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RESTAURANT XYZ PEAK HOUR WAITING TIME REDUCTION USING SIX SIGMA ANALYSIS

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ABSTRACT

This research analyzes the long waiting time experienced by customers of Restaurant XYZ during peak hours (Saturday-Sunday, 12:00PM-14:00PM and 17:00PM-19:00PM). The objective of this research is to find out the factors or root causes that contribute to the long waiting time. Apart from that, other objectives are also to identify, implement and evaluate effective strategies that can be used as a solution to optimize the ordering process system so that it can reduce the long waiting time experienced by XYZ Restaurant customers. Waiting time in this research is aimed at when customers queue to order food and beverage until the customer gets their food. The current waiting time that customers experience is 34 minutes. Meanwhile, Restaurant XYZ has a goal of reducing waiting time to 25 minutes. This target is determined by consideration of the customer and restaurant. To analyze, this research uses a combination of qualitative and quantitative approaches. The quantitative method will be used to collect data of ordering and queuing time directly through observation. Meanwhile the qualitative method will be used to collect the perceptions, experiences, and expectations of the company and customers through interviews. The qualitative data will be used as the benchmark and basis of the research analysis. With this approach, research will also adopt the DMAIC (Define, Measure, Analyze, Improve, Control) framework to identify problems, measure data, analyze data, generate solutions, and prepare control plans to maintain improvement. Overall, this research suggests changing the ordering system from Restaurant XYZ to a digital ordering system using a website which will reduce waiting time because the queue will change from physical to digital. Apart from that, this research also proposes some changes to integrate solutions and monitoring plans.

INTRODUCING

Based on the theory of Maslow's hierarchy of needs (Simons et al., 1987), Abraham Maslow has set up five levels of needs of humans starting from the very basics and tapering upwards as can be seen on figure 1.1. Maslow said that people are motivated by 5 categories: physiological, safety, love, esteem, and self-actualization. Based on Maslow theory, physiological needs are the most basic need and become the primary needs of a human to be fulfilled. Physiological needs would come first in the person's search for satisfaction. One of these physiological needs that humans need to have is food and water. This shows that food and water are considered as the foundation upon which all other needs are built in the pyramid.

Figure 1. Maslow's Hierarchy of Needs

As food becomes the foundation of the needs, the demand for food is also expected to increase from 59% to 98% by 2050 (Hopper, 2024). The increase of food demand year over year is related to the increase of population growth that has linear growth. This phenomena also faced by Indonesia with the existing total population of 267 million people and 0.6% annual population growth (The World Bank, n.d.). This significant population increase inevitably leads to a higher demand for food resources to sustain the growing number of people

Significant population and food demand increases has stimulated entrepreneurs' interest in working on the FnB business. In response, food and beverage industries in Indonesia keep increasing with a total of 7,498 units in 2021 from 6,677 units in 2020, (Santika, 2023) as can be seen on figure 1.2. This make food and beverage industry become one of the highly prospective businesses in Indonesia and even on the world, (Dewi, 2022).

