

# *Optimization Design in the Production and Delivery Process of a Food Truck*

*Alberto Morfi Pagán*  
*Master in Manufacturing Competitiveness*  
*Advisor: Carlos González, Ph.D.*  
*Industrial and Systems Engineering Department*  
*Polytechnic University of Puerto Rico*

---

**Abstract** – This abstract provides an overview of the optimization design strategies that can improve the production and delivery process of a food truck utilizing Lean Manufacturing and DMAIC methodology. A standardized menu, quality equipment, an optimized layout, a streamlined ordering process, and data-driven decision-making are key factors in enhancing the efficiency and profitability of a food truck. Lean Manufacturing and DMAIC methodology can help identify and eliminate waste, reduce errors, and increase customer satisfaction. By implementing these optimization design strategies, food truck owners can optimize their production and delivery process to meet the needs of customers while minimizing waste and maximizing efficiency, resulting in improved profitability and success in the highly competitive food truck industry.

**Key Terms** — *Continuous Improvement, Kaizen, Lean Manufacturing, Value Stream Mapping.*

## **INTRODUCTION**

A food truck is a mobile restaurant that serves food on the go. These trucks typically have a kitchen area, cooking equipment, and a serving window. They are able to move from location to location, often parking in public areas or at events, to serve customers. The process of a food truck involves preparing and cooking food to order, serving customers through the window, and handling payment and orders. The production and delivery process of a food truck is crucial for its success, as it determines how efficiently and effectively the business can serve customers and generate revenue. Optimization design strategies such as a standardized menu, quality equipment, an

optimized layout, a streamlined ordering process, and data-driven decision-making can help improve the production and delivery process of a food truck and lead to greater success in the highly competitive food industry.

## **Problem Statement**

Despite the increasing popularity and demand for food trucks, many food truck businesses struggle to maintain profitability and efficiency in their production and delivery process. The lack of optimization design strategies and a standardized approach to menu, equipment, layout, ordering, and decision-making can result in waste, errors, customer dissatisfaction, and decreased profitability. In addition, the highly competitive nature of the food truck industry requires businesses to continually improve and innovate to stay ahead of the competition. Therefore, there is a critical need for optimization design strategies and methodologies that can improve the production and delivery process of food trucks and increase their profitability and success in the market.

## **Research Description**

The objective of this research is to explore and evaluate the effectiveness of optimization design strategies and methodologies in improving the production and delivery process of food trucks. The study will investigate the impact of a standardized menu, quality equipment, an optimized layout, a streamlined ordering process, and data-driven decision-making on the efficiency, profitability, and customer satisfaction of food truck businesses. Lean Manufacturing and DMAIC methodology will be utilized to identify and eliminate waste, reduce errors, and improve the quality of service.

## **Research Objectives**

The research objectives of this study are to identify the current production and delivery process of food trucks and the challenges they face in terms of efficiency, profitability, and customer satisfaction.

## **Research Contributions**

This research study will make significant contributions to the understanding of food truck businesses in the food industry, identifying their challenges and opportunities by exploring and evaluating optimization design strategies. In addition, the study will investigate the implementation of Lean Manufacturing and DMAIC methodology in the food industry and assess their impact on eliminating waste, reducing errors, and improving the quality of service in food truck businesses. The research will also provide recommendations and best practices for food truck businesses to increase their efficiency, profitability, and competitiveness, while providing customers with an exceptional and convenient dining experience. The findings of this study will be of great value to policymakers, entrepreneurs, and investors in the food industry, providing them with insights into the challenges and opportunities of food truck businesses and strategies to enhance their performance.

## **LITERATURE REVIEW**

Lean manufacturing and DMAIC methodology are two concepts that have gained significant attention in the manufacturing industry in recent years. Lean manufacturing, also known as Lean Production or simply Lean, is a management philosophy that emphasizes the elimination of waste and the optimization of production processes to improve efficiency, quality, and customer value. On the other hand, DMAIC is a data-driven problem-solving methodology that is used to improve the quality of products and services by identifying and eliminating the root causes of defects and errors. In this literature review, we will

explore the origins of Lean manufacturing and DMAIC methodology and how they have evolved over time.

The concept of Lean manufacturing originated in Japan in the 1950s, where it was first implemented by Toyota in its production processes [1]. The approach was based on the principle of Kaizen, which means continuous improvement, and was aimed at reducing waste and increasing efficiency in manufacturing. The term "Lean" was coined in the 1990s by researchers at the Massachusetts Institute of Technology (MIT) who studied the Toyota Production System and found that the company's success was due to its lean approach to manufacturing.

