Lentera Multidisciplinary Studies

Lentera: Multidisciplinary Studies
Volume 3 Number 3, 2025
p- ISSN: 2987-2472 | e-ISSN: 2897-7031

Application of DMAIC Method to Improve the Quality of UMKM Products Roti Kukus Srikaya Balila

Yosefine Rejeki Marpaung[1], Ni Ketut Shantika Ardini[2], Herodion Pribadi[3]
Universitas Udayana, Indonesia
Corresponding Author: marpaungyosefine@gmail.com

ABSTRACT

Micro, Small, and Medium Enterprises (MSMEs) in Indonesia play a vital role in economic growth, but often struggle with inconsistencies in product quality. This study focuses on Roti Kukus Srikaya Balila, a Denpasar-based UMKM producing steamed bread. It aims to enhance product quality by applying the DMAIC (Define, Measure, Analyze, Improve, Control) methodology within the Six Sigma framework. Key factors were critical to maintaining quality, including taste, texture, appearance, and shelf life. Defect ratios were measured, revealing undercooked bread and inconsistent taste. Solutions were implemented to address these problems, including machinery maintenance, workforce training, and process standardization. The DMAIC methodology proved effective in improving quality consistency, stabilizing processes, and enhancing the competitiveness of UMKM.

Keywords: defect; DMAIC; UMKM; quality

INTRODUCTION

Micro, Small, and Medium Enterprises (UMKM) are businesses operated by individuals or entities with specific net assets and sales values that meet the criteria outlined in Law No. 20 of 2008. UMKM plays a crucial role in enhancing Indonesia's Gross Domestic Product (GDP) (Budiarto et al., 2018; Ghazani, 2015; Indonesia, 2021; Widjadja, Alamsyah, Rohaeni, & Sukanjie, 2018). In 2017, UMKM contributed 60.34% to Indonesia's GDP. In the export sector, UMKM accounted for 14.17% of total exports and 58.18% of total investments. (Faturrahman, 2021) One of the primary challenges faced by UMKM is maintaining consistent product quality. In the food industry, product quality determines customer satisfaction and influences businesses' competitiveness in the market. (Rasyidah, Bariroh, & Rahmawati, 2022); (Pancawati, 2022)

Prior research has identified the significance of maintaining product consistency to ensure customer satisfaction and business growth. For example, Rasyidah et al. (2022) highlighted that poor implementation of Total Quality Management (TQM) often leads to reduced operational effectiveness, while Palit (2021) pointed out that most UMKM still lack structured quality control mechanisms. Similarly, Maryanto, Chalim, and Hanim (2022) observed that operational weaknesses, such as untrained labor and improper process management, are among the main contributors to production inefficiencies and customer dissatisfaction.

Roti Kukus Srikaya Balila, a UMKM operating in Denpasar, is an example of a small enterprise specializing in producing traditional food with various flavors. Its steamed srikaya bread products have become a favorite among local customers and tourists. However, like many other UMKM, it struggles to maintain consistent product quality, which is often attributed to inaccuracies in the production process (Palit, 2021); (Maryanto, Chalim, & Hanim, 2022). The production process involves multiple stages, including selecting raw materials, dough preparation, steaming, and packaging. Each stage has the potential to impact the quality of the final product. Factors such as raw material quality, worker skills,

equipment condition, and control of the production process all contribute to the overall quality of the steamed bread.

Quality issues significantly affect Roti Kukus Srikaya Balila's growth. Declining product quality can lead to negative consequences, such as reduced customer satisfaction. (Masnun, Makhdalena, & Syabrus, 2024); (Syah & Pratama, 2020). Therefore, quality control is essential to ensure products meet company standards, align processes with plans, improve efficiency, and address opportunities, as modern consumers prioritize quality alongside price and availability. (Nasution & Sodikin, 2018); (Sugiantini, Khamaludin, & Rahayu, 2022). Dissatisfied customers are unlikely to make repeat purchases and may leave negative reviews that damage the business's reputation. (FA, Susanta, & Sadeli, 2023)(Susetyo, 2019). Ultimately, the UMKM may face financial losses due to declining demand, inefficient production, and increased waste.