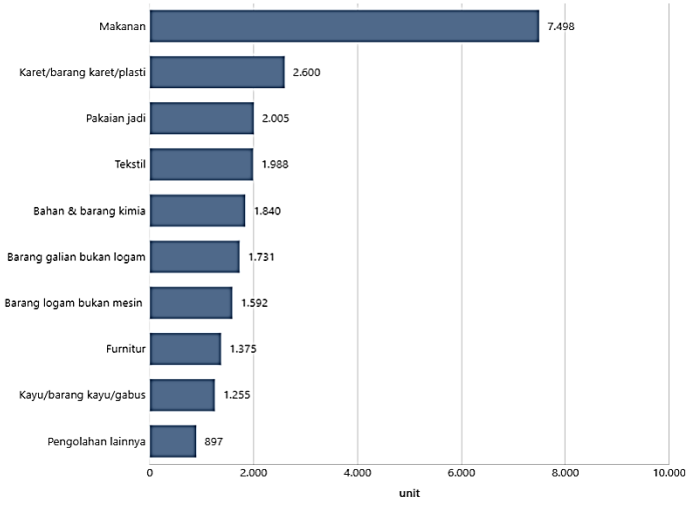

Figure 2. Number of Companies in the Medium-Large Industrial Category

In the food and beverage industry, people often being faced with waiting time. According to Maister, long waiting times can lead to customer dissatisfaction and frustration. The study found that customers are more likely to cancel or abandon their purchase or service if they experience extended waiting times, (Maister, 1985). long waiting times can lead to customer dissatisfaction and frustration. The study found that customers are more likely to cancel or abandon their purchase or service if they experience extended waiting times. This may lead to lost sales and the business's reputational damage. This emphasizes the importance of effective queue management in maintaining customer happiness. The increasing numbers of customers in restaurants can be good because it can escalate profit, but also can be bad due to the long waiting time that can lead to dissatisfaction of customers and even lose customers.

Restaurant XYZ in Bandung has experienced a large variance gap in terms of waiting time to buy food at the cashier and waiting for the food. As a result, Restaurant XYZ may experience a decrease in customer satisfaction for the short term and a decrease in profit in the long term.

METHODS

Methodology

The next step is to develop a methodology that contains a guide for conducting research. At this stage, the researcher will explain the methods used to conduct research starting from problem identification, theoretical foundation, research method, data collection and analysis, as well as conclusion and recommendation. This research will be done using both quantitative and qualitative methods. The quantitative method will be used to collect data of ordering and queuing time directly through observation. Meanwhile the qualitative method will be used to collect the perceptions, experiences, and expectations of the company and customers through interviews. The qualitative data will be used as the benchmark and basis of the research analysis.

Data Processing and Analysis

1. **Define**
   Define is the first step in the DMAIC analysis. In this step, Researcher will define the business process, ordering system, and queuing system in Restaurant XYZ. Researcher will do preliminary research before stating the problem through direct field observation and customer interviews. After that, the data will be analyzed to be able to state the existence problem. This step is needed to find the factors contributing to the long ordering time and high variance in ordering time.
2. **Measure**
   The second step of the DMAIC analysis is measure. After researcher has found and states the clear problem definition, researcher will do the data that has been collected and measure the data. From the observation and interview, researcher can measure the USL, sigma level of the waiting time, and capability index using Minitab. The result of the measurement will be used as the basis before doing the analysis of the data.

3. **Analyze**
   The third step of DMAIC analysis is analyze, In this stage, researcher will identify the factors that create the problem using the current reality tree. Researcher will also analyze the root cause from the factor using a qualitative verification to state and ensure the root causes.
4. **Improve**
   The fourth step of DMAIC is improve step. After knowing and analyze the problem, researcher will then generate solution that can be applied to solve the problem. The proposed solution will be constructed using SCAMPER (Substitute, Combine, Adapt, Modify, Put to other uses, Eliminate, Rearrange).
5. **Control**
   The last step in DMAIC is the control step. In this step, researcher will help Restaurant XYZ in implementing, maintaining, and controlling the solutions that have been proposed. In this control stage, researcher will develop five plans: training plan, documentation plan, monitoring plan, response plan, and aligning system and structure plan.

RESULT

Define

1. **BPMN**
   BPMN (Business Process Model and Notation) is a business process diagram used to visualize the steps, flow, or process of ordering food and beverages in restaurant XYZ. The process for Restaurant XYZ is divided into 2 pools, customers and restaurants. The restaurant's pool has 3 lanes, which are cashier, kitchen & bar, and assembly & checker. The pool is divided into 3 lanes to be able to visualize the process in more detailed due to the different activities the actors do. The process will cover the process from customers queuing to order their food and beverage until they get their order.
2. **Project Charter**
   The project charter for this research was explained previously in chapter one.

Measure

After defining the problem, it has been discovered that there is a problem in waiting for Restaurant XYZ. Therefore, it is necessary to measure the waiting time data taken to be analyzed further regarding sixpack capability and stability.

