Risk Management Analysis of Online Culinary SMEs Using Failure Mode and Effect Analysis (FMEA) and Fishbone Diagram: A Case Study of Stick Roll Chicken in Malang

Arie Restu Wardhani[1*], Muhammad Yusuf Bahtiar[2], Ahmad Fairuzabadi[3], Niken Paramita[4]

[1] *Industri Engineering, Faculty of Engineering, Universitas Widya Gama Malang, Jl. Borobudur 35 Malang East Java, Indonesia*
[2,3,4] *Digital Bussiness, Faculty of Economics and Bussiness, Universitas Widya Gama Malang, Jl. Borobudur 35 Malang East Java, Indonesia*

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Correspondence Email:
arierestu@widyagama.ac.id

Abstract

Small and Medium Enterprises (SMEs) in the culinary sector face growing technological and operational challenges due to digitalization and complex supply chains. This study analyzes the risks faced by Stick Roll Chicken, an online-based SME in Malang, Indonesia, using an integrated Fishbone Diagram and Failure Mode and Effect Analysis (FMEA). Data were collected through interviews, observations, and document analysis. The Fishbone Diagram identified root causes across six dimensions which is Man, Machine, Method, Material, Environment, and Management that highlighting issues such as inconsistent procedures, supplier dependence, unstable connectivity, and limited managerial control. FMEA scoring showed that technological dependency (RPN = 336) and operational inefficiencies (RPN = 320) were the most critical risks. Mitigation strategies recommended include SOP standardization, supplier diversification, improved technological backup systems, and strengthened management practices. The integrated FMEA–Fishbone approach offers a systematic framework for enhancing risk management and operational resilience in online culinary SMEs.

1. Introduction

Small and Medium Enterprises (SMEs) operating within the culinary sector are increasingly confronted with challenges posed by rapid digitalization, evolving consumer behaviors, and intricate supply chain dynamics. The reliance of online culinary businesses on technological platforms, real-time delivery systems, and consistent raw material availability introduces an array of operational and technological risks. A significant number of SMEs struggle with the incorporation of an up-to-date cyber-risk strategy, as noted in studies indicating that a substantial percentage of SMEs lack adequate cyber-risk management measures in place (Sukumar et al., 2023). Effective risk management is therefore imperative, as it ensures the preservation of service reliability, adherence to food safety standards, and overall business continuity (Civelek et al., 2023).

This study aims to systematically identify, evaluate, and prioritize the risks faced by Stick Roll Chicken, an online-based culinary SME located in Malang, Indonesia, through the integration of the Failure Mode and Effect Analysis (FMEA) and Fishbone Diagram frameworks. This research is motivated by the pressing need to support culinary SMEs in navigating uncertainties within digital marketplaces, where reliance on delivery platforms and volatile supply chains can precipitate significant service interruptions (Otokiti et al., 2022). By acknowledging these challenges, the importance of a robust risk assessment framework becomes apparent, as it equips SMEs with the necessary tools to mitigate potential disruptions effectively (Abukari & Saluja, 2025; Chueasawathi, 2025; Vdovichena & Hildebrant, 2024).

The contribution of this study is threefold: (1) it provides a structured risk identification approach specifically designed for digital culinary SMEs; (2) it quantifies risks using the FMEA methodology to produce priority rankings; and (3) it offers tailored mitigation strategies to bolster operational resilience. While the introduction remains approachable, it emphasizes the methodological integration discussed throughout the study and underscores the critical need for risk assessment in the context of SMEs in the digital age (Oriekhoe et al., 2024). This comprehensive overview sets the stage for a deeper exploration of how culinary SMEs can leverage effective risk management to enhance their sustainability and competitiveness in the evolving market landscape.

1.1 Literature Review

The application of risk management strategies within Small and Medium Enterprises (SMEs), particularly those operating in the online culinary sector, has gained increasing scholarly attention in recent years. The rapid expansion of digital marketplaces has compelled SMEs—such as Stick Roll Chicken in Malang, Indonesia—to adopt systematic and data-driven risk assessment methods to remain competitive and resilient. This literature review synthesizes key findings related to risk management in SMEs, with a specific focus on the use of Failure Mode and Effect Analysis (FMEA) and the Fishbone Diagram within digitally enabled culinary businesses.

