppet once said, “C is for cookie and cookie is for me!” How can we optimize the chocolate chip cookie making process so that Cookie Monster can have as many cookies as possible? We will explore and optimize the cookie making process from using decision support tools to find the nearest grocery store, to path optimization to get through the store as fast as possible, to the 5S system to organize everything when we get back home, to lean systems analysis to make sure we are getting the most out of our oven trays and racks, and finally to quality analysis to make sure that our cookies are within proper specifications. Our plan is to make the most efficient chocolate chip cookies without sacrificing on quality or taste.

# Literature Review

Before designing the process layout to bake the optimal chocolate chip cookie, we considered a few topics from our course textbook, *The Toyota Way*. The first chapter we looked at applying in this project was Principle 6. This principle states that manufacturers should   
“build a culture of stopping to identify out-of-standard conditions and build in quality” (Liker, 2021). We implemented this lean operations management principle throughout our project by checking our cookie dough, and frequently checking our cookies to ensure that they were properly baked. Furthermore, we standardized this process by precisely measuring each ingredient before adding it to the mixing bowl and by setting a timer for consistent baking times.

Next, we reviewed Principle 7 in *The Toyota Way*. This lean principle advises manufacturers to “use visual control to support people in decision-making and problem solving” (Liker, 2021). We were able to implement visual quality control by visually inspecting each of the cookies that were produced for outliers and discarding them (eating them) from the final production batch. This allowed us to increase our overall production quality with a more standard batch.

Lastly, we reviewed Principle 8: “adopt and adapt technology that supports your people and processes” (Liker, 2021). We learned from our Toyota Way project earlier this semester that technology is a tool, not a goal to achieve. We applied this to our project by utilizing timesaving equipment to automate manual labor inside of our process design. However, I was sure to keep in mind that a kitchen-aid mixer will never replace my teammate – that is, automation and equipment is not a substitute for a creative, thinking person.

Each of these principles that were considered and implemented throughout our project assisted in standardizing our cookie baking process to increase efficiency, decrease variability, and create the perfect batch.

# Research Design

In order to create the most efficient cookie, our plan was to optimize each step of the process, starting from the very beginning. For this, we decided to compare three local grocery stores on two factors: store distances and store prices. We wanted to buy our cookie ingredients at the lowest price and travel the shortest distance to minimize transportation costs.

With our ingredients efficiently purchased, the next step was to clear and organize our warehouse and production facility (aka the kitchen). We aimed to do this by implementing the 5S lean operations management system. There are many benefits of using the 5S system to organize the kitchen prior to starting the baking process. For example, a clean, organized workstation provides a more pleasant workplace that would improve our organization and reduce our physical labor by not having to search for each utensil and ingredient. Plus, 5S would help to boost our overall team attitude by enabling us to get the job done quicker so we could enjoy our cookies!

# Analysis

To begin designing our process, we compared the store distances and ingredient prices for three local grocery stores including Aldi, Publix, and Walmart. Looking first at Aldi, our analysis revealed that there were three alternative routes. The shortest route was a 4-minute trip to travel 0.7 miles to this grocery store. Next, we considered the shortest distance to Publix. Out of three routes, the shortest drive resulted in a 1.2-mile trip lasting 5 minutes. Lastly, we looked at the distance to pick up our ingredients from Walmart. Out of three routes, the shortest was a 1-mile trip lasting about 4 minutes.

Next, we wanted to compare the ingredient prices to determine the lowest prices for quality cookie ingredients at each of these grocery store locations. To ensure that we were comparing the prices of the same ingredients at each of these stores, we made a list. We would be comparing on the price basis of seven ingredients: butter, brown sugar, eggs, vanilla, salt, flour, and chocolate chips. First, we recorded all of the costs of these ingredients at Aldi as seen in Table 1. Since some of these ingredients at the three different stores were sold in different quantities, we then calculated the unit cost and wasted product as shown below.

Table : Aldi Ingredient Prices



As you can see, the total cost of ingredients at Aldi resulted in $26.52 with total waste costing us $5.29. From this, the total cost of producing one cookie from Aldi ingredients is approximately $0.25.

Next, looking at the ingredient prices for Publix yielded the following results.

Table : Publix Ingredient Prices



As shown in Table 2, the total cost of ingredients at Publix was $41.66 and total waste was about $6.89. From this, the cost per cookie from Publix ingredients is approximately $0.43.

Lastly, we compared the cost of cookie ingredients at Walmart. Shockingly, Walmart did not have the lowest overall cost. As seen in below in Table 3, ingredients at Walmart cost approximately $33.16 and total waste was approximately $4.65. From this, the cost per cookie from Walmart ingredients came out to be approximately $0.35.

Table : Walmart Ingredient Prices



Thus, after analyzing these results, we determined that it was most efficient to purchase our cookie ingredients from Aldi based on it having the shortest store distances and lowest ingredient prices.

Table : Total Cost Comparison



The next step after obtaining the cookie ingredients was to organize the workstation to prepare to bake! To do this, we utilized the lean 5S technique. In this method, the 5Ss stand for Sort, Straighten, Shine, Standardize, and Sustain. First, we began by sorting through our workspace to keep only what was necessary to bake the cookies and relocating or discarding unnecessary materials. Second, we straightened everything out to ensure that our materials were orderly and in their assigned place. This made it easier for us to find the tools and ingredients we needed. Next, we shined the kitchen to ensure cleanliness, after all, a clean kitchen is a happy kitchen! This step allowed us to inspect the kitchen for safety concerns, like making sure nothing was on the stove and that the oven was turned off when not in use. It also ensured that our cookies would be prepared in a clean environment free of contamination for food safety. Then, we standardized our process. By developing a system and procedure we were able to maintain the previous three steps of sorting, straightening, and shining. The system we put in place for this was to simply clean up after ourselves in the kitchen and put our utensils and ingredients back in their place. Lastly, we needed to sustain this process to maintain a stabilized workplace. Since we were baking multiple batches of cookies, it was important that we were able to stick to this process and maintain it for maximum efficiency for the following batches.

Now for the fun part: actually baking the cookies! In order to optimize our cookie production, we followed the process flowchart shown in Figure 1. In this diagram it outlines our cookie making process from preheating the oven to cooling the cookies. This process was then repeated to standardize the following batches.

Figure : Process Flowchart

Diagram

Description automatically generated

The order and precedence of each of these tasks was then summarized in a precedence relationship chart. According to our textbook, precedence relationship charts show “a natural order between activities, where some tasks must be completed before others can begin” (Tracy, 2019). This chart also allows us to estimate the time it will take to complete each task to minimize the total process time.

Table : Precedence Chart



Next, we wanted to calculate the total time it would take to complete our cookie baking process. In order to do this, we must first determine the takt time. According to page 125 of our textbook, “takt time is the number of seconds between units of output exiting the system” (Tracy, 2019). This can be calculated by dividing the total time in seconds by the units of forecasted demand.

Table : Total Project Time

Lastly, we conducted quality control testing to ensure product standardization and to minimize variability by sampling the cookies from the production output.

# Conclusion

In summary, we were able to satisfy the cookie monster by utilizing lean operations management techniques to optimize our cookie making process. By implementing tools such as transportation models, 5S organization, process flowcharts, and precedence relationship diagrams, we are confident that we were able to minimize costs, distance, labor, and time to make the most efficient chocolate chip cookies.

# References

Liker, J. K. (2021). Principle 6, 7, & 8. In *The Toyota way: 14 management principles from the world's greatest manufacturer* (pp. 205–245). essay, McGraw Hill Education.

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