1. **Goodness of Fit Test**
   In analyzing the data, researcher need to determine whether the data is capable or not. To determine the capability of the data, it is necessary to have a type of distribution that is suitable for analyzing capability sixpack. Therefore, a goodness-of-fit test will be carried out to find out what type of distribution is suitable for analyzing the capability of the data

Goodness of Fit Test

Distribution	AD	P	LRT P
Normal	1,110	0,006	
Box-Cox Transformation	1,110	0,006	
Lognormal	4,599	<0,005	
3-Parameter Lognormal	1,136	*	0,000
Exponential	31,334	<0,003	
2-Parameter Exponential	17,124	<0,010	0,000
Weibull	1,230	<0,010	
3-Parameter Weibull	0,768	0,023	0,192
Smallest Extreme Value	0,864	0,025	
Largest Extreme Value	3,482	<0,010	
Gamma	3,063	<0,005	
3-Parameter Gamma	1,374	*	0,000
Logistic	1,141	<0,005	
Loglogistic	3,370	<0,005	
3-Parameter Loglogistic	1,147	*	0,000
Johnson Transformation	0,378	0,403	

Figure 4. Goodness of Fit Test Result

For the normal distribution, the p-value is less than 5%, it means that it is not normally distributed. Hence, with the null hypothesis of "H0 = data normally distributed", we reject the null hypothesis.

Figure 4. shows that the highest p-value is johnson transformation with the number of 0.403. However, based on the minitab, johnson transformation is best to be used towards data that contain negative values (or 0), (Minitab, n.d.–a). Therefore, capability sixpack analysis in this research will use the 3-parameter weibull as it has the lowest AD. 3-Parameter Weibull is designed to handle positive data. In the context of restaurant XYZ waiting times, the data is always positive (there are no negative wait times). The 3-parameter Weibull distribution ensures that the model can handle situations where there is a non-zero minimum waiting time. (Minitab, n.d.–b). Other than that, The Weibull distribution is very flexible and is able to handle various forms of data, including right-skewed, left-skewed, and symmetric data. This makes it very suitable for many types of analysis, including waiting time analysis which may have various distribution patterns, (Minitab Blog Editor, n.d.).

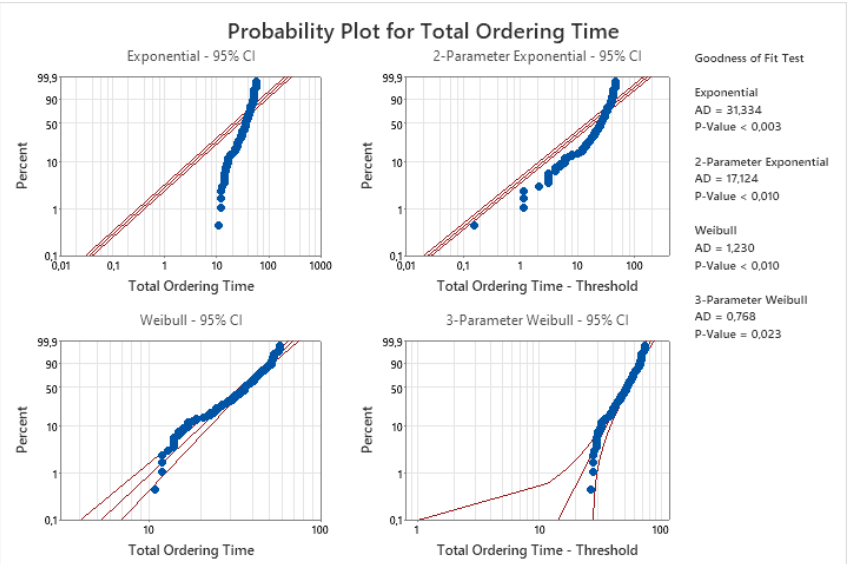

Figure 5. Probability Plot of 3-Parameter Weibull

The probability plot for the 3-parameter Weibull can be seen at the bottom right in figure 5 The proximity of the blue dots to the red line indicates how well the 3-parameter weibull distribution fits the empirical data. can be seen in that figure. The dots on the figure are seen to closely follow the red line which indicate that the 3-parameter weibull distribution is a good fit for the data.

2. **Capability Sixpack Analysis**

After knowing the best fit distribution, capability sixpack analysis can be done. Researcher set the distribution of 3-parameter weibull and USL of 25 minutes. Figure 4.10 below shows the capability sixpack analysis result of the total ordering time in restaurant XYZ.

