Integrating Occupational Safety and Health Management Systems (SMK3) with Total Quality Management (TQM) in Micro-Scale Manufacturing Enterprises

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Abstract. Improving a company's Occupational Safety and Health Management System (SMK3) is key to achieving Total Quality Management (TQM) goals. This study uses questionnaires, fishbone diagrams, and Fault Tree Analysis to evaluate SMK3 implementation at a micro-scale manufacturing business, Malang Roster. The primary goal is to ensure work quality while maintaining a sustainable safety system. Findings show the most significant issues are low discipline in using personal protective equipment (PPE), poor supervision, and outdated equipment. Other challenges include inadequate health insurance planning and the use of subpar equipment. While safety signs are present, unauthorized access to hazardous areas remains a problem, requiring corrective action. To effectively integrate SMK3 into a TQM framework, companies must strengthen provisions, implementation, and monitoring. This study suggests that consistent supervision, targeted training, and structured audits are crucial for improving occupational safety in small manufacturing environments.

Keywords: Total Quality Management (TQM), Occupational Safety and Health, SMK3Implementation, Small-Scale Manufacturing, Risk Prevention, Craft Industry, SMEs, TQM-SMK3 Integration

1.   Introduction

Total Quality Management (TQM) is a strategic management approach that contemporary organizations are recommended to adopt with a view to enhancing product quality, reducing production costs, and improving overall productivity. Empirical studies have established that the deployment of TQM has a positive effect on both cost efficiency and revenue generation [1]. As a response, business enterprises that apply TQM best practices continuously register more profitable performances [2]. With the inherently hazardous nature of most business operations, the establishment of an Occupational Safety and Health Management System (SMK3) that complies with related laws and regulations becomes

imperative [3], in support of the overall TQM objectives. In Indonesia, the application of Occupational Safety and Health (K3) is mandated by law in all industrial sectors, emphasizing that K3 is not a cost but a strategic investment in accident prevention and minimization of operational losses, such as waste treatment and energy consumption [4].

Home Industry Roster Malang is a small enterprise established in 2019 with five workers at Jalan Kana No. 20, Jatimulyo, Malang City. The company specializes in the manufacture of rosters, ventilation components used to regulate the airflow in indoor spaces, with a daily production capacity of 400 units. These devices, typically installed on doors or windows, consist of opening or closable grids or partitions which may be adjusted to allow ventilation based on specific requirements [5].

This domestic industry falls under the services-manufacturing category with a primary focus on the fulfillment of customized orders. The process entails a heightened risk of occupational injury due to the intensive use of machinery and supporting equipment. On both production and post-production levels, heavy and hard materials such as sand, cement, and shovels are involved. Additionally, the final rosters themselves are heavy in weight, creating potential hazards if not handled properly or if they come into contact with workers' bodies [6,7].

Due to these risks, the implementation of a strict Occupational Safety and Health Management System (SMK3) is paramount in ensuring worker safety. The level of SMK3 application should be in proportion to the size and intensity of the operation. Despite awareness of the risks involved, the company still faces a high frequency of workplace accidents related to inadequate equipment safety, non-compliance with safety procedures, and lack of discipline among employees [8,9].

Incident records from the previous year show recurring work accidents in three home-based businesses, Roster A, B, and C, in Malang, as indicated in the tabulated data below [10].
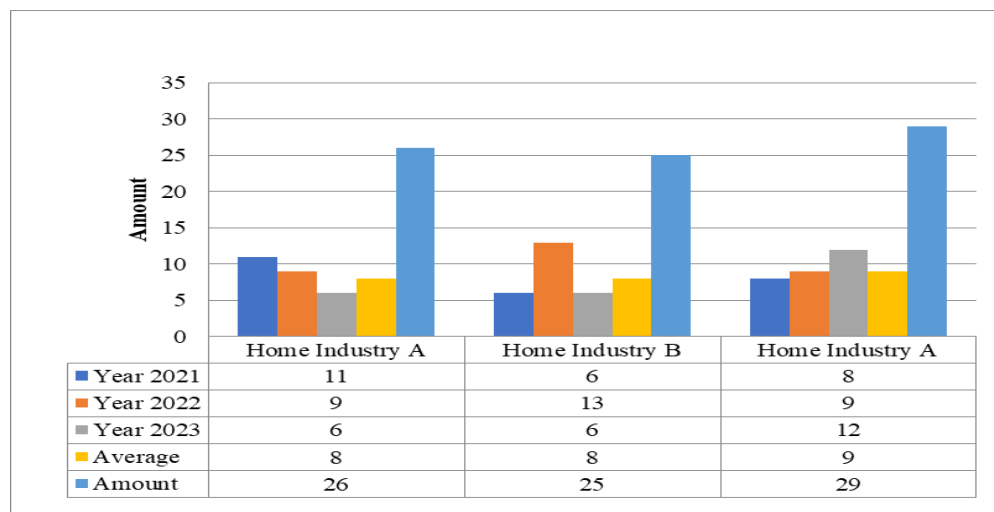

