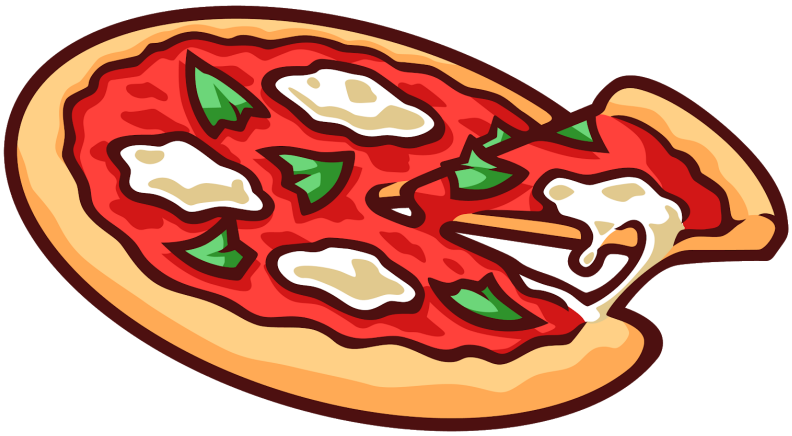
“Making a Pizza”



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IME 223 - Process Improvement Fundamentals
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TABLE OF CONTENTS

TABLE OF FIGURES

INTRODUCTION

Continuous process improvement is essential to building an efficient and profitable business. key objectives should be derived from kaizen philosophy, including quality control, just-in-time delivery, standardized work, the use of efficient equipment, and the elimination of waste. Through the use of time studies, MUDA analysis, and the 5S procedure, we sought to improve the pizza making process. This process was selected because as a new company, our processes have just been created and there is naturally a lot of waste. As of right now, the total cycle time for the process is too high; it takes too long for us to produce a quality pizza, and we are only able to output one pizza per day. We want to provide our customers with the highest quality pizza, made from fresh ingredients and cooked to perfection. The scope of our process begins with making the dough, then assembling the toppings, and ends with cooking the pizza.

FIGURE 1: PERFORMANCE RATINGS

Name	Performance Rating
Katrina	0.9
Dylan	1.0
Ronel	1.1

As seen above in Figure 1, our performance ratings for each member of the team were assigned based on time study data collected before our process improvements were made. Ratings reflect our performances relative to one another for our initial total cycle times.