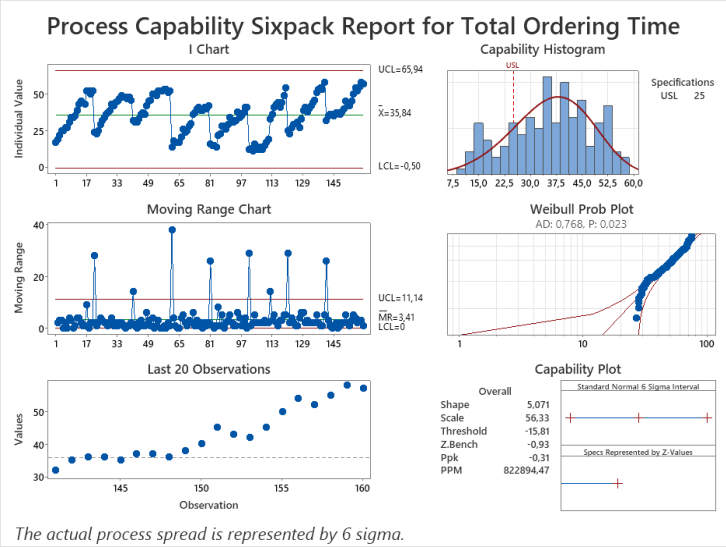

Figure 6. Capability Sixpack Analysis with 3-Parameter Weibull

On Figure 6, It can be seen in the capability plot that the sigma level at the waiting time for Restaurant XYZ shows 0.57. This number is obtained from z-bench plus 1.5 which is a representation of getting the sigma level for the long term. The sigma level of 0.57 shows that Restaurant XYZ is still below the industry standard, which has a sigma level of 3-4.

Still in the same figure, the performance index (Ppk) can also be seen. Restaurant XYZ has a ppk of -0.31. This figure also shows that the capability at Restaurant XYZ is still below the industry standard, which is 1.33.

Therefore, restaurant XYZ must try to improve it by reducing waiting time so it can be more capable and in accordance with the targetted USL of 25 minutes.

3. **I-MR Chart Analysis**

After analyzing the sixpack capability, it is also necessary to analyze stability. Stability refers to the consistency of the process over time. In this research, the stability of waiting time at restaurant XYZ will be measured by looking at the control chart using I-MR. I-MR is chosen because the collected data from the observation is total ordering time, which is classified as variable data (has numerical value associated) with one sub group. Therefore, an I-MR chart will be employed to monitor the mean and variation in the process.

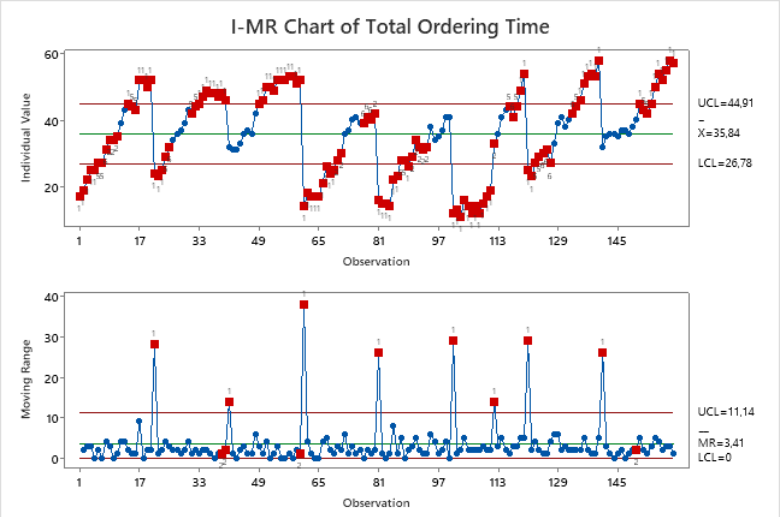

Figure 7. I-MR Chart Analysis

On figure 4.10, the control chart is being analyzed using 4 WECO rules. Based on the control chart, most of the data are out of control with the LCL of 26.78 minutes, UCL 44.91 minutes, and mean of 35.84 minutes. It indicates that the total ordering time process in Restaurant XYZ is unstable and too long. Therefore, Restaurant XYZ needs to reduce variations and reduce the average ordering time so that the process becomes more stable and able to meet the desired specification limits, which is 25 minutes.