	Home Industry A	Home Industry B	Home Industry A
Year 2021	11	6	8
Year 2022	9	13	9
Year 2023	6	6	12
Average	8	8	9
Amount	26	25	29

Figure 1. Occupational Accident Statistics
Source: Data Collection, 2024

Figure 1.1 illustrates workplace accident statistics, indicating an average of 6 to 9 accidents annually. Home Industry A and B each experience an average of 8 accidents per annum, while Home Industry C reports 9. These similarly high statistics indicate deficiencies in existing Occupational Safety and Health Management Systems (SMK3), underscoring the urgent need for system development and more effective implementation [11]. Effective implementation of SMK3 demands strategic planning and wholehearted commitment at all organizational levels [12]. This study discusses SMK3 within the framework of Total Quality Management (TQM) in home-based roster industries, where stakeholder participation, from frontline workers to top management, determines the sustainability and success of

occupational safety and health practices [13].

Rosters, or ventilation blocks, are building components typically constructed from concrete or other durable materials, with uniformly distributed perforations, according to Yuliana [14]. Their primary function is to supply air circulation between outdoor and indoor environments, thereby maintaining optimal indoor air quality. These components are commonly found in factory buildings and multi-story structures. Despite their prevalence, research on SMK3 implementation in such small-scale enterprises remains limited. Most existing studies focus on large-scale industrial settings, with minimal attention to microenterprises or home industries operating in high-risk environments.

This study aims, firstly, to examine SMK3 implementation in home-based roster industries from the TQM point of view, grounded in Government Regulation No. 50 of 2012 [15]; and secondly, to unveil and investigate the underlying reasons for the failure to comply with SMK3 regulations in these enterprises, despite the adoption of TQM principles. The findings are expected to contribute to the development of more applicable, scalable, and sustainable safety practices in similar small-scale industries.

2. Research Methods

3.1. Type of Research

The study in this research discusses the implementation of the Occupational Safety and Health Management System (SMK3) under the framework of Total Quality Management (TQM), using the case of Roster Malang in East Java. Following a qualitative method, data were collected through surveys, interviews, and literature reviews. The research also makes use of field observation and secondary sources, which serve as significant advantages in data gathering [16]. A total of 10 respondents, including seven employees and three members of the management team, participated in the study. Purposive sampling was used to ensure that participants had direct experience with SMK3 procedures and implementation.

Qualitative research generates descriptive data from written or spoken words and observable behavior [17]. It seeks to provide detailed and contextualized information about individuals, groups, communities, or organizations by examining their behaviors and utterances in depth. Based on data collection procedures, qualitative research can be divided into two general categories. The first is historical-comparative research, which involves collecting data to compare aspects of social life across different historical periods or societies, while employing a combination of observation, interviewing, statistical analysis, and document analysis. The second category is qualitative research proper, which is characterized by a specific approach to one phenomenon, concept, or idea. It commonly uses action verbs such as explain, understand, explore, or discover, while maintaining an objective tone throughout the study. This type of research emphasizes transparency in the methodology employed, requires the clear identification of study participants, and provides a strong and detailed description of the research site.