FMEA has long been established as a structured methodology for identifying potential failure modes, evaluating their consequences, and prioritizing corrective actions. Sulaman et al. (2017) demonstrate the broad applicability of FMEA in detecting operational hazards and enabling preventive measures across both developmental and operational project phases. Complementing FMEA, the Fishbone (Ishikawa) Diagram serves as a visual diagnostic tool that maps root causes of failures across categories such as human factors, materials, methods, and managerial processes. Although the provided references did not offer a direct citation for this complementary role, its widespread use in quality management underscores its relevance in root-cause identification.

Recent scholarship also highlights persistent challenges faced by SMEs, particularly in relation to supply chain sustainability and resilience. Sutrisno & Kumar (2022) stress the importance of tailored risk assessment models in supply chain settings, advocating the use of multi-criteria decision-making tools to evaluate critical risk factors. Similarly, Asamoah et al. (2020) find a strong positive association between supply chain resilience and customer-oriented performance, further reinforcing the value of proactive and structured risk management approaches. Despite these insights, the adoption of such frameworks remains inconsistent among online culinary SMEs, indicating a notable gap in both practice and literature.

The intersection of digitalization and food supply chain risk has also been explored in studies such as Zhang (2025), who used process analysis and FMEA to evaluate vulnerabilities that emerged in fresh food supply chains during the disruptions of the COVID-19 pandemic. This case highlights the growing need for culinary SMEs to anticipate and manage risks arising from their dependence on digital platforms, logistical partners, and shifting consumer expectations.

These studies collectively point toward an emerging research agenda addressing the unique needs of digital culinary SMEs. Future investigations should incorporate empirical applications of FMEA and other analytical tools tailored to the digital culinary context, where challenges such as platform dependency, variable delivery logistics, and algorithm-driven market visibility introduce new layers of risk. Comparative analyses between traditional and digitally focused risk assessment methods would also be valuable in evaluating their real-time effectiveness for small, rapidly evolving enterprises.

In synthesizing prior work, it becomes evident that while FMEA offers considerable promise for structured risk prioritization, its application in small culinary businesses remains limited. Furthermore, FMEA has been critiqued for its reliance on subjective scoring and its limited capacity to account for interrelated risks. Integrating it with root-cause tools such as the Fishbone Diagram can help address these limitations by strengthening analytical rigor and contextual relevance. This study responds to the identified research gaps by applying an integrated FMEA–Fishbone approach to assess multi-dimensional risks, technological, operational, financial, legal, market, and reputational, in a digital culinary SME.

In risk management research, such synthesis is essential for identifying gaps, inconsistencies, and contextual limitations that justify new empirical inquiry (Jill E . Perry-Smith & Shalley, 2003). The present review highlights several key aspects relevant to this study: risk management practices in SMEs, especially those in the culinary and online sectors; operational and supply chain risks associated with digital platforms; the application of FMEA as a quantitative risk assessment tool; and the use of Fishbone Diagrams to identify root causes across human, process, material, and environmental dimensions.

Overall, the literature reveals a lack of structured, data-driven risk assessment frameworks specifically designed for online culinary SMEs. While both tools (FMEA and Fishbone) are used widely in industry, their integrated application for evaluating multi-dimensional risks in small, online-based culinary SMEs remains underexplored. Most FMEA studies focus on large-scale industries, not micro food businesses. By integrating FMEA and Fishbone methodologies, this study contributes to filling that gap and advances the development of more robust, context-sensitive risk management strategies.

2. Research Methods

The study employs a descriptive qualitative methodology, complemented by a quantitative assessment utilizing Failure Mode and Effect Analysis (FMEA). This duality in approach allows for a detailed exploration and evaluation of risk factors specifically within Stick Roll Chicken, an online-based culinary small and medium enterprise (SME) in Malang, Indonesia. The integration of qualitative and quantitative methods enhances the study's reliability by providing a holistic view of the operational challenges faced by this SME.