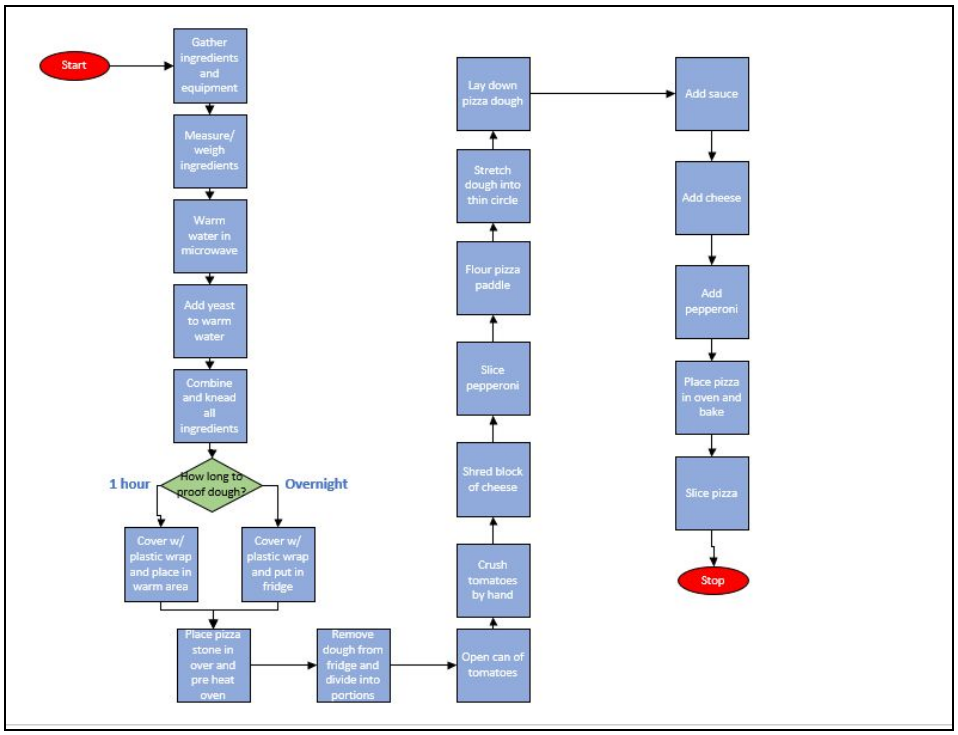
RECORD OF ORIGINAL PROCESS

FIGURE 2: ORIGINAL SEQUENCE OF OPERATIONS

1	Gather ingredients
2	Measure ingredients
3	Warm water in microwave
4	Add yeast
5	Combine/knead all ingredients
6	Cover with plastic wrap and put in fridge
7	Proofing dough overnight
8	Place pizza stone in oven and preheat oven
9	Remove dough from fridge and divide into portions
10	Open can of tomatoes
11	Crush tomatoes
12	Shred block of cheese
13	Slice pepperoni
14	Flour pizza paddle
15	Stretch dough
16	Lay down dough
17	Add sauce
18	Add cheese
19	Add pepperoni
20	Place pizza in oven and bake
21	Slide baked pizza

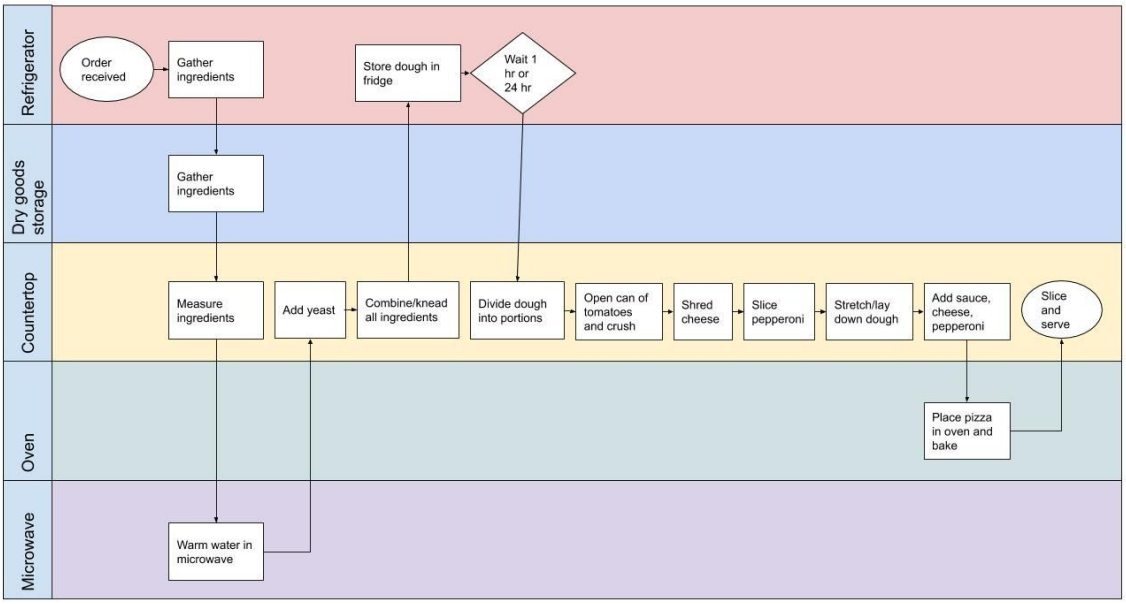
In Figure 2, nearly every step in our process is done manually, or with the assistance of a cooking utensil. There are 21 total operations, starting with gathering ingredients and finishing with slicing the cooked pizza. The dough is created from scratch and kneaded by hand. The dough is then stretched and laid down by hand. The cheese is grated by hand, pepperoni cut from a full stick, and sauce created from fresh/canned tomatoes. Essential appliances include a refrigerator, microwave, and conventional oven. A sturdy knife, cheese grater, can opener, pizza stone, and saucepan are all the necessary cooking utensils.