To ensure validity and reliability, questionnaire instruments were pre-tested, and triangulation was employed by cross-referencing data from observations, interviews, and document reviews. Responses were coded and categorized to identify recurring patterns and key themes. Member checking was also conducted to confirm the accuracy of interview summaries with participants. This study emphasizes that the implementation of SMK3 and TQM is not only crucial to large industries but also to home industries because the right to occupational health and safety covers all workers regardless of workplace size. Qualitative information was obtained through direct observations and worker questionnaires at Roster Home Industry Malang. The findings were interpreted to produce valid and meaningful results, contributing to broader arguments and enhancing knowledge on occupational health and safety in comparable situations [18].

3.2. Data Analysis Techniques

The research will be conducted by the following methods:

a. Cause and Effect Diagram (Ishikawa Diagram)
This diagram illustrates the relationship between the effects of a problem and its root causes. It is used to identify core issues and guide corrective action. In this study, brainstorming sessions were held with both workers and supervisors to trace sources of problems such as work procedures, tools and equipment, measuring systems, manpower, and the work environment. These were then categorized into specific contributing factors, labeled as primary causal themes. As a key tool within the Six Sigma process, the Ishikawa Diagram identifies and organizes influential variables for study quality [19]. To ensure reliability, findings from the fishbone analysis were cross-validated with interview data and observational field notes.

b. Questionnaire
Two structured questionnaires were employed, one targeting employees and the other management. The employee questionnaire assessed the practical implementation of SMK3 in daily operations, while the management version focused on policy formulation and organizational oversight.

Responses from a total of 10 participants (7 employees and 3 management representatives) were gathered. To strengthen credibility, the questionnaire items were developed based on Government Regulation No. 50 of 2012 and existing SMK3 literature, then pre-tested for clarity and consistency. Data from the responses were processed using descriptive statistical tools, particularly the Relative Importance Index (RII) method, to quantify the degree of influence and perceived practice levels for each item [20].

The triangulation of questionnaire responses with qualitative interviews and field observations enhanced the trustworthiness of the findings. Manual coding was used to identify themes and patterns in qualitative responses, which were then interpreted in the context of SMK3 and TQM integration.

4. Result and Discussion

Concrete rosters are traditionally produced in various shapes with relatively simpler methods and indigenous materials, referred to as sand [5]. The method entails traditional methods with the composition tested through trial-and-error by the artisans. Since the character of their know-how is tacit, such methods are often difficult to articulate and transfer, and so roster manufacture is a complex skill to learn. The aims of this study are: (a) to discover and investigate the tools, material, and hand manufacture practices followed by the local craftsmen in Malang; and (b) to test the compressive strength and water absorption of the rosters manufactured by them.

Based on primary and secondary data, the chapter is a systematic point-by-point discussion to bring clarity and coherence to the interpretation of findings.

4.1. Implementation of the Occupational Safety and Health Management System (SMK3) incorporating Total Quality Management (TQM) principles, in accordance with Government Regulation No. 50 of 2012.
Installation of the Occupational Safety and Health Management System (SMK3), as mandated by Government Regulation No. 50 of 2012 [15], includes setting and operation of a sustained safety management system. This is achieved through establishing a workplace in line with security laws and regulations, having facilities and infrastructures in place, and conducting education and training on K3 principles to all employees.

SMK3 as a component of the company's management system has the purpose of managing work risk, offering benefits in the sense of increasing workers' protection, cost efficiency, as well as organized management of systems. These objectives reflect the emphasis on planning, integration, and continual improvement, consistent with TQM frameworks [2,21].

To confirm this, fishbone diagrams serve as effective tools in identifying and researching root causes through systematic brainstorming sessions [22]. The diagrams categorize potential problems into major categories of human factors, materials, machinery, methods, and policies. In this research, a fishbone analysis was applied to evaluate K3 practices implementation within the Malang roster home industry. Despite being small, with a mere ten employees, the company shows exemplary execution of K3 under current constraints. However, certain key high-risk aspects still exist and need to be addressed. Observations drawn from owner and staff interviews advise the fishbone diagram, showing frequent production problems that can help in future development and act as a guide for comparable businesses. These findings resonate with Babalola et al. [3], who emphasized the recurring challenges in small-scale enterprises regarding poor equipment maintenance and inconsistent PPE usage. Similarly, Parsamehr et al. [7] found that ineffective communication and low awareness of hazards contributed significantly to risk exposure in local development projects, a pattern mirrored in Malang's roster industry.

