MOD PIZZA : Front of House Improvements

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Objective

Identify and analyze variables affecting store capacity, throughput, and profit to provide recommendations of improvement, while still retaining MOD culture.

- Increased Throughput: By 16-44%
- Decreased Customer TIS: By 28-40%
- Decreased Queue Time: By 90-91%
- Increased Maximum Revenue: By 16-22%

Current State

Background

MOD Pizza is pioneering restaurants that create individual artisan-style pizzas and salads at a self described "super-fast" rate. With hundreds of stores and a rapid growth strategy, MOD struggles with inefficiencies on its makeline, causing a long cycle time for the customer. Our team aimed to find these inefficiencies and give scalable recommendations MOD can implement in both existing and future stores.

Our project sponsor initially tasked our team with determining the current capacity of their stores during peak production hours, and to build a model that could adapt to potential future demands. Over the course of our project, we worked with our client to expand our scope to include making operational improvements and suggestions that could be implemented into pre-existing stores and influence the design of future expansions.

Scope

Our client laid out a well defined scope to maximize noticeable and immediate effects. This includes:

- Front of House
- Peak Hours
- No infringement on MOD's unique culture

Overview of a MOD Store

Stations considered:

- Makeline (green)
  - ⇒ Point, Cheese/Sauce, Meat, Veggie, Finish
- Point of Sale (purple)
- Oven (orange)
- Expo (Cut pizza and customer pick-up, red)
- Dough Press (blue)

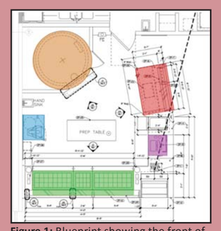


Figure 1: Blueprint showing the front of house for MOD in Ballard

Data Collection

In addition to data that we received from our client our team conducted thorough data collection to help determine an accurate model of a typical MOD store's current state. The data was collected both in stores and through test kitchen videos. An example of data metrics collected include:

- Customer arrival rate
- Customers per group
- Customer time in system
- Customer queue time
- Pizza throughput & cycle time
- Station processing times
- Order variability
- Worker utilization
- Immersion shift observations

Simulation Model of Current State

Utilizing SIMIO modeling software, the team developed a simulation that significantly improved on MOD's current model. Our version considered both the product and customer in the system at all points of worker interaction. This model accurately represents a typical MOD store during peak production times and can collect a large variety of valuable data.

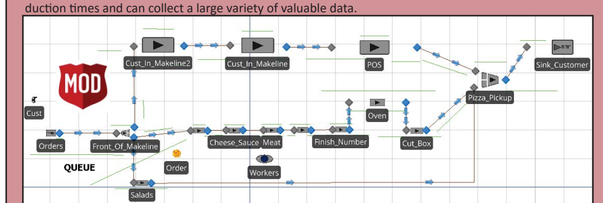


Figure 2: Simulation model empty before a test. Customers follow the top track through the system, while orders follow either the middle track (pizzas) or bottom track (salads).

Key Functions:

- Tracks both customers and pizzas as they move through the system
- Utilizes a resource that can easily vary the number of workers
- Batches customers into groups upon arrival that generate between 1-7 pizzas
- Matches customers with their pizzas before they can exit the system
- Determines utilization of stations, identifying the point station as the bottleneck
- Easily modifiable to accommodate for future state testing

MOD's previous model:

- Simple model of only pizzas entering the system and processing at a single server
- Inaccurately modeled throughput, and other key statistics

Iteration One:

- Separated the makeline into individual stations using an easily variable worker resource
- Displayed information about worker utilization and throughput

Iteration Two:

- Added customers to the system
- Helped visualize customer and pizza interactions, and collected information about customer cycle time

Iteration Three:

- Added customer batching, reoptimized layout of model, improved internal logic
- Displayed data on customer queue times, customer time in system, makeline station utilization, total throughput, and bottlenecks

Controlled Experimentation

While creating a simulation model to represent the current state of a typical MOD store, we made a conscious effort to design a model that is dynamic and can adapt to a variety of changes. Our team used these traits to design experiments to test changes that can affect throughput and to design hypothetical future states.

Experiment Metrics	Customer Time In System	Total Throughput	Customer Queue Time	Point Utilization
Current State of MOD	12.9 Minutes	117.5 Pizzas	5.36 Minutes	97.6 Percent

This model creates a bottleneck at the point station, the first station a customer reaches on the makeline. Our goal was to relieve the pressure on the point station while increasing throughput and decreasing customer cycle time.