FIGURE 3: PROCESS FLOWCHART



In Figure 3 above, the flowchart for the pizza making process is fairly one-dimensional, with one decision block regarding the length of time we should leave the dough in the fridge to rise. That block is by far the longest step and had potential to cause significant delays to our process.

FIGURE 4: SWIMLANE DIAGRAM

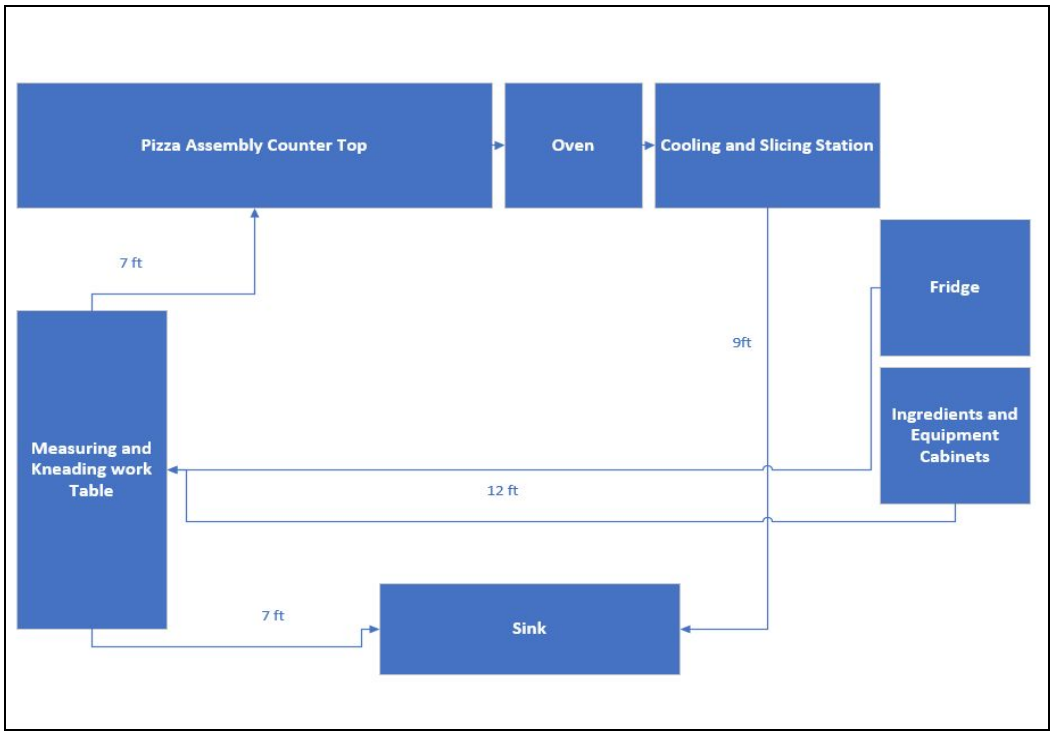


In Figure 4 above, the swim-lane diagram illustrates the process by sorting each work element into categories based on location in the kitchen. The large majority of steps are completed on the countertop/pizza assembly station.