Production activities adhere to predetermined Standard Operating Procedures (SOPs) and Work Instructions (Attachments 2 and 3) to ensure product quality and worker safety in accordance with TQM and SMK3 concepts. Figure 3 outlines potential hazards within the production process, emphasizing the necessity for effective SMK3 implementation. Furthermore, Figure 2 shows end results derived from questionnaire information, offering a platform for based findings and suggestions towards enhanced occupational safety and health practices.
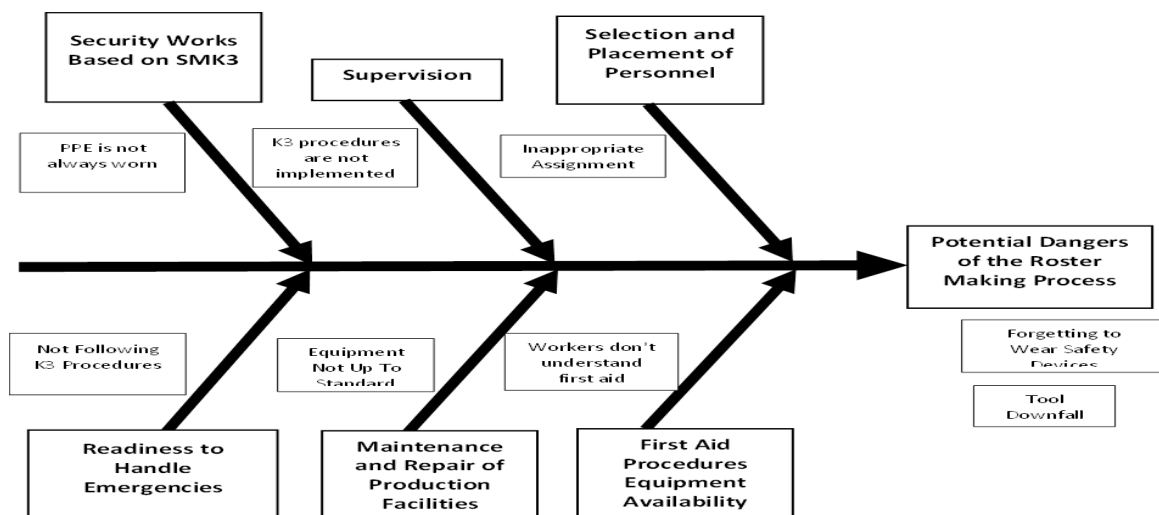

Figure 2. Fishbone Diagram illustrating the root causes of the identified issue through a structured cause-and-effect analysis

The Fault Tree Analysis (FTA) model (Figure 3) identifies significant process-related failure points. The structure of the FTA provides a qualitative diagnosis, emphasizing weak supervisory enforcement and inconsistent safety equipment usage. These findings align with Musungwa and Kowe [12], who reported that lack of routine audits and weak managerial involvement lead to similar patterns of workplace negligence in other sectors.
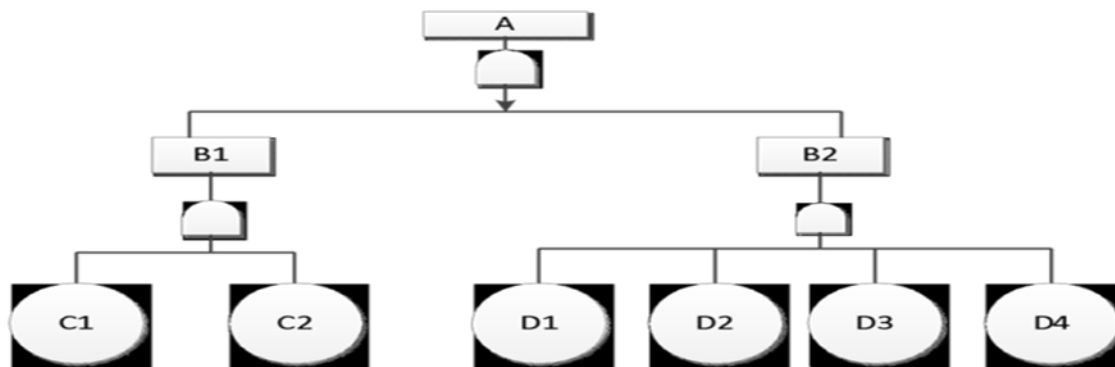
Figure 3. Graphical Model of Job-Related Hazards Utilizing Fault Tree Analysis (FTA)