Central to the methodological framework is the Fishbone Diagram, also known as the Ishikawa diagram, which serves as an effective tool for root cause analysis. This diagram helps visualize the potential sources of problems by categorizing them into various contributing factors such as people, processes, materials, and environment (Nurunisa & Fadila, 2022). The FMEA complements this by quantifying the risks associated with identified failure modes, allowing for prioritization based on severity, occurrence, and detection (Ferdiansyah & Dewi, 2025). Together, these tools facilitate a robust risk assessment process, enabling stakeholders to identify critical failure points and strategize accordingly.

Qualitative data, largely derived from interviews and observations, provide insights into the operational dynamics of Stick Roll Chicken, corroborating the findings obtained from diagrammatic analyses (Alanudin, 2024). Using the FMEA method, a Risk Priority Number (RPN) is calculated for different failure modes, which helps assess the urgency of addressing specific risks (Ferdiansyah & Dewi, 2025). This systematic evaluation enhances the organization's ability to allocate resources and efforts effectively towards mitigating high-priority risks, ultimately aiming to improve operational efficiency and product quality.

The qualitative approach is particularly relevant in the context of culinary SMEs, as it allows for an in-depth understanding of personal interactions and customer feedback, which are essential in high-contact service environments like food businesses (Alanudin, 2024). Thus, the research not only underscores the technological aspects of risk management but also highlights the importance of human and operational elements in achieving sustainable improvement. This study's methodological combination of qualitative analysis and quantitative metrics, via FMEA and Fishbone Diagram, enables a comprehensive and structured approach to risk evaluation within Stick Roll Chicken, reflecting a model that can be adapted across various SMEs in Indonesia.

2.1 Research Design

This study uses a case study research design to analyze the operational and technological risks faced by online culinary SMEs in real-world settings, a method well-suited for exploring complex challenges such as digital platform dependency, supply chain variability, and online order management (Liu et al., 2017; Seiti et al., 2018). The approach follows three structured stages: (1) risk identification through qualitative methods such as interviews and observations, which provide contextual insights into operational nuances (Haievskyi, 2020); (2) root-cause analysis using the Fishbone (Ishikawa) Diagram to categorize causes across human, process, material, and environmental dimensions (Jiang et al., 2019); and (3) risk prioritization using Failure Mode and Effects Analysis (FMEA), which quantifies each failure mode through severity, occurrence, and detection scores to generate a Risk Priority Number (RPN) that guides targeted interventions (Cao & Leung, 2019; Daneshvar et al., 2020; Seiti et al., 2018).

This integrated qualitative–quantitative framework aligns with scholarly recommendations emphasizing the need for mixed-method risk analysis (Du et al., 2014) and provides a robust basis for identifying and mitigating risks in online culinary SMEs.

2.2 Research Context and Sampling

Research Context

The study focuses on Stick Roll Chicken, a micro-scale culinary enterprise specializing in chicken-based snacks sold primarily through online delivery platforms such as GrabFood, GoFood, and ShopeeFood. Its reliance on digital ordering systems, outsourced delivery services, and daily raw-material procurement increases exposure to operational and technological risks.

Sampling Technique

A purposive sampling technique was applied to select individuals directly involved in operational processes and decision-making. Participants include Owner/Manager, Production Staff, Delivery Coordinator/Admin.
The sample responsibility comprises:

- Owner/Manager – responsible for strategic decisions, supplier coordination, and financial oversight
- Production Staff – involved in raw material preparation, cooking, and packaging
- Delivery Coordinator/Admin – manages online ordering platforms, customer interactions, and delivery coordination

This composition ensures representation across technological, operational, and managerial functions.

2.3 Data Collection Methods

Multiple data collection techniques were employed to enhance validity through methodological triangulation.

1. Interviews

Semi-structured interviews were conducted with the owner and staff to explore operational workflows, technology usage, supplier relationships, platform reliability, and challenges experienced during peak

hours or service disruptions. These interviews assisted in identifying potential failure modes and understanding their impacts.

2. Observations

Direct observations were carried out during production and order-processing activities. Observation focused on:

- material handling,
- process timelines,
- potential error points,
- interactions with delivery platforms.

These observations captured risk events that participants might inadvertently overlook.

3. Document Analysis

Supporting documents were reviewed, including:

- supplier schedules,
- digital order records,
- customer complaint logs,
- standard operating procedures (SOPs),
- raw material inventories.