Lean manufacturing focuses on identifying and eliminating waste in all aspects of production, including overproduction, waiting, unnecessary transportation, overprocessing, excess inventory, unnecessary motion, defects, and unused talent. The approach also emphasizes the importance of continuous improvement and employee involvement in the production process. Over the years, Lean manufacturing has been applied in various industries, including healthcare, construction, and services, with significant success [2].

On the other hand, DMAIC methodology was developed in the 1980s by Motorola, a telecommunications company, as part of its Six Sigma quality improvement program. DMAIC stands for Define, Measure, Analyze, Improve, and Control, and it is a data-driven problem-solving methodology that is used to improve the quality of products and services by identifying and eliminating the root causes of defects and errors.

### **Steps to Create a Lean Manufacturing Procedure**

Implementing a lean manufacturing procedure can improve efficiency and reduce waste in your organization. Follow these steps to create a procedure that fits your specific needs [2].

1. Identify the process to improve: Identify the process or area of your business that needs

- improvement. This could be anything from the production process to supply chain management or inventory control.
2. Analyze the process: Analyze the process to identify waste and inefficiencies. This can be done by mapping the process, observing it, or talking to the employees who work on it. Identify areas where there is waste or inefficiency, such as waiting time, excess inventory, or unnecessary steps.
  3. Identify improvement opportunities: Once you have identified areas of waste or inefficiency, identify opportunities for improvement. This could involve simplifying the process, eliminating unnecessary steps, or automating certain tasks.
  4. Develop a plan: Develop a plan for implementing the improvements. This should include a timeline, budget, and resources needed to carry out the changes.
  5. Implement the changes: Implement the changes to the process. This may involve training employees, changing procedures, or investing in new equipment or technology.
  6. Monitor and evaluate: Monitor the process to ensure that the changes are having the desired effect. Evaluate the results and make further improvements if necessary.
  7. Continuously improve: Continuously improve the process by repeating the above steps. Lean manufacturing is a continuous improvement process, and there is always room for improvement.

### **Lean Manufacturing Characteristics**

Lean manufacturing is a systematic approach that emphasizes the elimination of waste and continuous improvement to optimize processes and increase value to customers. Keep reading to discover the key characteristics of a lean manufacturing system.

- Continuous Improvement: Lean Manufacturing is a continuous improvement process. This means that the focus is on continually

identifying and eliminating waste in order to improve efficiency and quality.

- Value Stream Mapping: Value stream mapping is a key component of Lean Manufacturing. It is a tool used to map out the entire production process, from start to finish, in order to identify areas of waste and inefficiency.
- Just-in-Time (JIT) Production: Lean Manufacturing is often associated with Just-in-Time (JIT) production. JIT is a production system in which goods are produced only when they are needed, and in the quantities that are needed. This helps to reduce inventory levels and minimize waste.
- Kaizen: Kaizen is a Japanese term that means "continuous improvement." It is a key principle of Lean Manufacturing, and involves making small, incremental improvements to the production process on a regular basis.
- Standardization: Lean Manufacturing places a strong emphasis on standardizing processes. Standardization helps to eliminate variation and reduce waste.
- Employee Involvement: Lean Manufacturing recognizes the importance of employee involvement in the production process. Employees are encouraged to contribute ideas and suggestions for improving the production process.
- Total Quality Management (TQM): Lean Manufacturing is often associated with Total Quality Management (TQM). TQM is a management philosophy that focuses on continuous improvement of product quality.

### **DMAIC METHODOLOGY**

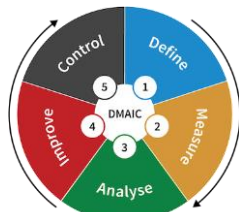
DMAIC is a problem-solving methodology that is commonly used in Lean Six Sigma projects to improve business processes. The acronym stands for Define, Measure, Analyze, Improve, and Control.

DMAIC is often used in conjunction with other quality improvement methodologies, such as Lean Manufacturing and Six Sigma. It is a structured

approach to problem-solving that can be applied to a wide range of industries and processes. The concepts and tools used in DMAIC, such as process mapping, statistical process control, and root cause analysis, can be used to identify and eliminate waste, reduce errors, and improve the quality of service. DMAIC methodology can help organizations to increase efficiency, reduce costs, and improve customer satisfaction. Please refer to Figure 1.

## PROJECT METHODOLOGY

The project methodology involves studying how to improve the efficiency and profitability of food truck businesses. The approach includes defining the problem, reviewing relevant literature, designing the research, collecting, and analyzing data, making recommendations, and reporting findings. Data will be collected through primary and secondary sources, and both qualitative and statistical analysis will be used to draw conclusions [3].