Analyze

1. **Current Reality Trees**

After knowing the capability and stability condition inside Restaurant XYZ, researcher will do more analysis to be able to know the root cause of the condition. Current reality tree will be used to find the root cause of the problem.

With the target from restaurant XYZ regarding waiting time of:

a) Purchasing time for buying food: 5 minutes
b) Payment time: 3 minutes
c) Time for waiting the food (Cooking process): 17 minutes

The payment time can be removed from the problems as from the observation, the choosing food and payment time is already aligned with the target, even better because the average is 2 minutes.

Therefore, the current reality tree will be created with two basis of queuing to purchase food time and waiting for food to be ready time. Below is the current reality tree of the problem.

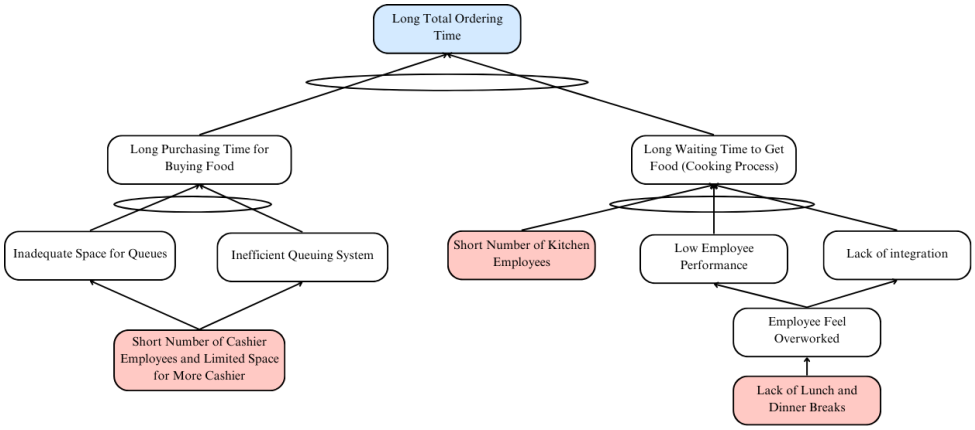

Figure 8. Current reality Tree of Restaurant XYZ Long Ordering Time

Figure of 8 indicates the main general problem in Restaurant XYZ that is easy to be noticed is the long ordering time. The long total ordering time is divided into two main factors that become the cause, the long purchasing time for buying food at the cashier and also the long waiting time for customers in getting their food ready because of the cooking process.

After doing some exploration and analysis, researcher analyzed that the long purchasing time for buying food at the cashier is caused by two conditions:

a) **Inadequate space for queues**
   Restaurant XYZ does not have enough space to accommodate queues and it leads to crowding. This makes the environment uncomfortable for customers and may even deter potential customers if the restaurant appears too crowded.

b) **The inefficient queuing system**
   The queuing line on Restaurant XYZ is used for both ordering and payment. It can create a bottleneck if the service is slow, therefore the queue builds up quickly. There are also no system to manage the flow of customers so queues become disorganized.

   Both of the factors are caused by the **short number of cashier employees and limited space for more cashier.** There are 2 cashier space available. On weekdays, only 1 cashier is open. However, on weekends and peak hours there are 2 cashier employees who will be in charge. The cashier employee's job is to record and receive customer orders. However, with this amount of employees and the current space of 2 cashiers, the waiting time experienced by customers to order food is still above the target of 5 minutes maximum.

   Meanwhile, the long waiting time experienced by customers to get their food ready (cooking process) is also caused by three conditions:

   a) **Short number of kitchen employees**
      Based on observation, the manager and supervisor will help the kitchen during high order and overload. This is done so that employees in the kitchen can make customer orders more quickly.

   b) **Low performance of employees**
      Based on an interview with the supervisors, it is said that employees need to finish making the order within 5 minutes. However, they aren't able to

fulfill customers' orders within 5 minutes maximum and tend to exceed 5 minutes during peak hours.

c) **Lack of integration**

The integration between employees in the kitchen often collides. For example, when assembling food, employees often miscommunicate the sequence of order which cause longer processing time.