While several studies have explored implementing Six Sigma methodologies in larger manufacturing environments, their application within small-scale food enterprises remains limited and often lacks contextual adaptation. For instance, Azwir (2022) demonstrated Six Sigma's effectiveness in food packaging, yet the study focused on large-scale operations with access to advanced quality control infrastructure. Likewise, Achmad, Lubis, and Nugrahaini (2023) investigated DMAIC in textile production but did not consider the resource constraints typical of UMKM settings. Furthermore, Rifaldi & Sudarwati (2024) applied Six Sigma in a mechanical component context, offering limited translatability to perishable, taste-sensitive food products.

These studies overlook challenges unique to traditional culinary microenterprises, such as limited automation, workforce variability, and the high subjectivity of quality indicators like taste and texture. Consequently, a clear gap exists in the literature regarding tailored Six Sigma strategies for artisanal food production within the UMKM framework.

Applying the DMAIC (Define, Measure, Analyze, Improve, Control) methodology offers a viable solution to address these quality challenges. DMAIC, a key component of Six Sigma, is a data-driven and systematic approach to improving quality and business process efficiency by identifying and resolving quality issues (Rifaldi & Sudarwati, 2024). This research employs the DMAIC method to help small and medium-sized enterprises (UMKM) improve the quality of traditional products, such as Roti Kukus Srikaya Balila. It utilizes tools such as Pareto diagrams, fishbone diagrams, and control charts to identify underlying issues. By adapting to modern consumer preferences, the study helps SMEs enhance process stability, improve customer satisfaction, and strengthen their competitive market position.

This study seeks to fill this gap by offering a contextualized application of the DMAIC methodology to Roti Kukus Srikaya Balila, addressing technical process improvement and human and environmental factors influencing product quality. By integrating tools such as control charts, Pareto analysis, and root cause diagrams into a real-world microenterprise context, the research introduces a scalable and replicable model for quality enhancement in similar settings. Thus, the study's contribution lies in bridging the methodological rigor of Six Sigma with the practical realities of small-scale traditional food production. This area remains underrepresented in the existing literature.

METHOD

The study was conducted from June 24 to July 3, 2024. Data collection occurred at three outlets: Balila Teuku Umar, Balila Letda Tantular Renon, and Balila Gatsu Barat. Additional data was gathered through online interviews with the business owner.

The DMAIC method is a systematic approach in Six Sigma to improve business processes and product quality. The five stages that must be performed in the quality improvement and control process are as follows:

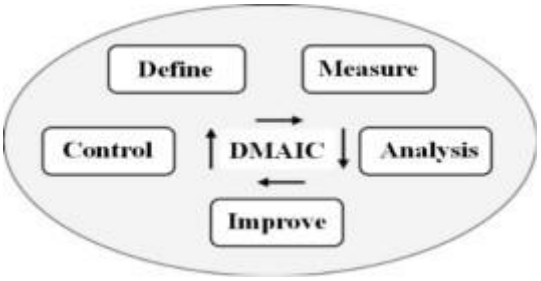

Figure 1. DMAIC Process Stages
Source: Lamtinulu, 2022

A. Define

The Define stage is the initial step in applying the DMAIC method. The main goal at this stage is to determine the Critical to Quality (CTQ) and identify the types of defects occurring in the Roti Kukus Srikaya Balila. CTQ refers to a product's key characteristics that customers deem important and directly impact their satisfaction. Steps taken in this stage include identifying the aspects of the product that matter most to customers, such as taste, texture, size, and packaging of the bread (CTQ), collecting information about the types of defects commonly encountered, and gathering production and quality data from previous periods for analysis in the Measure stage.

B. Measure

The Measure stage focuses on assessing current performance and collecting data necessary for further analysis. A Pareto diagram and control chart should be developed to prioritize improvements by addressing the most significant issues and ensuring that the production process remains under control. There are three measurement concepts in this phase based on probability:

$$Defect\ per\ Unit = \frac{Defect}{Unit}$$

$$Defect\ per\ Opportunities\ (DPO) = \frac{Defect}{Total\ Opportunities}$$

$$DPMO = Defect\ per\ Opportunities\ x\ 1000000$$

C. Analyze

The Analyze stage aims to identify the root causes of the quality issues measured in the Measure stage. This involves creating a fishbone diagram to identify various factors contributing to the quality problems, including people, machines, methods, materials, environment, and measurements.