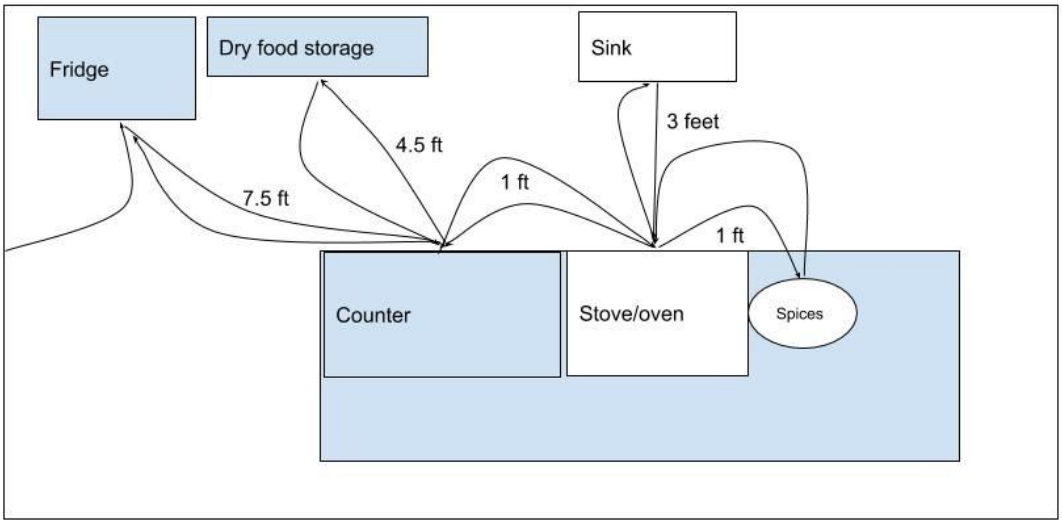
OPERATION LAYOUTS

Due to the current pandemic our team members do not have access to identical kitchens. The different distances between workstations are indicated in the spaghetti diagrams. However, we decided that travel times between the stations would not have a significant effect on our overall cycle times. After obtaining ingredients and supplies to make the pizza, most of the work elements are completed at the same station, without the need for moving back and forth between locations in the kitchen.