**Figure 1**  
**DMAIC**

### Define

In this step, the problem or opportunity for improvement is defined, and the project goals and objectives are established. The team also identifies the stakeholders and customers affected by the process.

### Measure

The next step involves collecting data and measuring the process to establish a baseline. This step helps the team to identify the root cause of the problem and quantify the impact of the issue.

### Analyze

In this step, the team uses statistical analysis to identify the root cause(s) of the problem. This may involve using tools like cause-and-effect diagrams, process maps, and Pareto charts to analyze the data and determine the factors that are contributing to the problem.

### Improve

Once the root cause has been identified, the team develops and implements solutions to improve the process. This may involve testing different solutions to determine which ones are most effective.

### Control

The final step involves establishing controls to ensure that the improvements are sustained over time. This may involve creating standard operating procedures, training employees, and monitoring the process to ensure that it continues to meet the established goals and objectives.

## RESULTS AND DISCUSSIONS

The five phases of the DMAIC methodology have yielded the results discussed below.

### Define

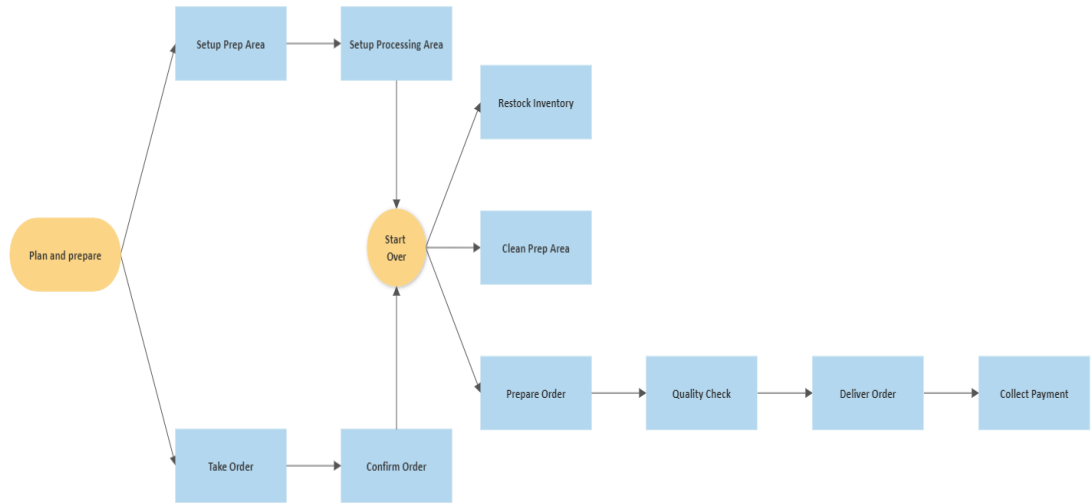
During the Define phase, the Project Charter was utilized as a tool to identify the project's problem statement, goal, and measurable objectives. The information obtained from this tool will serve as the foundation for the remainder of the DMAIC methodology. Refer to Table 1.

**Table 1**  
**Project Charter**

Project Charter	
<b>Project:</b>	<b>Optimization Design in the Production and Delivery Process of a Food Truck</b>
<b>Business Case:</b>	By implementing an optimization design strategy, food truck businesses can increase their efficiency, reduce waste, and improve their profitability. The project's results and recommendations will provide valuable insights for food truck business owners, policymakers, entrepreneurs, and investors in the food industry.
<b>Problem Statement:</b>	Despite the growing popularity and profitability of food trucks in the food industry, many food truck businesses struggle to maintain a consistent level of efficiency and customer satisfaction due to challenges such as inefficient equipment and layout, lack of standardized menu, and a disjointed ordering process. These challenges can result in increased waste, lower profits, and decreased customer loyalty.
<b>Goal:</b>	To optimize the production and delivery process of a food truck through the implementation of Lean Manufacturing and DMAIC methodology, in order to enhance the efficiency, profitability, and customer satisfaction of the business.
<b>Project Scope:</b>	This project will focus on the optimization of the production and delivery process of a food truck by implementing Lean Manufacturing and DMAIC methodology. The scope of the project will include the analysis of the current process, identification of areas of improvement, and the implementation of optimization design strategies such as a standardized menu, quality equipment, optimized layout, streamlined ordering process, and data-driven decision-making.

Another tool that can be used in the Define stage of a process improvement project is a Process Map. It is a visual brainstorming tool that helps to

capture and organize ideas and information related to a particular topic or problem. Refer to Figure 2.