Analysis of Point vs Whole Line Improvements

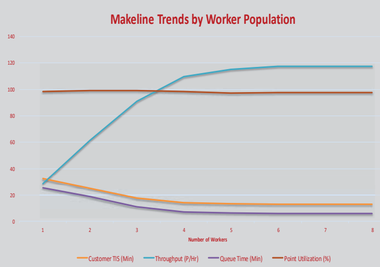
MOD has limited resources dedicated to improvements within a store. We wanted to determine whether a small improvement in speed and variance to the whole line or a larger improvement to the point station would be better for MOD.

	Customer Time In System	Total Throughput	Customer Queue Time	Point Utilization
Decreasing all stations processing time by 20%	29% Decrease	15% Increase	64% Decrease	8% Decrease
Decreasing point station down by 30%	34% Decrease	18% Increase	77% Decrease	17% Decrease
Decreasing all stations variance by 25%	11% Decrease	4% Increase	22% Decrease	4% Decrease
Decreasing point station variance by 40%	14% Decrease	7% Increase	31% Decrease	5% Decrease

Decreasing point processing speeds and variance by a larger amount is more effective than decreasing all stations by a smaller amount. Future MOD resources should focus on reducing the point processing time and standardizing work to remove variance.

Different Staffing Levels

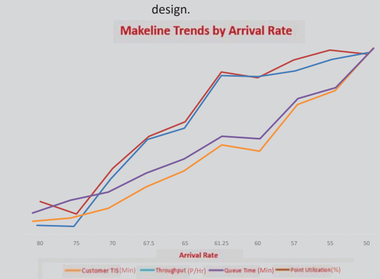
Finding the optimal number of workers to maximize throughput can help MOD maximize profit.



Staffing five workers between eight stations results in an optimal tradeoff between maximizing throughput and minimizing staffing costs. Therefore, MOD should staff six workers during peak hours since our model has a constant oven operator, as seen in a real life MOD store.

Arrival Rate Stress Test

Identifying the critical point where MOD's current makeline cannot accommodate customer inflow allows MOD to accurately make decisions regarding store design.



Throughput and point utilization increase constantly until 61.25 seconds, then begin to cap out. The time in queue and the customer time in system begins to rise dramatically at the same time. Therefore, if the arrival rate is more than 61.25 seconds per customer, the current makeline system is inadequate.

Graph not to scale

Main Recommendations

After running our experimentation phase, the team focused on forming recommendations of change that would both challenge the current state of MOD and bring about a more efficient system. In order to find the most productive of these ideas, we conducted tests in a controlled test kitchen environment. Our three best recommendations are listed below.

Experiment Metrics	Customer Time In System	Total Throughput	Customer Queue Time	Point Utilization
Recommendation One: Round Robin				
Change in System Measured Against Control in SIMIO	38% Decrease	16% Increase	90% Decrease	38% Decrease
Change in System Measured Against Control in Test Kitchen	40.2% Decrease	43.8% Increase	-	-

Round Robin is a staffing deployment strategy that features a static point. The rest of the workers revolve about the makeline when orders have been generated, completing a pizza in its entirety. This also drastically reduces the processing time at the point station by moving some duties to other workers on the line, evening out worker utilization.

Some of the qualitative feedback garnered from the test kitchen:

- Lots of walking for employees, but they enjoyed having a prolonged interaction with customers.
- The makeline was messy - deployment would require someone who restocks/cleans the lines.
- Employees did not have time to switch gloves between handling meat and vegetables.

In order to combat these issues, the team created a **best practices implementation strategy** so that this staffing deployment system could be more easily implemented into existing stores.

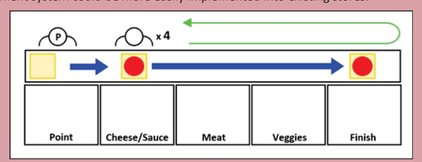


Figure 3: Visualization of the Round Robin staffing deployment strategy

	Customer Time In System	Total Throughput	Customer Queue Time	Point Utilization
Recommendation Two: Two Points				
Change in System Measured Against Control in SIMIO	40% Decrease	22% Increase	91% Decrease	33% Decrease
Change in System Measured Against Control in Test Kitchen	28% Decrease	38.8% Increase	–	–

In a two point staffing deployment strategy, MOD would move from having one point to two rotating points, without adding an extra worker. This recommendation is driven by our identification of the point as the bottleneck due to the challenge the point faces in acquiring proper information from the customer.