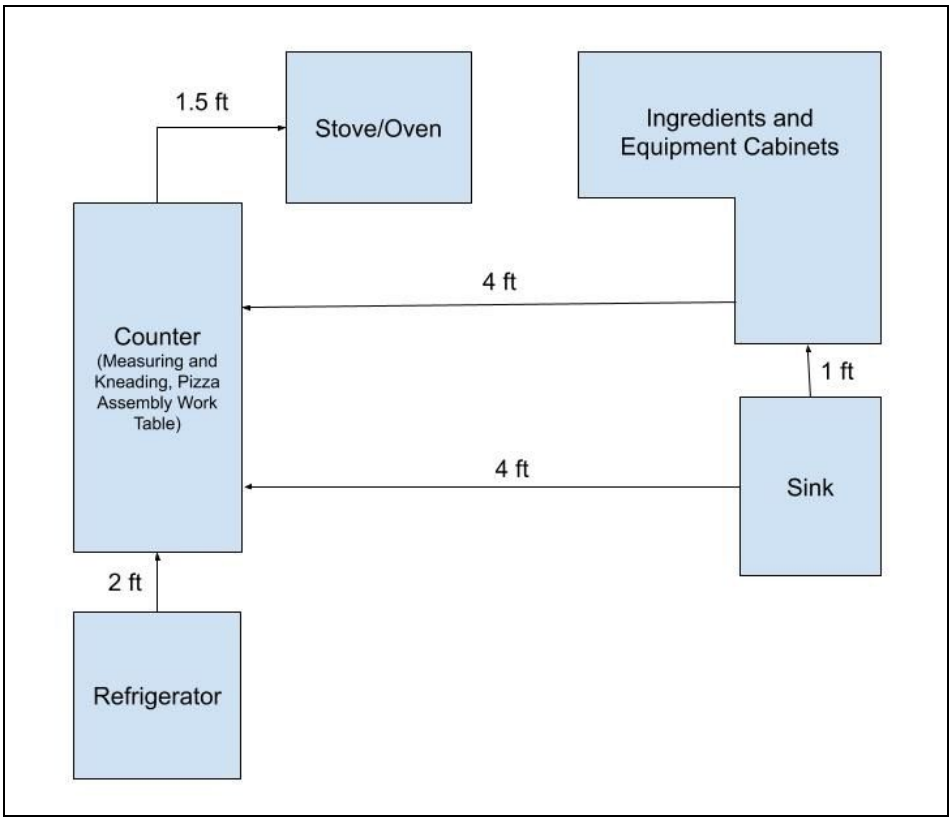
Ronel's Kitchen



Dylan's Kitchen



Katrina's Kitchen



PROCESS EXAMINATION

FIGURE 5: AVERAGE NORMAL TIMES

Work Element	Total Average Normal Time
Proofing dough overnight	480.00
Place pizza in oven and bake	20.00
Combine/knead all ingredients	15.69
Measure ingredients	10.83
Stretch dough	4.97
Shred block of cheese	4.75
Crush tomatoes	4.31
Gather ingredients	3.64
Slice pepperoni	3.36
Cover with plastic wrap and put in fridge	1.61
Remove dough from fridge and divide into portions	1.51
Add sauce	1.44
Slide baked pizza	1.36
Lay down dough	1.22
Add cheese	1.16
Place pizza stone in oven and preheat oven	1.12
Add pepperoni	0.80
Open can of tomatoes	0.54
Warm water in microwave	0.50
Flour pizza paddle	0.38
Add yeast	0.27

For examining the process, we broke down the pizza making process into 21 work elements. Although we timed each work element, the work elements involving adding ingredients were far outweighed by the fixed proofing and baking times. Since each team member did one cycle of the process, there were a total of three cycles. We took the normal times of each work element from the three cycles, and took the averages to compile the list in Figure 5. Dough proofing takes 8 hours, or 480 minutes, and it would be an inevitable bottleneck of the process. Due to the proofing the dough being the longest work element, we reworked the Pareto chart so that the other work elements can be easier to interpret. As we can see in Figure 6, what takes up time is food preparation and having to cut ingredients.