D. Improve

The Improve stage focuses on developing and implementing improvement recommendations to address the root causes identified in the Analyze stage. Steps taken at this stage include formulating improvement recommendations and prioritizing the issues to be addressed based on their impact on product quality, followed by implementing the developed solutions.

E. Control

The Control stage aims to ensure that the improved processes remain stable and that the improvements are sustained in the long term. Steps taken at this stage include developing clear and detailed Standard Operating Procedures (SOPs) for each stage of the production process and establishing corrective mechanisms to promptly address issues that arise and prevent them from recurring in the future.

RESULT AND DISCUSSION

A. Define Stage

This stage identifies specific quality issues and critical-to-quality (CTQ) factors directly impacting customer satisfaction. (Achmad, Lubis, & Nugrahaini, 2023); (Azwir, 2022)Table 1 presents the identified CTQ factors, based on customer surveys and discussions with the business owner.

Table 1. CTQ Roti Kukus Srikaya Balila

No	Variable	Key Points
1	Taste	Consistency of srikaya flavor and other variants.
2	Texture	Appropriate softness and elasticity.
3	Appearance	High-quality packaging, attractive, and informative design.
4	Shelf Life	Adequate product durability.

Common defects observed in the product included flavors that were either excessively sweet or lacking in taste, resulting in an unpleasant or inconsistent flavor profile. Additionally, some batches of the bread were undercooked, leading to a soggy or raw texture that failed to meet expectations for doneness. Other defects involved an improper texture, with the bread being either too dense or too soft, which compromised its overall quality and appeal. Furthermore, the packaging was often deemed unattractive or lacking essential information, making it difficult for customers to quickly identify the product or understand its features, which could negatively impact consumer perception and satisfaction.

B. Measure Stage

Table 2. Observation Results of Quantity and Type of Defects

Observation Date	Quantity Observed	Quantity of CTQs				Quantity
		Undercooked Bread	Inconsistent Taste	Unsatisfactory Bread Texture	Packaging Complaints	
24/6/24	360	8	3	1	2	14
25/6/24	288	0	6	0	1	7
26/6/24	288	4	4	0	1	9
27/6/24	312	0	1	0	0	1
28/6/24	408	8	0	0	0	8
29/6/24	432	4	0	2	0	6
30/6/24	456	0	2	1	1	4
1/7/24	264	0	3	0	0	3
2/7/24	240	0	2	0	0	2
3/7/24	240	0	0	0	0	0
4/7/24	288	4	0	0	0	4
Total	**3576**	**28**	**21**	**4**	**6**	**59**
Mean	**325,09**	**2,55**	**1,91**	**0,36**	**0,55**	**5,36**

Here are the calculations for the three measurement concepts in the DMAIC method: Defects Per Unit (DPU), Defects Per Opportunity (DPO), and Defects Per Million Opportunities (DPMO) (Montgomery, 2020; Allen, 2019). DPU calculates the average number of defects per product unit, and DPO evaluates the proportion of defects based on the total opportunities for defects to occur. DPMO scales this proportion to one million opportunities, providing a standardized measure to compare process quality effectively.

$$Defect\ per\ Unit = \frac{Defect}{Unit} = \frac{59}{3576} = 0{,}0165 = 1{,}65\%$$

$$Defect\ per\ Opportunities\ (DPO) = \frac{Defect}{Total\ Opportunities} = \frac{59}{14304} = 0{,}00412$$

$$DPMO = Defect\ per\ Opportunities\ x\ 1000000 = 0{,}00412x1000000 = 4124{,}72$$