The combined insights from interviews, observations, and documents strengthened the identification and verification of risk factors.

2.4 Risk Identification Procedure

All potential failure modes were mapped across six risk dimensions:

1. Technological
2. Operational
3. Financial
4. Market
5. Legal
6. Reputational

Each failure mode represents a specific event with the potential to disrupt business operations (e.g., platform downtime, delivery delays, supply shortages).

2.5 Root-Cause Analysis Using the Fishbone Diagram

To determine the underlying causes of each major risk, the study employed a Fishbone (Ishikawa) Diagram. Risk causes were categorized into:

- Human: skills, training, workload
- Methods: SOPs, process flow, work instructions
- Machines/Technology: apps, devices, internet reliability
- Materials: raw material quality, supplier consistency, packaging
- Environment: weather conditions, demand fluctuations, competition
- Management: planning, supervision, coordination

This analysis distinguishes between surface-level symptoms and deeper systemic causes.

2.6 Failure Mode and Effect Analysis (FMEA)

FMEA was used to quantify and prioritize risks by evaluating each failure mode based on three parameters:

- Severity (S): the magnitude of impact on operations or customer satisfaction
- Occurrence (O): the likelihood of the failure occurring
- Detection (D): the capability of detecting or preventing the failure prior to its impact

Each parameter was rated on a scale of 1–10, and the Risk Priority Number (RPN) was computed as:

$$\text{RPN} = S \times O \times D \qquad (1)$$

Description:

S = Severity
O = Occurrence
D = Detection

Scale Meaning:

- 1–3 (Low): Minimal impact; customer or operations barely affected.
- 4–6 (Moderate): Noticeable disruption; reduced performance or minor customer dissatisfaction.
- 7–8 (High): Significant operational impact or major customer complaints.
- 9–10 (Very High/Critical): Severe failure causing major service breakdown, safety concerns, or complete process stoppage.

Higher RPN values indicate higher-priority risks requiring immediate mitigation.

2.7 Data Validation

To ensure credibility, dependability, and confirmability, the study implemented:

- Method triangulation: comparing findings from interviews, observations, and documents
- Investigator triangulation: cross-checking FMEA scoring among participants
- Member checking: validating interpretations with respondents

These validation techniques enhance the reliability and accuracy of qualitative and quantitative results.

2.8 Ethical Considerations

All participants were informed about:

- the objectives of the study,
- voluntary participation,
- confidentiality of operational data,
- the use of information exclusively for academic purposes.

Informed consent was obtained from all participants prior to data collection.

3. Result and Discussion

3.1 Overview of Identified Risks

Based on data collected through interviews, observations, and document analysis, six primary categories of risk were identified in Stick Roll Chicken's business operations:

1. Technological Risk: Dependence on third-party digital platforms such as GoFood and GrabFood for online transactions, coupled with vulnerability to system outages or algorithmic changes that affect product visibility.
2. Financial Risk: High platform commission fees (20–30%) and frequent order cancellations that result in raw material losses.
3. Operational Risk: Delays in raw material supply (especially fresh chicken) and limited manpower during peak demand hours, leading to slower production and delivery.
4. Market Risk: Intense competition and rapidly changing food trends that can reduce customer retention.
5. Legal Risk: Limited regulatory compliance due to the absence of a PIRT (Produk Industri Rumah Tangga) certificate and unregistered brand trademark.
6. Reputational Risk: Customer dissatisfaction reflected in negative online reviews related to delayed deliveries or inconsistent taste.

3.2 Root Cause Analysis Using the Fishbone Diagram

The **Fishbone Diagram** (Figure 1) was employed to determine the root causes of each identified risk under six analytical dimensions—**Man, Machine, Method, Material, Environment, and Management**.

- **Man (Human Factors):** Lack of trained staff, multitasking roles, and inconsistent food handling practices.
- **Machine (Technology):** Platform dependency, unstable internet connectivity, and limited POS (Point-of-Sale) integration.
- **Method:** Absence of standardized SOPs for order processing and quality control.
- **Material:** Dependence on single suppliers and variability in ingredient quality.
- **Environment:** Limited kitchen space and exposure to temperature fluctuations affecting food freshness.
- **Management:** Informal financial recording, reactive decision-making, and limited contingency planning.