The results provided a tree diagram that identifies significant issues in the process of roster production. The outcome emphasizes the necessity of conducting an Occupational Safety audit according to SMK3 standards to ensure proper usage within the home industry. In addition, closer and more consistent monitoring of the production process is required to safeguard both employee health and product quality. From the workers' perspective, enforcing OHS discipline is key to the creation of a safety culture that will be useful as the business expands in the future. This aligns with Babalola et al. [3], who also found that inadequate PPE and outdated tools were significant risk factors in small-scale operations.

The event labels used in the Fault Tree Analysis (FTA) model for workplace accidents are listed in Table 1.

Table 1. Fault Tree Analysis (FTA) graphical model Job

Event	Information
A	Occupational safety achieved through adherence to SMK3 standards
B1	Poor supervision at work
B2	Inconsistent use of personal protective equipment (PPE)
C1	Excessive time delays in task completion
C2	Poor implementation of occupational safety precautions
D1	Improper assignment of tasks
D2	Non-adherence to set safety procedures
D3	Use of substandard or non-compliant equipment
D4	Insufficient worker awareness of first aid procedures

4.1.1. Failure Causes to Comply with SMK3 Requirements Under Statutory Rules in the Home- Based Roster Business in a TQM Environment

The Occupational Safety and Health Management System (SMK3), legislated and operating on the principles of Total Quality Management (TQM), is an integral part of the overall general management system. It encompasses the stages of planning, organizing, implementing, and supervising, whose aim is to produce a safe, organized, and productive work environment.

The responses to the questionnaire from ten employees at the Malang roster home industry were cross-checked in order to determine the factors that hindered the effective implementation of SMK3.

4.1.2. Measures *to Ensure Effective Implementation of SMK3*

The information gathered from the questionnaires were processed further to determine and order the necessary measures for enhancing the implementation of the Occupational Safety and Health Management System (SMK3) in Malang Roster Home Industry.

4.1.3. *Results of the Questionnaire Data Analysis*

Questionnaire responses were analyzed to identify the degree of importance of management practices in the Malang Roster Home Industry based on the mean scores of each item. The Relative Importance Index (RII), a non-parametric statistical method, was utilized to compute both the degree of influence and the degree of practice [28].

4.1.4. *Analysis of Factors Influencing the Implementation of the K3 Management System*

The results of the questionnaire data on the key determinants of SMK3 implementation are presented in terms of mean scores, rankings, and descriptive interpretations. All sixteen items recorded mean values above 2.50, indicating a strong interpersonal influence on respondents' perceptions. In the area of planning, the mean scores for the four related items ranged from 3.00 to 4.00, reflecting strong applicability to SMK3 implementation. The most significant issue identified was the unsuitable placement of safety equipment, with a mean score of 3.90, highlighting its importance for employee safety and accident cost reduction. Organizational factors also scored between 3.00 and 4.00, confirming their effectiveness in system implementation. The highest-rated problem in this category was the lack of discipline among employees in adhering to SMK3 regulations, particularly in the use of personal protective equipment (PPE) and the avoidance of hazardous acts, which received the highest score of 4.00. Implementation factors were similarly impactful, with all items scoring between 3.00 and 4.00. The most pressing issue was workers' lack of knowledge about occupational safety, which also received a mean score of 4.00, emphasizing the urgent need for more safety training and education. Supervisory factors proved equally important, with mean scores ranging between 3.00 and 4.00. The most concerning problem in this area was the inadequate provision of personal protective equipment, which scored 3.80, indicating that business owners need to improve access to proper safety gear.