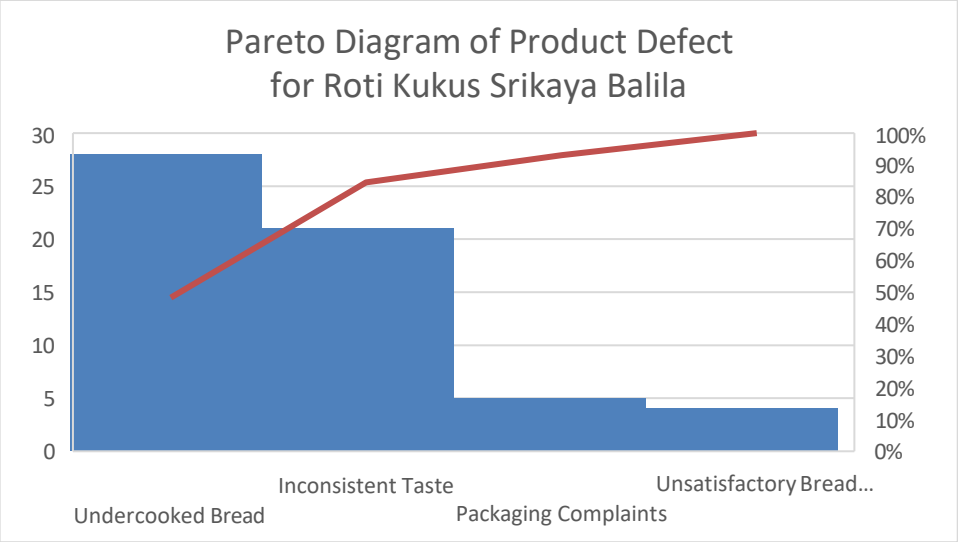

Figure 2. Pareto Diagram of Product Defect for Roti Kukus Srikaya Balila

According to the Pareto principle, improvement efforts should primarily focus on the most frequent issues, specifically Undercooked Bread and Inconsistent Taste, as these categories contribute approximately 80% of the total defects. Once these critical issues are resolved, attention can be directed toward addressing packaging defects and suboptimal bread texture, which have lower frequencies.