This analysis revealed that most high-impact risks stemmed from **process inconsistency** (Method) and **resource dependency** (Material and Machine).

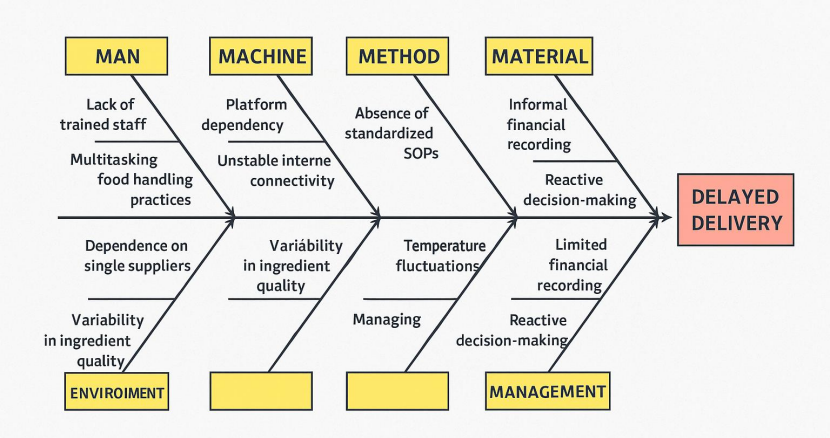

Figure 1. Fishbone Diagram of Risk

3.3 Risk Evaluation Using FMEA

Failure Mode and Effects Analysis (FMEA) is a structured method used to identify potential failures within a process, evaluate their effects, and prioritize risks for mitigation. It begins by listing failure modes and assessing their possible impacts on performance or safety (Joly-Mischlich et al., 2021; Streimelweger et al., 2016), helping organizations uncover issues such as inadequate training, data management weaknesses, or insufficient quality control (Luan et al., 2025). Each failure is then rated for severity, occurrence, and detection on a numerical scale, with these scores multiplied to produce a Risk Priority Number (RPN) that ranks risks according to urgency (Čička et al., 2022; Yücesan, 2020). High-RPN failures are prioritized for corrective action, enabling more efficient resource allocation and targeted improvements (Fan et al., 2020; Zhou et al., 2022). Due to its adaptability across contexts, including healthcare and service industries, enhanced versions of FMEA, such as fuzzy FMEA, have also been developed to address uncertainty in real-world applications (Yücesan et al., 2021). Tabel 1 shows the result of the Failure Mode and Effect Analysis (FMEA). The results show that technological dependence and operational inefficiencies represent the most critical risks, requiring immediate mitigation. High RPN values for these categories indicate both frequent occurrence and significant business impact. Meanwhile, legal and market risks were ranked as lower priorities but remain important for long-term strategic planning.

Tabel 1. The Failure Mode and Effect Analysis (FMEA) result

Risk Category	Severity (S)	Occurrence (O)	Detection (D)	RPN (S×O×D)	Priority
Technological Risk	8	7	6	**336**	1
Operational Risk	8	8	5	**320**	2
Financial Risk	7	6	6	**252**	3
Reputational Risk	8	6	6	**288**	4
Market Risk	6	7	5	**210**	5
Legal Risk	5	5	7	**175**	6

3.4 Interpretation of Results

The findings demonstrate that *Stick Roll Chicken's* greatest vulnerabilities lie in its dependence on external delivery platforms and lack of standardized operational procedures. Interruptions in digital platforms directly reduce customer access and revenue, while raw material delays and limited human resources contribute to production bottlenecks. Financial and reputational risks are secondary effects arising from these core issues.

The analysis further shows that most risk causes are interrelated technological disruptions often trigger financial losses and reputational decline. The combined use of the Fishbone Diagram and FMEA effectively revealed these cross-linkages, enabling a deeper understanding of how risk factors propagate across business functions.