4.1.5. *Analysis of Activities in Implementing the K3 Management System*

Questionnaire analysis of the implementation of the K3 Management System in the Malang Roster Home Industry produced mean values, rank scores, and interpretive descriptions. All sixteen items had mean values above 2.50, indicating strong relevance and influence on the respondents' work practices. In terms of planning, all four related items fell within the $3.00 < X \leq 4.00$ range, signifying their importance to the successful implementation of SMK3. The highest-rated item, with a mean value of 3.80, concerned the necessity of neatly arranging tools to reduce workplace accidents. Organizational structure factors also scored within the same range, with the most critical aspect being the actualization of a K3 organization based on Government Regulation No. 50 of 2012, which recorded a mean score of 3.70 and highlighted the necessity of a formalized legal foundation. Implementation factors showed similar strength, as three of the four issues addressed scored in the same range. The most effective action, with a mean score of 3.90, was providing training and awareness programs for safety, ensuring that precautionary action becomes second nature in hazardous environments. Supervisory actions also demonstrated effectiveness, with all items scoring between 3.00 and 4.00. The most prominent factor in this category was the routine inspection of the workplace and equipment, which achieved a mean score of 3.70, emphasizing its significant contribution to accident prevention.

4.2. *Implementation System Model of SMK3 in the Roster Malang Home Industry*

The findings of this study have been encapsulated in a practical model for implementation of SMK3 in the home-based roster company. The model offers an organized format for the process of

implementation and serves as a useful guide for similar enterprises. While details may vary between companies, that is predicated on real conditions, so it is more likely to be useful than theoretical models.

The structure aligns with the TQM principles of continuous improvement, employee involvement, and process focus as noted by Dezi [23] and Riaz et al. [2]. Unlike more centralized models of SMK3 implementation discussed by Parsamehr et al. [7], this approach relies on localized initiatives, highlighting flexibility and adaptability in micro-enterprise environments.

The application of SMK3 in the Roster Malang Home Industry involves several well-structured steps that ensure systematic implementation and continuous improvement. The process begins with commitment and policy, which includes a formal declaration of leadership and commitment, an initial measurement of K3 conditions, and the development and enactment of a comprehensive K3 policy. This is followed by the planning stage, where sector-specific risk control plans tailored to Roster Malang are developed, measurable targets and objectives are established in accordance with the K3 policy, and performance indicators are applied to monitor K3 outcomes. Accountability and risk management then play a crucial role by identifying the competencies of personnel responsible for implementing K3, conducting supportive activities to guarantee proper execution, and carrying out hazard identification, risk assessment, and the application of control measures. The implementation stage focuses on monitoring and tracking SMK3 performance indicators, evaluating the achievement and effectiveness of implementation activities, and identifying areas that require improvement while applying corrective actions. Finally, measurement and evaluation provide a thorough review of both the implementation process and the outcomes of K3 by monitoring goals, targets, and achievement levels, auditing SMK3 practices and responding to the findings, and evaluating overall system performance to determine areas for future improvement.

4.3. Implementation of Total Quality Management of Occupational Safety and Health (K3) in the Roster Malang Home Industry.