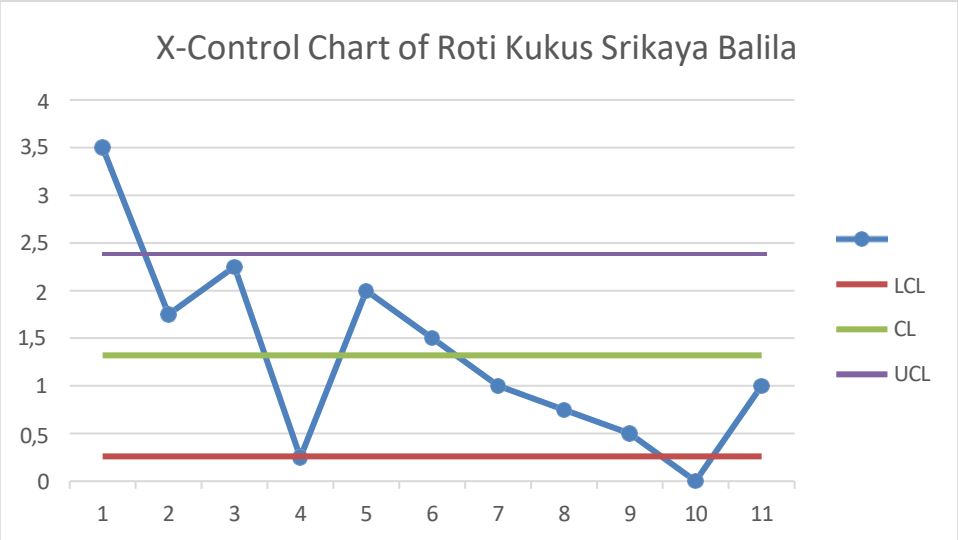

Figure 3. X-Control Chart of Roti Kukus Srikaya Balila

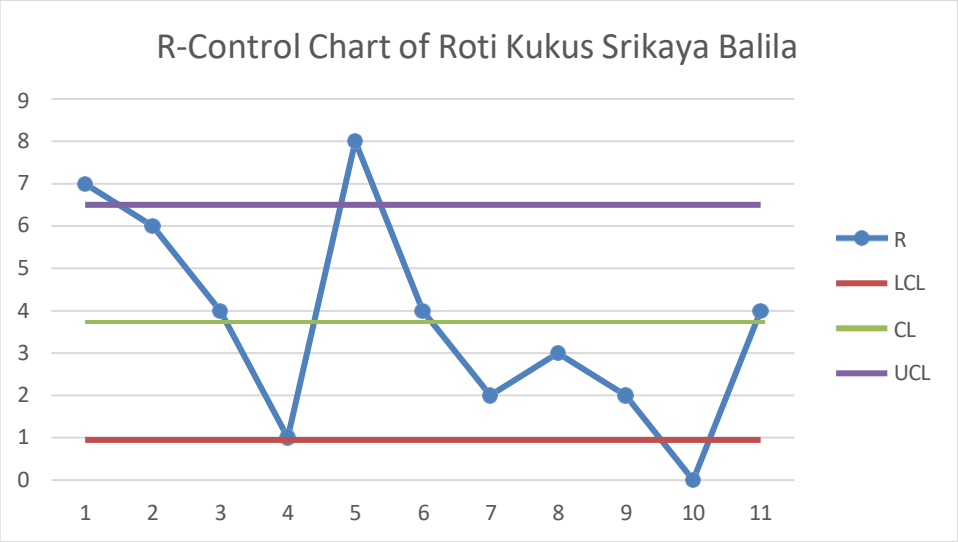

Figure 4. R-Control Chart of Roti Kukus Srikaya Balila

The X-Control Chart for "Roti Kukus Srikaya Balila" reveals that point 1 exceeds the upper control limit (UCL), while points 4 and 10 fall below the lower control limit (LCL), indicating significant deviations in the process average that may lead to defective or inconsistent products. Similarly, the R-Control Chart shows that points 1 and 5 exceed the UCL, reflecting excessive variability, whereas point 10 falls below the LCL, further highlighting inconsistencies in the sample ranges. An out-of-control X-Control Chart signifies a shift in the process average, potentially causing outputs to deviate from established quality standards. In contrast, out-of-control points on the R-Control Chart indicate instability in process variability, undermining production consistency. By addressing the root causes of these control violations, the process can move toward stability and better alignment with quality standards, ensuring product consistency and overall performance.

C. Analyze Stage

Four variables have been identified as the primary sources of defects in the Roti Kukus Srikaya Balila production. The fishbone diagram in Figure 6 outlines each variable.

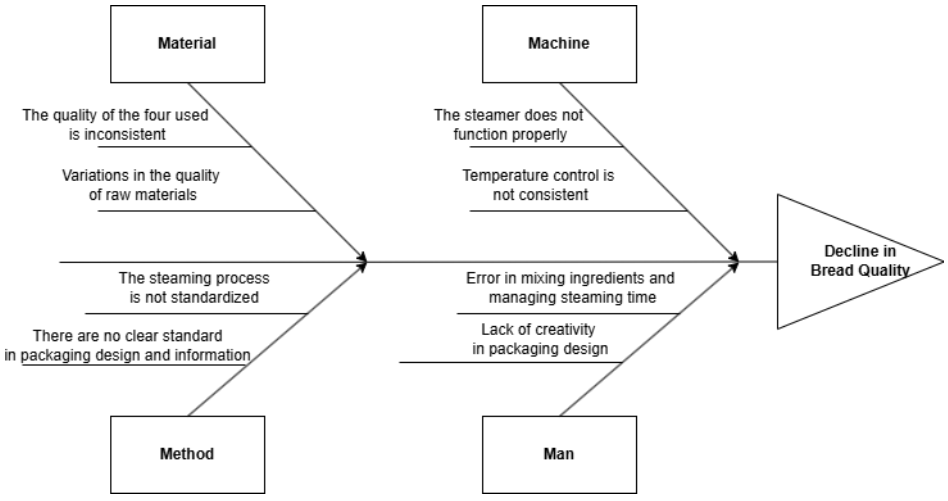

Figure 5. Fishbone Diagram of Factors Contributing to Defects

D. Improve Stage

Table 3. List of Priority Problems and Solutions

Priority Level	Issue	Solution
High	Undercooked Bread	1. Implement a maintenance and calibration schedule for machinery. 2. Conduct intensive training programs for workers on the operation of machines. 3. Regularly monitor environmental conditions.
High	Inconsistent Taste	1. Enforce strict SOPs for the ingredient mixing process. 2. Perform routine supervision and testing of raw materials. 3. Conduct performance evaluations for workers and provide feedback for continuous improvement.
Medium	Bread Too Hard or Too Soft	1. Implement calibration procedures for steaming equipment. 2. Standardize steaming procedures. 3. Perform periodic quality testing of raw materials.
Low	Packaging Lacks Informative and Aesthetic Appeal	1. Redesign the packaging with input from professionals. 2. Train the production team on the importance of packaging design. 3. Test the packaging in the market to gather consumer feedback.