**Figure 2**  
**Process Map**

### Measure

During the Measure phase, we conducted a SIPOC analysis and used a VOC tool to identify customer requirements and needs, as well as to identify the inputs and outputs of our processes through the SIPOC tool. Refer to Table 2.

As a conclusion from the SIPOC analysis, we have gained better understanding of the inputs, outputs, and the high-level process steps involved in delivering value to our customers. This analysis has allowed us to identify areas where we can improve our processes to better meet customer needs and expectations.

**Table 2**  
**SIPOC**

Suppliers	Inputs	Processes	Outputs	Customers
<ul style="list-style-type: none"> <li>Local Farmers and Producers</li> <li>Food Distributors</li> <li>Equipment Manufacturers</li> </ul>	<ul style="list-style-type: none"> <li>Fresh Ingredients</li> <li>Non-perishable goods</li> <li>Kitchen Equipment</li> <li>Food Packaging and Disposals</li> <li>Labor</li> </ul>	<ul style="list-style-type: none"> <li>Plan menu and order ingredients</li> <li>Set up the food truck and equipment</li> <li>Take orders from customers – Onlines and On-Site</li> <li>Check food quality</li> <li>Deliver food</li> <li>Collect Payment</li> <li>Clean up equipment and prep area</li> <li>Restock Inventory</li> </ul>	<ul style="list-style-type: none"> <li>Freshly prepared food items</li> <li>Satisfied customers</li> <li>Revenue from sale</li> <li>Waste from unused ingredients and packaging</li> </ul>	<ul style="list-style-type: none"> <li>Individuals and groups of people who are hungry and want to try local food in a different concept.</li> <li>Local workers who want a quick and convenience lunch</li> <li>Tourist who wants to try local food while exploring the city</li> </ul>

Based on the Voice of Customer (VOC) table, it is clear that food truck customers prioritize quick and efficient service, fresh and high-quality food, and short wait times. Therefore, any process optimization efforts in food trucks should focus on these key areas to meet customer needs and expectations. It is also important to note that

customers place a medium level of importance on easy ordering and payment processes, menu variety and options, and a clean and hygienic food truck. Refer to Table 3 [3].

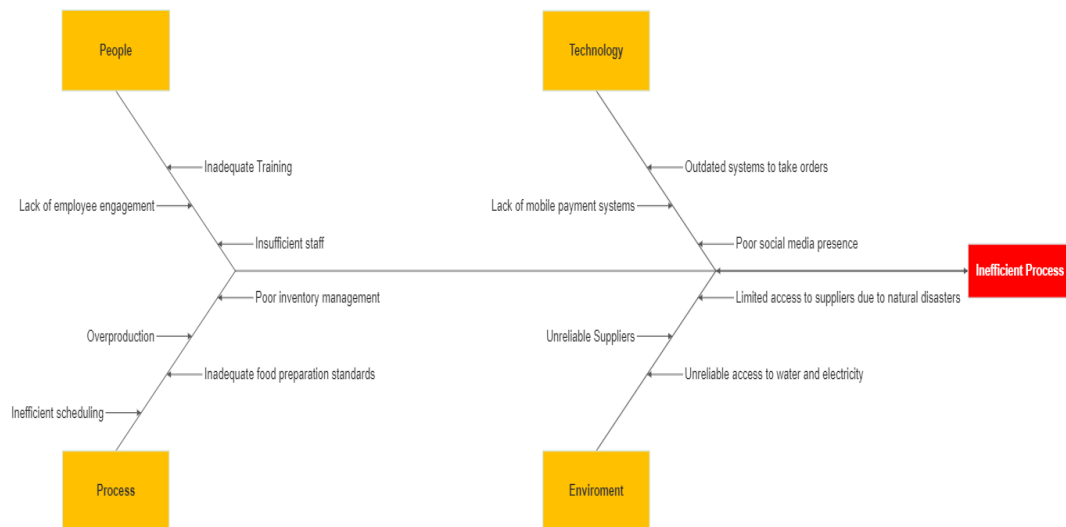
**Table 3**  
**VOC**

Customer	Needs and Requirements	Importance
Local Customers	Quick and efficient service	High
Online Customers	Fresh and high-quality food	High
Tourists	Short wait time	High
	Easy ordering and payment process	Low
	Menu variety and options	Medium
	Clean and Hygienic food truck	Medium
	Reasonable prices	High

### Analyze

The analyze phase of DMAIC involves identifying the root causes of a problem, in this case, inefficient processes in the food truck business. One tool that can be used to help with this

analysis is a fishbone diagram, which visually represents the various factors that contribute to the issue. The fishbone diagram for the food truck business includes four categories: People, Processes, Technology, and Environment. Under each category, specific causes are listed, such as inadequate training, poor inventory management, and slow POS systems. The fishbone diagram helps to provide a comprehensive view of the various factors that contribute to the inefficiencies and can help businesses to develop a plan for addressing those issues. By using the fishbone diagram in the analyze phase of DMAIC, businesses can gain a deeper understanding of the problem and work towards developing effective solutions. Refer to Figure 3.