Being a micro-enterprise, the Roster Malang Home Industry is one common entry for would-be entrepreneurs [24]. Its availability provides opportunities for people from all walks of life to venture into roster manufacturing. However, strict conformity to occupational safety and health (K3) habits is needed to ensure that the company's vision and mission of minimizing workplace accidents are maintained. The inclusion of Total Quality Management (TQM) in the K3 system is thus deemed imperative. The next graph indicates the number of workplace accidents at Roster Malang Home Industry during 2021–2023.
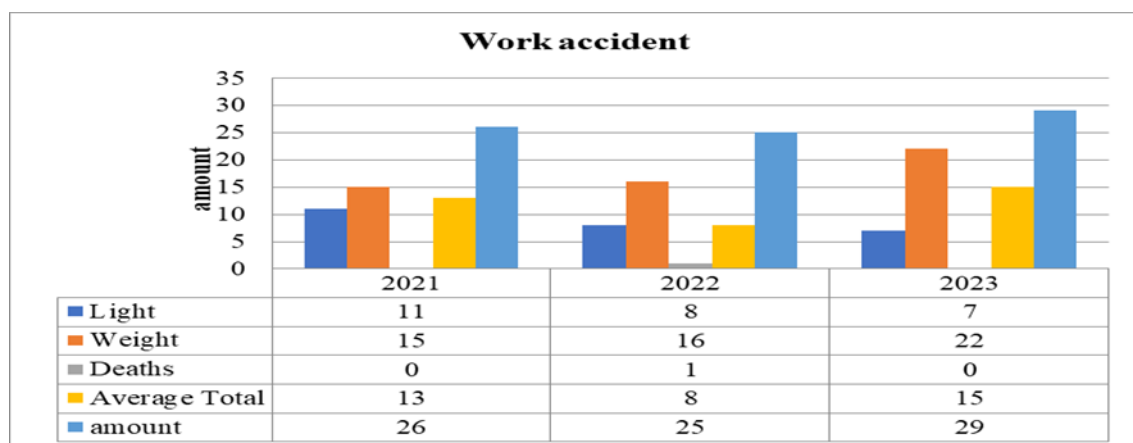

Work accident	2021	2022	2023
■ Light	11	8	7
■ Weight	15	16	22
■ Deaths	0	1	0
■ Average Total	13	8	15
■ amount	26	25	29

Figure 5. Graph of Work Accidents from 2021 to 2023

According to Figure 5, work-related accidents within the Roster Home Industry increased from 2021 to 2023. There were 26 occurrences in 2021, decreasing slightly to 25 in 2022, but with one instance of fatality that year. Then an increase again in 2023 with 29 instances.

The Malang Roster Home Industry applies its Occupational Safety and Health Management System (SMK3) integrated with its environmental and quality management systems. At the planning phase, standards and guidelines are clearly defined through written SMK3 procedures that act as tools for monitoring, reviewing, and evaluating employees' compliance. These procedures are designed in accordance with customer specifications, legislative requirements, and other relevant standards, and are periodically reviewed to comply with the law, contracts, and ongoing improvement.

The elements of SMK3 are regulated by the Republic of Indonesia Minister of Manpower Regulation No. 50 of 2012 [15], which prescribes key elements of commitment, policy, planning, evaluation, and management review. In Roster Malang Home Industry, some occupational hazards have been identified, with poor management of equipment organization and poor K3 systems management contributing significantly to work risks.

The results of this research are useful for the process of conforming the PP No. 50 of 2012 [15] initially targeted at big businesses to the environment of small-scale enterprises. Its size notwithstanding, the Roster Home Industry uses heavy equipment that presents significant hazards to employees, hazards compounded by the lack of adequate safety controls, cluttered tools, and procedural non-adherence. Therefore, the current study stresses the utmost importance of appropriate application of SMK3, according to national laws, in order to improve worker safety and health even in home-based industries.

4.4. Review of the Occupational Safety and Health Management System (SMK3).

According to the provisions of laws concerning home-based roster businesses, the main components of SMK3 review include occupational safety and health (K3) inspections, the application of proper K3 management practices, and the implementation of corrective and preventive actions.

This review structure is also supported by TQM's emphasis on structured evaluations and data feedback loops [2,20]. To be effective, these reviews must not only confirm compliance but also serve as drivers for long-term process improvement. As emphasized by Dezi et al. [23], continuous feedback and performance metrics must inform future safety policies, thereby reinforcing a learning organization culture, which is still emerging in the current home industry context.

4.5. Management Review at Roster Malang Home Industry

The periodical and systematic review of SMK3 in the Roster Malang Home Industry is carried out with the purpose of improving occupational safety and health performance. This process includes the verification of the implementation of K3 policies, the assessment of established goals, targets, and performance measures, the review of SMK3 audit findings, and the evaluation of the overall effectiveness of SMK3 implementation.

However, current practices remain mostly descriptive and lack alignment with strategic TQM principles. TQM frameworks stress that management reviews should function not only as evaluative checkpoints but also as strategic decision-making tools for enhancing future performance [2,23]. Without actionable insights and feedback loops, these reviews risk becoming procedural rather than transformational. Embedding TQM-aligned indicators, such as defect rates, near-miss incidents, or compliance levels, can strengthen the review's impact and foster a safety-oriented culture.