FIGURE 6: ORIGINAL PROCESS PARETO CHART

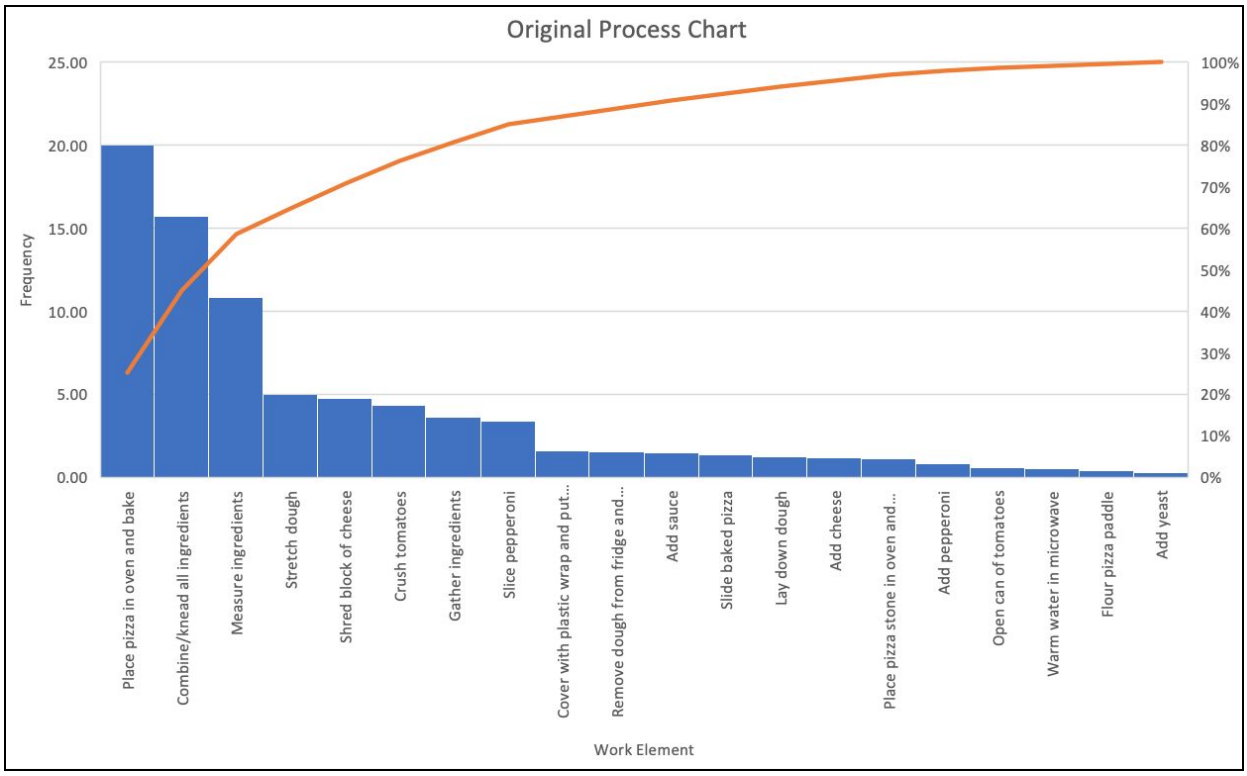


FIGURE 7: DIRECT TIME STUDY ORIGINAL SUMMARY TABLE

Original Process		
	Value	Units
Total Allowance:	0.09	
Total Observed Time:	1680.4	minutes
Total Normal Time:	1678.3	minutes
Average Normal Time:	559.43	minutes
Standard Time Per Pizza:	609.78	minutes
Number of Pizzas Per Day:	1	pizzas

FIGURE 8: PIZZA-MAKING FLOW PROCESS CHART

PRESENT METHOD (X) PROPOSED METHOD ( )

SUBJECT CHARTED: PIZZA MAKING PROCESS DATE: 11/1/20

DEPARTMENT: CHARTED BY: DB SHEET NO. 1

DIST IN FEET	TIME IN MINS	CHART SYMBOLS	PROCESS DESCRIPTION
12	3.64		Gather ingredients
	10.83		Measure ingredients
4.5	0.50		Warm water in microwave
	0.27		Add yeast
	15.69		Combine/knead all ingredients
	1.61		Cover with plastic wrap and put in fridge
7.5	480.00		Proofing dough overnight
	1.12		Place pizza stone in oven and preheat oven
	1.51		Remove dough from fridge and divide into portions
	0.54		Open can of tomatoes
	4.31		Crush tomatoes
	4.75		Shred block of cheese
	3.36		Slice pepperoni
	0.38		Flour pizza paddle
	4.97		Stretch dough
	1.22		Lay down dough
	1.44		Add sauce
	1.16		Add cheese
	0.80		Add pepperoni
1	20.00		Place pizza in oven and bake
	1.36		Slide baked pizza
25	559.43		TOTALS

From Figure 7, we can see that we can only produce one pizza per day, which is not ideal if we were to apply this process to a business setting. The standard time per pizza is about 610 minutes, or about 10 hours.

In Figure 8, we have the flow process chart, which clearly details value-added and non-value-added activities. The circle (◯) symbol represents operations, which are jobs or tasks normally performed at one location. The arrow (→) symbol represents transportation, which is the movement of an item from one location to another. The rhombus (◇) symbol represents delays, which causes a pause or interruption in scheduled work when material is waiting to be processed. The triangle (△) symbol represents storage, where there's a scheduled holding of items before, during, or after production operations.

FIGURE 9: MUDA SUMMARY TABLE

	Description	Cause	Potential Solution
Overproduction	Pizza dough is made in large batches which often sit out for a long period of time without being pressed out or cooked	The frequency of customers changes throughout the day	*Just-in-Time (JIT)*
Unevenness (Mura)	Having an excess of dough sitting out when it is slow and then not enough dough ready when it is very busy	No knowledge of busiest times	*Just-in-Time (JIT)*
Inventory	Having left over ingredients at the end of the day, which cannot be used the next day because they will spoil	Daily ingredient requirements differ from day to day based on how many pizzas are sold	*Kanban (pull system)*

If we were to apply this original process to a business setting, overproduction, inventory, and unevenness would be the top three categories of concern in Figure 9.