Some of the qualitative feedback garnered from the test kitchen:

- Felt faster—workers felt a sense of urgency and the two point workers competed against each other.
- While this competition sped the line up, customers felt like they were being pressured to make quicker decisions, and were confused by the rotating point.

One of the main issues with this recommendation is that it is not easily implementable into existing makelines due to space constraints. **However, MOD has already recognized the potential impact of this recommendation and has made plans to increase the size of the makeline and implement this staffing deployment in future stores.**

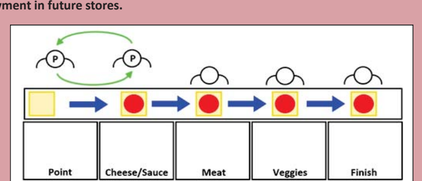


Figure 4: Visualization of the Two Points staffing deployment strategy

Main Recommendations

Recommendation Three: Organized Makeline

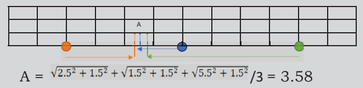
MOD pizza stores lack a clear company wide policy on ingredient layout. In order to combat this randomness in the system, the team created a Euclidean distance based ranking algorithm for each spot on the makeline. This ranking algorithm paired with each ingredient's order popularity (acquired by compiling 400,000 online orders) allowed the team to design the "perfect" makeline layout for each store.

Craft Makeline

2.92	2.55	2.55	2.92
2.12	1.58	1.58	2.12
1.58	0.71	0.71	1.58

The craft makeline ranking system was based on the idea that each station would work independently of each other, so ingredient layouts should be optimized based on distance from the worker in that station only.

Shared Makeline



$$A = \sqrt{2.5^2 + 1.5^2} + \sqrt{1.5^2 + 1.5^2} + \sqrt{5.5^2 + 1.5^2}/3 = 3.58$$

2.92	2.55	2.55	2.92	2.92	2.55	2.55	2.92	2.92	2.55	2.55	2.92	2.92	2.55	2.55	2.92	2.92	2.55	2.55	2.92
2.12	1.58	1.58	2.12	2.12	1.58	1.58	2.12	2.12	1.58	1.58	2.12	2.12	1.58	1.58	2.12	2.12	1.58	1.58	2.12
1.58	0.71	0.71	1.58	1.58	0.71	0.71	1.58	1.58	0.71	0.71	1.58	1.58	0.71	0.71	1.58	1.58	0.71	0.71	1.58
Point				Sauce & Cheese				Meat				Vegetables				Finish			

The shared makeline ranking algorithm featured adjacent cells being able to work with each other, therefore the ranking was an average of three distances from the workers. The only station that did not follow this logic was the point, as we assumed the point would only be concerned with its own operations.

Conclusion

Our project aimed to improve MOD stores by conducting an in-depth analysis of their current front of house practices, then incorporating these insights into effective future solutions. Over the course of this project our team has impacted MOD in the following ways:

- **Analyzed MOD's two different store models** and determined the advantages and disadvantages of the layouts
- **Aggregated and collected data** on a large amount of key store statistics
- **Developed a clear understanding of the current state, processes, and capacity of a typical MOD store**
- **Identified the major bottlenecks** in MOD's pizza making process
- **Delivered a robust, easily modifiable simulation model** that can be used to accurately represent the current state of a MOD store, as well as design experiments to test a variety of future state improvements
- **Developed the two point and round robin staffing deployment strategies** that significantly increase throughput, decrease customer cycle time, and mitigate the point bottleneck in the system
- **Conducted test kitchen experiments** that validated and confirmed the success of our two makeline recommendations, and prompted MOD to immediately look into real store implementation of the two point system
- **Determined the optimal layout of pizza ingredients on the makeline** using distance weighted popularity based line layouts
- **Created implementation plans** for our two staffing deployment strategies so that MOD can easily and seamlessly implement our recommendations into current and future MOD stores

Overall, the project culminated in the first engineering based perspective on MOD's processes. We were able to provide solutions that are scalable to current and future stores, are based in logic and test verifications, and will seamlessly integrate with MOD's current culture. MOD still has many challenges it faces based on customer demand, but by using engineering practices and systematic thinking the company can maintain a competitive advantage and lead its industry in innovation and production.

Acknowledgements

Christina Mastrangelo - Provided guidance and mentorship regarding project deliverables and project status.

Patty Buchanan - Provided an invaluable amount of time mentoring and troubleshooting SIMIO.

John Goedert - Provided amazing sponsorship and support of our project as well as insight into MOD.

The MOD Squad - Provided a great atmosphere for us to learn about day to day operations and MOD culture.