E. Control Stage

The Control phase in the DMAIC method is the stage where quality control is maintained to ensure that the improvements made in the Improve phase are sustained and that the production process remains stable. During this phase, the development of clear and detailed Standard Operating Procedures (SOPs) is crucial for each step of the production process. Furthermore, corrective mechanisms need to be developed to address emerging issues promptly and prevent their recurrence in the future.

First, developing clear and detailed SOPs covers several critical aspects of the production process. For the steaming process, the SOP ensures that the bread is perfectly cooked through steps such as checking the steamer, arranging the dough, adjusting the temperature and time, monitoring the process, and performing a final check for doneness. For ingredient mixing, the SOP is designed to maintain the consistency of the bread's taste by weighing ingredients according to the recipe, mixing the ingredients in the correct order, checking the dough consistency, and storing the dough under proper conditions. The SOP aims to ensure informative and aesthetically pleasing packaging by selecting appropriate materials, printing informative labels, packaging the bread neatly, and storing the finished products in a clean environment.

Next, developing corrective mechanisms is crucial for promptly addressing defects as they arise. A defect reporting system, periodic quality reviews, and employee training and development are key components of this mechanism. The defect reporting system ensures that any detected defects are promptly addressed by identifying, reporting, and implementing corrective actions. Employee training and development aim to enhance their skills and knowledge of the production process and quality control through regular training, competency tests, evaluations, and feedback.

Following these steps is expected to stabilize the production process and maintain and improve product quality. This will not only increase customer satisfaction but also enhance the competitiveness of SMEs in the market.

CONCLUSION

Based on the results and discussion above, it can be concluded that applying the DMAIC methodology offers a viable solution to address the quality inconsistencies in Roti Kukus Srikaya Balila. The Define stage identified Critical to Quality variables, including taste, texture, appearance, and shelf life, which directly impact customer satisfaction. In the Measure stage, observational data revealed a Defects Per Unit value of 1.65%, a Defects Per Opportunity value of 0.00412, and a Defects Per Million Opportunities value of 4,124.72. A Pareto chart indicated that undercooked bread and inconsistent taste were the most significant issues, contributing to 80 percent of defects, while X-bar and R-bar charts highlighted process instability. The Analyze stage utilized a fishbone diagram to identify root causes across four variables: man, material, machine, and method. To address identified issues, the Improve stage provided prioritized solutions, including machinery maintenance, workforce training, standardization of steaming procedures, and packaging redesign. In the Control stage, solutions were implemented to sustain improvements, including developing detailed Standard Operating Procedures for each production stage, a defect reporting system, periodic quality reviews, and employee training programs. By applying the DMAIC methodology systematically, the study achieved consistent product quality, ensured process stability, and strengthened the competitiveness of the MSME in the market.

REFERENCES

Achmad, Fandi, Lubis, Marina Yustiana, & Nugrahaini, Yunita. (2023). Proposed Design of Sewing Process Improvement to Minimize Polyester Technical Sportswear Product Defect at PT. X Based on The DMAIC Method Approach. *Jurnal Sistem Teknik Industri*, *25*(1), 25–40.

Allen, Theodore T. (2019). *Introduction to engineering statistics and lean six sigma: Statistical quality control and design of experiments and systems* (Vol. 3). Springer.

Azwir, Hery Hamdi. (2022). Improving the Finishing Process of Food Packaging Products Using DMAIC Method. *Jurnal Rekayasa Sistem Industri*, *11*(2), 129–144.

Budiarto, Rachmawan, Putero, Susetyo Hario, Suyatna, Hempri, Astuti, Puji, Saptoadi, Harwin, Ridwan, M. Munif, & Susilo, Bambang. (2018). *Pengembangan UMKM antara konseptual dan pengalaman praktis*. Ugm Press.

FA, Giovanni Rizky F. A. Rizky, Susanta, Susanta, & Sadeli, Sadeli. (2023). Pengaruh Kesadaran Merek dan Citra Merek terhadap Loyalitas Merek Serta Implikasinya pada Minat Beli Ulang. *Jurnal Administrasi Bisnis (JABis)*, *21*(2), 96–125.