With the dough being the foundation of the pizza, it's important to make enough dough for the predicted number of customers. However, customer demand can change day by day, so overproduction can occur. We can reduce overproduction by implementing *Just-in-Time (JIT)*, where we pull dough through production based on customer demand instead of pushing dough through production based on projected demand.

Unevenness goes hand in hand with overproduction, especially since the dough is a critical component of the pizza. By overproducing dough, there will be times when there are leftovers of dough, especially on days when business is slow. Similar to overproduction, we can implement *Just-in-Time (JIT)* to reduce unevenness.

Based on how many pizzas are sold, ingredient requirements can differ. Customers have different preferences, so we can determine which ingredients to restock by keeping track of which ingredients run out quickly throughout the day. We can implement a *kanban*, or a pull system, which will automatically replenish ingredients through signal cards that indicate when more ingredients are needed. A kanban will regulate the flow of ingredients both within the restaurant and with outside suppliers and customers.

DEVELOPMENT OF A NEW AND IMPROVED PROCESS

For our new and improved process, we would bake a pizza using a premade pizza dough and pre-cut ingredients to eliminate MUDA. By using this method, we would eliminate all work elements involving dough and food preparation. For the dough, we would take the premade dough, then lay down and stretch it out. We would simply have to add the ingredients on top of the dough, and then place it in the oven. We would still have to take into account the baking time, but eliminating the dough proofing time greatly reduces our standard time per pizza.

FIGURE 10: IMPROVED SEQUENCE OF OPERATIONS

1	Gather ingredients
2	Place pizza stone in oven and preheat oven
3	Remove dough from fridge and divide into portions
4	Open can of tomatoes
5	Flour pizza paddle
6	Stretch dough
7	Lay down dough
8	Add sauce
9	Add cheese
10	Add pepperoni
11	Place pizza in oven and bake

For Figure 10, we were able to eliminate 10 work elements, and break the process down to only 11 work elements. This is because we got rid of the work elements with dough proofing and food preparation. Figure 11 illustrates the improved process Pareto chart. Although the pizza baking time is shown as the bottleneck, this is a fixed time. Therefore, our actual bottleneck is stretching out the dough, which is a vital part to making the pizza to ensure the dough maintains its elasticity.