3.5 Key Findings

The integration of FMEA and the Fishbone Diagram enabled a comprehensive risk evaluation by combining quantitative prioritization with qualitative root-cause analysis. The assessment revealed that technological risks (RPN = 336) and operational risks (RPN = 320) were the most critical, exerting the strongest impact on overall business performance. Root causes were primarily concentrated in the Method, Material, and Management dimensions, indicating weaknesses in standardized procedures, supplier reliability, and managerial control. These findings underscore the need for immediate short-term mitigation actions, such as implementing backup ordering systems and establishing clear SOPs, alongside long-term strategies that include diversifying suppliers and reducing reliance on third-party digital platforms.

3.6 Mitigation Recommendations

Based on the interview with the owner, to address the highest-priority technological risks, Stick Roll Chicken should reduce its dependence on a single delivery platform by operating across multiple channels such as GrabFood, GoFood, and ShopeeFood. In the short term, the business can introduce a backup ordering system through WhatsApp Business or direct phone communication to maintain sales continuity during platform outages. Strengthening internet reliability is also essential and can be achieved by using dual internet service providers or maintaining a mobile hotspot as a secondary connection. In the long run, developing a simple independent website and integrating a Point-of-Sale (POS) system that synchronizes orders from all

platforms will support greater operational stability. Continuous monitoring of platform analytics can further help anticipate visibility changes caused by algorithm updates.

Operational risks also require strategic attention, particularly those related to raw material delays, inconsistent workflows, and limited manpower. The business should begin by establishing detailed Standard Operating Procedures (SOPs) for production, packaging, and order handling to minimize errors and improve efficiency. Short-term improvements include adjusting production schedules based on peak-hour trends and preparing buffer stocks to prevent shortages during high-demand periods. For long-term resilience, Stick Roll Chicken can formalize agreements with suppliers to ensure timely delivery, cross-train staff so they can handle multiple roles during peak times, and adopt basic automation tools such as digital checklists or inventory monitoring applications.

Material-related risks stem from dependency on a single supplier and inconsistency in ingredient quality. In the immediate term, Stick Roll Chicken can implement quality checks for incoming materials and identify at least one alternative supplier to reduce vulnerability. Over time, developing stronger partnerships with suppliers through clear expectations and quality standards will help maintain product consistency. Standardizing measurement tools and ingredient portions can also strengthen quality control and reduce variability.

Method-related risks arise from inconsistent work processes and unclear instructions. These risks can be mitigated by formally documenting all operational procedures and conducting regular training sessions to ensure staff understand food handling, hygiene, and order management requirements. As a long-term improvement strategy, the business should adopt a continuous improvement approach, such as the Plan–Do–Check–Act (PDCA) cycle, and display visual workflow charts in the kitchen to reinforce correct practices and reduce human errors.

Environmental and reputational risks can be reduced by improving kitchen layout, ventilation, and food-storage conditions to ensure consistent temperature control. Using insulated packaging can help maintain food freshness during delivery. Prompt and empathetic responses to customer complaints—such as offering replacements or discount vouchers—can protect the brand's reputation. Over time, the business may benefit from upgrading equipment for enhanced temperature regulation and implementing a more systematic customer feedback review process to identify recurring service issues.

4. Conclusions

This study examined the risk management practices of Stick Roll Chicken, an online-based culinary SME in Malang, through the integrated application of the Fishbone Diagram and Failure Mode and Effect Analysis (FMEA). By employing a descriptive qualitative approach supported by quantitative scoring, the study successfully identified, analyzed, and prioritized the key risks affecting the enterprise's operational continuity and competitiveness in the digital marketplace.

The results highlight six major categories of risk i.e.: technological, operational, financial, market, legal, and reputational, with technological dependency and operational inefficiencies emerging as the most critical. The highest Risk Priority Numbers (RPN), 336 for technological risk and 320 for operational risk, indicate that reliance on third-party delivery platforms and inconsistent raw material supply pose significant threats to business performance. Root cause analysis further revealed that most high-impact risks originate from process inconsistency (Method), resource dependency (Material and Machine), and limited managerial control.

The integrated use of Fishbone and FMEA frameworks proved effective in uncovering the interrelationships among risks, offering both diagnostic clarity and strategic prioritization. The findings underscore the importance of establishing standardized operating procedures, diversifying suppliers and digital platforms, strengthening management practices, and enhancing technological readiness.

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