4.6. Results of Work Accident Data in the Malang Roster Home Industry

Trends in workplace accidents in the Roster Malang Home Industry have varied. Low-level accidents increased by 5.76% in 2023 but fell by 4.64% in 2024. Medium-level accidents increased by 4.76% in 2023 and declined by 2.16% in 2024. High-level accidents increased by 9.33% in 2023, then decreased by 3.33% in 2024. These fluctuations reveal the positive impact of systematic SMK3 implementation, as mandated in Government Regulation No. 50 of 2012 [15].

The initial spike in accidents across categories in 2023 can be attributed to inconsistent enforcement of safety practices and insufficient follow-up after training, as identified earlier in the FTA model.

Improvements in 2024 suggest that corrective actions were taken, albeit unevenly. For example, the decline in low-level incidents indicates growing employee awareness, while the reduction in high-level incidents likely stems from better equipment maintenance and procedural checks.

Viewed through the TQM lens, this reflects a partial execution of the Plan–Do–Check–Act (PDCA) cycle. The 'Check' and 'Act' phases remain underutilized, resulting in slow institutional learning. Musungwa and Kowe [12] emphasize that without systematic feedback and corrective mechanisms, safety performance tends to fluctuate rather than improve steadily.

This reinforces findings by Babalola et al. [3], who argue that sustainable safety improvements require not only structural changes but cultural shifts, particularly in small business environments. Moreover, as Hassan and Jaaron [21] note, aligning safety goals with green manufacturing and lean principles enhances both safety and operational efficiency. Therefore, TQM practices must be embedded into day-to-day safety routines, not only in formal documents but also through behavior modeling, incentive systems, and continual retraining [25].

5. Conclusion and Suggestions

5.1. Conclusion

Based on research on home-based roster businesses in Malang, several important conclusions can be drawn. The implementation of SMK3 based on Total Quality Management (TQM) principles in these businesses has not yet fully aligned with Government Regulation No. 50 of 2012 [15]. This misalignment is particularly evident in areas of commitment and policy, where the Home Industry Roster Malang manages occupational safety and health (K3) risks responsibly but remains inconsistent in adhering to national policy commitments. Similarly, while objectives and targets such as ensuring product quality, minimizing work accidents, and promoting health are clearly defined, their fulfillment is hindered by gaps in implementation. The study also identifies major constraints that obstruct optimal SMK3 application. From a planning perspective, the absence of employee health insurance negatively affects morale and confidence in workplace safety. In terms of organization, employee indiscipline in using personal protective equipment (PPE) and following established procedures undermines safety efforts. Implementation challenges are also evident, as outdated tools and unfit equipment continue to pose hazards and reduce efficiency. Furthermore, oversight remains a weakness, with unsafe zones inadequately marked, thereby endangering both employees and visitors. To strengthen SMK3 through the perspective of TQM, several responsive strategies are necessary. These include offering performance-based rewards to foster a stronger safety culture, conducting routine audits and supervision to assess the effectiveness of implementation, and emphasizing monitoring and evaluation as continuous processes to ensure improvement and compliance.

These findings emphasize that TQM-aligned SMK3 practices can enhance safety culture and operational outcomes even in micro-industries. The integration of structured planning, ongoing evaluation, and staff engagement is essential to achieving these goals.

5.2. Suggestions

The following suggestions are recommended for home-based roster business owners as considerations to further facilitate the implementation of the Occupational Safety and Health Management System (SMK3). It is important to regularly provide socialization and training for all personnel engaged in the roster production process to strengthen their understanding of occupational safety and health (K3). In addition, raising awareness of the vital significance of SMK3 implementation is essential for instilling a culture of safety and compliance across the organization. Strengthening human resource capability through specialized education in SMK3 principles is also necessary to ensure that the system can be applied effectively and consistently in daily operations. These actionable strategies can enhance both safety performance and organizational resilience, particularly when integrated into a broader Total Quality Management (TQM) approach.

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