The factors of b and c have been caused by the exhaustion that employees feel due to **overwork**. This exhaustion is caused by the **lack of lunch and dinner breaks.** Employees of Restaurant XYZ have lunch and dinner breaks of one hour each. However, there are no definite time rules for restaurant XYZ. Employees can rest at certain intervals during the day and night for one hour because they still have to serve customers. However, during peak hours, employees can only rest briefly and continue working because many customers come and buy. This makes customers lack time to rest, even for lunch and dinner

Therefore, based on the current reality tree, the last root cause that has been identified are:

a) Short number of cashier employees and limited space for more cashier
b) Short number of kitchen employees
c) Lack of lunch and dinner breaks

This proves that the root cause of the CRT results still have a relationship with the conceptual framework in figure 2.8. There are similarities in the number of employees and employee performance.

2. Root Cause Verification

To prove and verify the root cause from the current reality tree, further analysis will be carried out to find out the main root cause. The analysis will be done through qualitative verification. Qualitative analysis is done due to the limitation of the data. This qualitative verification will be used to provide an overview of the context of the situation and conditions of the root causes.

a) Short number of cashier employees and limited space for more cashier

With the number of cashiers and employees of two. There is still a queue that goes all the way to the back. These long queues are always found at peak hours. The frequency of this root cause has always occurred during peak hours on weekend. Therefore, this limitation needs to be addressed because it is very crucial and contributes to the bottleneck.

b) Short number of kitchen employees

There are 13 kitchen employees who work during peak hours. However, after making observations, these employees still seem to have difficulty fulfilling customer demands quickly. This happens because managers and supervisors are seen helping in the kitchen during peak hours so that food can be ready more quickly. However, even when managers and supervisors help the kitchen workers, there is still a long queuing time to order food and a long waiting time for the food to be ready. This root cause also very crucial as the employees in the kitchen is the manpower of the cooking process inside Restaurant XYZ that create long waiting time.

c) Lack of lunch and dinner breaks

The rest time given by Restaurant XYZ is 1 hour. However, in reality, employees often rest for less than 1 hour. They just eat and rest for a while and come back to work serving customers who are already queuing and waiting. This problem has been stated by the employees of Restaurant XYZ which make the problem more significant and need to be solves as not only one employees has stated this problem.

Improve

1. SCAMPER

After determining the root causes of the existing problems through CRT, regression analysis, and qualitative verification, SCAMPER analysis will be used to create alternatives of solutions to reduce and make the ordering system of Restaurant XYZ more effective. SCAMPER is used to generate creative ideas that can develop the ordering system and reduce the variance of time in waiting for Restaurant XYZ.

2. Chosen Solution Summary and Integration

After generating several alternative solutions using a SCAMPER, the best solution will be selected. The chosen solution will be integrated into a new system that can make XYZ Restaurant operations more effective and efficient and reduce waiting time for customers. The following is the summary and integration of the chosen solution:

a) Restaurant XYZ should change the current ordering system with a digital ordering system through a website. The website can be attached in each table for dine in customers and at the entrance for takeaway customers. Therefore, the sequence of the ordering will be slightly different as customer will find seat and table first before ordering the food through website;

b) In the web application, customers will enter the table number and pay immediately after ordering on their table. The cash payment will be eliminated, therefore the payment will be directly on the website after the order has been placed. Payment will be done through website with e-wallet that integrate one click system payment;

c) Current cashier employees will be transferred to help the kitchen as the ordering system will be via the website. But there is still one cashier employee that will temporarily move to cashier if there are customers who want to pay with cards;

d) After the order is placed, the website will also provide an estimate of when the food will be ready, as well as provide a notification and ring sound to inform the customer that the order is ready. With this, dine-in customers can do other things at their table and takeaway customers can also do other things, including leaving the restaurant and picking up their food when it's ready.

e) Restaurant will provide small instruction posters at entrance and each table to guide customers and inform them about the new digital ordering system. Lobby employees will help socializing customers in adapting;

f) Kitchen employees will prepare the food using batch and portioning strategy to reduce food making time;

g) Manager will stop the order temporarily during peak hour when customer has reach certain number by putting out notice board by the manager;

Employees will have a break before peak hours and quick exercise sessions to maximize the energy level.