Faturrahman, Fadli. (2021). Pertambahan Jumlah Umkm Sebagai Potensi PAD Kabupaten Sumbawa. *Journal of Accounting, Finance, and Auditing*, *3*(02), 48–56.

Ghazani, Nabila. (2015). Kemitraan Pengembangan UMKM (Studi Deskriptif Tentang Kemitraan PT.PJB (Pembangkit Jawa Bali) Unit Gresik Pengembangan UMKM Kabupaten Gresik). *Kebijakan Dan Manajemen Publik*, *3*(2), 142–151.

Indonesia, Kamus Bahasa. (2021). Definisi Modal dalam Konteks UMKM.

Maryanto, Maryanto, Chalim, Munsharif Abdul, & Hanim, Lathifah. (2022). Upaya Pemerintah Dalam Membantu Pelaku Usaha Umkm Yang Terdampak Pandemi Covid-19. *Audi Et AP: Jurnal Penelitian Hukum*, *1*(01), 1–11.

Masnun, Siti, Makhdalena, Makhdalena, & Syabrus, Hardisem. (2024). Pengaruh Kualitas Produk terhadap Kepuasan Konsumen. *JIIP-Jurnal Ilmiah Ilmu Pendidikan*, *7*(4), 3736–3740.

Montgomery, Douglas C. (2020). *Introduction to statistical quality control*. John wiley & sons.

Nasution, Syarifuddin, & Sodikin, Renny Desiana. (2018). Perbaikan Kualitas Proses Produksi Karton Box Dengan Menggunakan Metode DMAIC Dan Fuzzy FMEA. *Jurnal Sistem Teknik Industri*, *20*(2), 36–46.

Palit, Silvester Magnus Loogman. (2021). Perlindungan Hukum Melalui Kebijakan Terhadap Umkm Pada Masa Pandemi Covid 19 Di Kota Jayapura. *Jurnal Hukum Ius Publicum*, *1*(2), 147–163.

Pancawati, Ni Luh Putu Anom. (2022). Total quality management dan biaya mutu: Meningkatkan daya saing melalui kualitas produk. *Ganaya: Jurnal Ilmu Sosial Dan Humaniora*, *5*(2), 185–194.

Rasyidah, Alvi Nuur, Bariroh, Arrizqah, & Rahmawati, Dyah Emi. (2022). Analisis total quality management (TQM) dalam meningkatkan mutu manufaktur dan jasa pada PT. Dahana (Persero) Subang. *Sibatik Journal: Jurnal Ilmiah Bidang Sosial, Ekonomi, Budaya, Teknologi, Dan Pendidikan*, *1*(12), 2917–2926.

Rifaldi, Muhammad, & Sudarwati, Wiwik. (2024). Penerapan Metode Six Sigma dan FMEA Sebagai Usaha untuk Menggurangi Cacat pada Produk Bracket. *Prosiding Semnastek*.

Sugiantini, Eka, Khamaludin, Khamaludin, & Rahayu, Monita. (2022). Analisis Pengendalian Kualitas Produk Carton Box Menggunakan Metode Six Sigma Di Pt. Cipta Multi Buana Perkasa. *JUITECH: Jurnal Ilmiah Fakultas Teknik Universitas Quality*, *6*(2), 93–101.

Susetyo, Hendri Rahman. (2019). *Pengaruh Kepercayaan Merek, Citra Merek, Dan Kepuasan Merek Terhadap Loyalitas Merek Serta Keinginan Pembelian Ulang Koran Jawa Pos Pada Masyarakat Surabaya*. STIE Perbanas Surabaya.

Syah, Arman, & Pratama, Angga. (2020). Analisis Pengaruh Kualitas Produk dan Kualitas Pelayanan terhadap Kepuasan Pelanggan (Studi Kasus pada Holland Bakery Pamulang). *JGK (Jurnal Guru Kita)*, *4*(3), 11–19.

Widjadja, Yani Restiani, Alamsyah, Doni Purnama, Rohaeni, Heni, & Sukanjie, Bambang. (2018). Peranan Kompetensi SDM UMKM Dalam Meningkatkan Kinerja UMKM Desa Cilayung Kecamatan Jatinangor, Sumedang. *Jurnal Abdimas BSI: Jurnal Pengabdian Kepada Masyarakat*, *1*(3).