FIGURE 11: IMPROVED PROCESS PARETO CHART

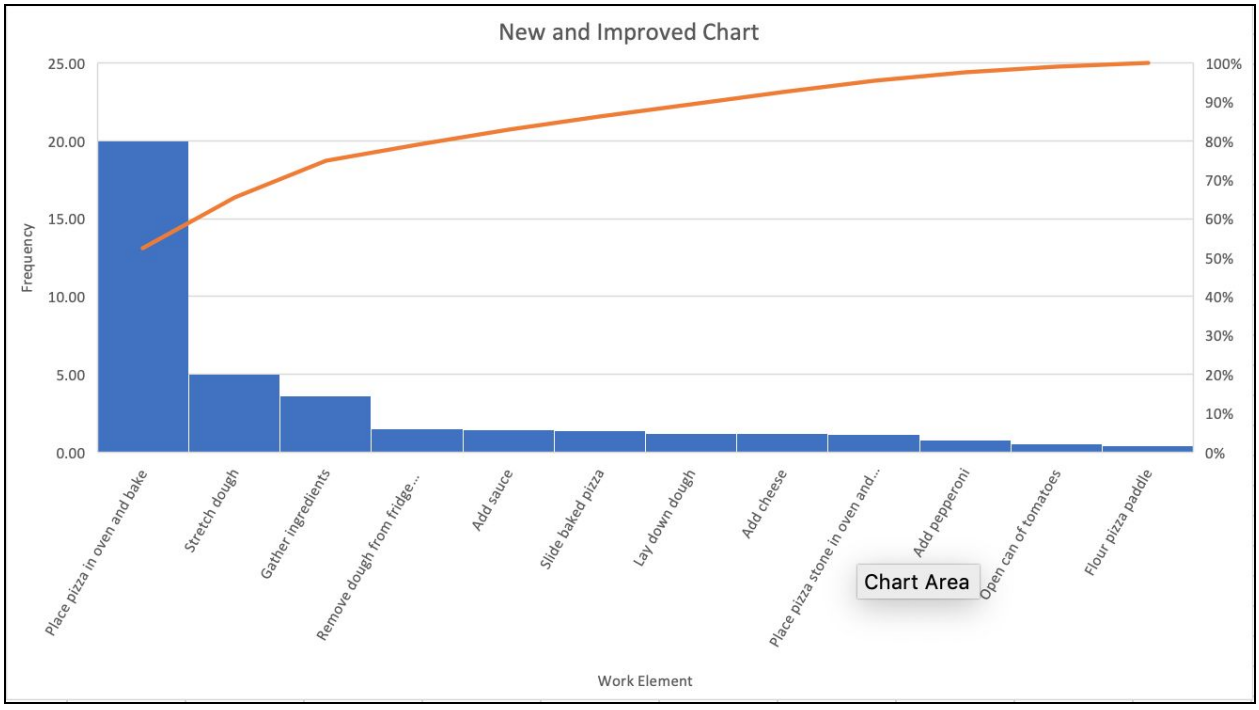


FIGURE 12: DIRECT TIME STUDY IMPROVED SUMMARY TABLE

New and Improved Process		
	Value	Units
Total Allowance:	0.09	
Total Observed Time:	115.1	minutes
Total Normal Time:	114.41	minutes
Average Normal Time:	38.14	minutes
Standard Time Per Pizza:	41.57	minutes
Number of Pizzas Per Day:	13	pizzas

With our new and improved process shown in Figure 12, we have greatly reduced our standard time per pizza with a difference of 568 minutes—going from about 610 minutes to 42 minutes. Figure 12 is based on the original direct time study data, using the same equations as Figure 7. For more details on equations, there is reference in the Appendix for the Excel analysis file.

It's important to note how much of a difference the improved process is without the dough proofing time of 480 minutes. Since the dough proofing time can easily be eliminated with premade dough, we can now make 13 pizzas in an 8-hour shift compared to the one pizza we can make in the original process.

DOCUMENTS

The importance of proper documentation of the new process is vital for repeatability and reproducability. It is also crucial to have everything well documented in order to be able to find any inefficiencies so they can be resolved accordingly. Continuous process improvement is responsible for the longevity of the business. Having documentation of the process makes it possible to analyze if we are making the product to specification. Key performance indicators are being able to produce a pizza within the specified time and meeting demand. At the moment our new process is able to produce a pizza in 41.57 minutes and meet a demand of 13 pizzas in an 8 hour work period. We can judge our performance based on if we are over or under these standards. The operations manual would not only be a step by step guide on how to make pizzas but also hold other important documents such as analysis, safety guides and emergency contact numbers. These must be well documented not only for the staff but for legal reasons as well. Since there will be lots of documentation we would have separate binders to organize them all into sections. One binder will be for written reports and maintenance logs and another for inventory.

FIGURE 13: OPERATIONS/ANALYSIS

Sample Analysis Table:

Day	Thursday	Friday	Saturday	Sunday	Monday
Average time to make a pizza					
Total pizzas made					

With the table above, we are able to track progress of our time and pizza output. If we were to change something in the process we would be able to easily see how it affected the output.

FIGURE 14: MAINTENANCE

Sample Maintenance Check:

	Clean:	Lubricate:	Service/replaced part:
Oven			
Dough mixer			
Refrigerator			

The maintenance binder will have documentation on how to use certain equipment such as the oven and also maintenance check logs to keep track of cleaning and lubricating as well as servicing if needed. Documentation of maintaining equipment is necessary to stay on top of the tasks need to extend the life of the equipment.

FIGURE 15: INVENTORY

Sample Inventory Check:

	Quantity:	Use by date:
Dough		
Tomato Sauce		
Cheese		

Having proper documentation of inventory not only ensures that we rotate soon to be expired foods out but also to keep track of how much we are spending on ingredients and what amount should be purchased for the next shipment.

APPENDIX

Click for full analysis Excel file