**Figure 3**  
**Fishbone Diagram**

### Improve

During the Improve phase of DMAIC, various tools and techniques are used to identify, evaluate, and implement solutions for the identified problems. One of the techniques used during this phase is the implementation of Kaizen Events, which are short-term improvement projects aimed at improving specific areas of the process. The specific Kaizen Events chosen will depend on the unique needs and challenges of the food truck business.

- Streamlining the production process: This Kaizen event could focus on reducing the time it takes to prepare food by optimizing the layout of the kitchen, minimizing the number of steps in the food preparation process, and eliminating waste [1].
- Improving the delivery process: This Kaizen event could focus on optimizing the delivery routes and schedules, improving communication with customers, and finding

ways to deliver food faster and more efficiently.

- Reducing food waste: This Kaizen event could focus on identifying the sources of food waste in the production process, such as overproduction or spoilage, and finding ways to minimize waste while maintaining quality.
- Improving customer satisfaction: This Kaizen event could focus on gathering feedback from customers and using that feedback to improve the quality of the food, the speed of service, and the overall customer experience.
- Enhancing the design of the food truck: This Kaizen event could focus on improving the layout of the food truck to make it more efficient and comfortable for workers, as well as more attractive and welcoming for customers.
- Optimizing inventory management: This Kaizen event could focus on finding ways to better manage inventory levels to reduce waste, minimize stockouts, and improve overall efficiency.
- Implementing Lean principles: This Kaizen event could focus on applying Lean principles, such as 5S, to improve the organization and cleanliness of the food truck, as well as the efficiency of the production process. The 5S methodology is a workplace organization technique that is widely used in Lean manufacturing and other process improvement methodologies. The 5S stands for five Japanese words, each beginning with the letter "S" [2].
  - Seiri (Sort)
  - Seiton (Set in Order)
  - Seiso (Shine)
  - Seiketsu (Standardize)
  - Shitsuke (Sustain)

### **Control**

The Control Phase of DMAIC is crucial to ensuring that the improvements made during the optimization design project in the production and delivery process of a food truck are sustained over time. To establish control metrics, the project team

could consider using customer satisfaction ratings, food quality metrics, delivery time metrics, and inventory metrics to track the performance of the food truck process. Once the control metrics are established, the team can implement control measures to ensure that the process remains stable and continues to meet the established metrics. This may involve creating new procedures for quality control, training employees on the new process, or establishing new policies for inventory management. The performance of the food truck process should be monitored and measured regularly against the established control metrics to identify any issues or deviations from the expected performance. If any issues or deviations are identified, the project team should take corrective action to bring the process back into alignment with the established control metrics. By following these steps, the project team can ensure that the improvements made during the optimization design project are sustained over time, and the food truck process continues to operate at a high level of efficiency and effectiveness.

### **CONCLUSION**

In conclusion, the optimization design project in the production and delivery process of a food truck was a success thanks to the implementation of various DMAIC tools and methodologies. The project team used a Voice of Customer (VOC) analysis to understand the needs and expectations of customers, and a SIPOC diagram to map out the entire process. A Fishbone diagram was also used to identify root causes of issues, and Kaizen events were implemented to optimize the process. As a result of these efforts, the food truck production and delivery processes were significantly improved, with faster delivery times, higher quality food, and improved customer satisfaction. Moreover, the process is being continuously monitored and controlled, ensuring that any deviations are addressed, and the process remains optimized. By using DMAIC methodologies and tools, the project team was able to not only identify and address

process improvement opportunities but also to sustain the improvements made over time. The success of this project is a testament to the power of the DMAIC methodology and its ability to drive continuous improvement and operational excellence.

## **REFERENCES**

- [1] Liker, J. K. (2004). *The Toyota way: 14 management principles from the world's greatest manufacturer*. McGraw-Hill Professional.
- [2] Womack, J. P., & Jones, D. T. (1996). *Lean thinking: Banish waste and create wealth in your corporation*. Simon and Schuster
- [3] Radziwon, A., & Bogers, M. (2013). Lean startup and the business model: Experimenting for novel customer value. *Journal of Engineering and Technology Management*, 30(1), 1-22.