CONCLUSSION

This research was made based on the problem of long waiting times experienced by customers of Restaurant XYZ during peak hours (Saturday-Sunday, 12:00PM-14:00PM and 17:00PM-19:00PM). The data collected in this research comes from primary data and secondary data. Primary data is taken from direct observation, customer interviews, and employee interviews. while secondary data was obtained from restaurant reviews on the internet such as TikTok and Google Review.

The goal of this research is to reduce the waiting time experienced by customers from an average of 34 minutes to a maximum of 25 minutes. This waiting time starts when customers start queuing to purchase food at cashier, order food, pay, and get their food. This research uses DMAIC layout analysis as a basis. Step define is a step to analyze the process and identify problems that occur using BPMN and project charter. Measure step is a step to measure and calculate data that has been obtained using sixpack capability, I-MR. In the analyze step, the measurement results will be analyzed further using the current reality tree. After getting the factors and root causes of the problem, several alternative solutions will also be created using SCAMPER. From many alternatives, some of these solutions will be chosen. Finally, it will be closed with a control step where a control system will be created to maintain the improvements that have been made and even to make them better if there are further problems.

With the DMAIC analysis carried out in this research, it can be seen that the gaps that are a problem in Restaurant XYZ require analysis and solutions. The results of the analysis that has been carried out can answer research questions that have previously been created:

RQ1: What are the factors or root causes contributing to the long waiting time when buying food and drink at Restaurant XYZ during peak hours on weekends?

Based on the analysis from the research, especially in the analysis section using CRT to determine factors or root causes. There are four things that are the root causes that cause long waiting times when buying food and drinks from restaurant XYZ. The root causes are:

1. Short number of cashier employees and limited space for more cashier
   The limited number of cashier employees and space is another critical factor. During peak hours, the existing cashiers struggle to keep up with the high volume of orders, which causes bottlenecks at the ordering station.
2. Short number of kitchen employees
   Due to a limited number of kitchen employees, the preparation and cooking of orders become slower, especially when the restaurant needs to handle a lot of customers. This creates delays and waiting time for customers because of the long food preparation.

3. Lack of lunch and dinner breaks

   Employees who lack breaks, especially for lunch and dinner, will affect their productivity and efficiency. Employees who don't get enough breaks may grow weary and perform less well in their jobs to maintain the standards of service during peak hours.

RQ2: How can the ordering system process in Restaurant XYZ be effectively improved to reduce waiting time?

Based on the analyze and improve step of the DMAIC analysis, the researcher has proposed alternative solutions in the scamper and selected some solutions and that are relevant and have a big impact on solving the problem. The chosen solutions are being combined and integrated into the system.

The solution is to change the ordering system at Restaurant XYZ to a digital using system that can be accessed via website. This system will allow dine in customers to order their food and beverage from their tables and at the entrance for takeaway customers. This will eliminate the physical queuing and waiting time spent by customers previously. Customers can also put in their table number and pay through the website. The payment system will use an integrated one click system, which is more user friendly and faster. This also eliminates payment using cash to avoid theft and fraud. This shift not only accelerates the ordering and payment procedures but also allows current cashier employees to be redeployed to assist in the kitchen, ensuring faster preparation of orders.

Additionally, the digital system provides customers with an estimated preparation time and notifies them when their food is ready. This allows customers to do other activities while waiting. The restaurant will facilitate the transition by placing instructional posters at strategic locations and having lobby employees assist customers with the new system. The kitchen will adopt a batch and portioning strategy to expedite food preparation, further reducing waiting times. To manage peak hours effectively, the manager will control the order flow by temporarily halting new orders once a certain customer threshold is reached. Moreover, ensuring that employees take breaks and engage in quick exercises before peak hours will maintain high energy levels, enhancing their efficiency and productivity. Collectively, these measures are designed to optimize the ordering system, minimize waiting times, and improve operational efficiency at Restaurant XYZ. By implementing this solution, the waiting time experienced by the customers may decrease from 34 minutes to 24 minutes, which is fit to the target of 25 minutes maximum.

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