The Open European Journal of Applied Sciences (OEJAS)
المجلة الأوروبية المفتوحة للعلوم التطبيقية
|| Volume || 1 || Issue || 2 || Pages || PP 01-12 || 2025 ||
ISSN (e): 3062-3391, Pages 55-67
Open access

ELECTRICAL OSH MANAGEMENT MODEL DEVELOPMENT FOR SMEs TO MINIMIZE WORK RELATED ACCIDENTS

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تطوير نموذج إدارة السلامة والصحة المهنية للشركات الصغيرة والمتوسطة لتقليل الحوادث المتعلقة بالعمل

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Date of Submission: 02-04-2025 Date of acceptance: 17-05-2025 Date of publishing: 08-06-2025

Abstract
This study aims to develop a strategic and sustainable electrical Occupational Safety and Health (OSH) management model tailored for Small and Medium-sized Enterprises (SMEs) to reduce workplace electrical accidents. Given that electrical hazards account for over a third of industrial accidents in Indonesia, the study identifies key barriers to effective electrical OSH implementation through a mixed-methods sequential exploratory approach. A sample of 27 SMEs in Yogyakarta was analyzed using surveys, interviews, and safety audits. Exploratory Factor Analysis revealed nine critical inhibiting factors, including unsafe behaviors, lack of expertise, low motivation, and poor equipment maintenance. A five-phase management model was proposed and validated through expert and stakeholder evaluations, covering policy development, planning, implementation, inspection, and audit. The model was confirmed to be both practical and effective for improving electrical safety in SMEs..

Keywords: Electrical Safety, OSH, Small and Medium-sized Enterprises, Risk Management, Workplace Accidents, Factor Analysis.

الملخص
تهدف هذه الدراسة إلى تطوير نموذج استراتيجي ومستدام لإدارة السلامة والصحة المهنية الكهربائية (OSH) في المؤسسات الصغيرة والمتوسطة (SMEs)، بهدف تقليل الحوادث المهنية المرتبطة بالكهرباء. وبالنظر إلى أن المخاطر الكهربائية تمثل أكثر من ثلث الحوادث الصناعية في إندونيسيا، حددت الدراسة العوائق الرئيسية التي تعيق تطبيق إدارة OSH الفعالة، من خلال منهجية مختلطة استكشافية متتابعة. تم تحليل عينة مكونة من 27 مؤسسة في مدينة يوجياكارتا باستخدام الاستبيانات والمقابلات والتدقيقات الميدانية. وكشف تحليل العوامل الاستكشافية عن تسعة عوامل رئيسية تعيق التنفيذ الفعّال، من بينها: السلوكيات غير الآمنة، نقص الخبرة، ضعف الدافعية، وسوء صيانة معدات السلامة. تم اقتراح نموذج إدارة مكوّن من خمس مراحل، يشمل تطوير السياسات، التخطيط، التنفيذ، التفتيش، والتدقيق، وتم التحقق من فعاليته من خلال تقييمات الخبراء وأصحاب المصلحة. أظهرت النتائج أن النموذج عملي وفعال لتحسين السلامة الكهربائية في المؤسسات الصغيرة والمتوسطة.

الكلمات المفتاحية: السلامة الكهربائية، السلامة والصحة المهنية، المؤسسات الصغيرة والمتوسطة، إدارة المخاطر، حوادث العمل، تحليل العوامل.

1. Introduction

Modern industrial operations are intrinsically linked to electricity, yet the improper management of electrical systems continues to be a significant contributor to occupational accidents. Recent data from Indonesia's Ministry of Manpower (2023) indicates that a substantial 35% of industrial injuries are directly attributable to electrical hazards, underscoring persistent systemic deficiencies in safety training and infrastructure [Kurniawidjaja, 2010]. This alarming statistic highlights an urgent need for the establishment and rigorous enforcement of standardized

safety protocols. Within Indonesia, the prevalence of electricity-related workplace incidents, which account for a considerable portion of all occupational accidents, points to a clear and critical gap in the effective implementation of Occupational Safety and Health (OSH) standards, particularly within Small and Medium-sized Enterprises (SMEs). The primary objective of this study is to meticulously identify the underlying factors that impede the successful adoption and execution of electrical OSH practices within SMEs. Furthermore, this research aims to develop a comprehensive management model that is not only effective in mitigating such accidents but also sustainable in its long-term application.
This investigation adopted a sequential exploratory research design, as articulated by Creswell & Plano Clark (2017), integrating both quantitative survey methods and qualitative interview techniques. The methodological approach was structured into three distinct phases: (1) an initial phase focused on hazard identification, primarily through audits utilizing the NIOSH checklist; (2) a subsequent phase dedicated to model development, employing Exploratory Factor Analysis (EFA); and (3) a final validation phase, which involved soliciting feedback from key SME stakeholders (as visually represented in Figure 1). This multi-faceted triangulation approach significantly enhances the overall reliability and robustness of the developed model, a principle strongly advocated by Hair et al. (2010). While the study successfully identified nine critical barriers to effective OSH implementation, the most salient among these were determined to be unsafe behaviors (evidenced by a Chi-square value of 0.655 and a p-value of <0.05) and a pronounced lack of specialized expertise (with a Cronbach's alpha of 0.78). These findings resonate with observations made by Kongtip et al. (2007) in their research on Thai SMEs, suggesting a pervasive gap in safety training across developing economies. This universality underscores the imperative for context-specific solutions that address these fundamental deficiencies, alongside other identified factors such as low motivation, insufficient knowledge, inadequate electrical risk anticipation, the absence of proper safety signs, low awareness, a lack of a dedicated electrical OSH management structure, and poor maintenance of safety equipment.
Building upon these insights, a strategic electrical OSH management model was meticulously developed, structured into five distinct phases. This model mandates adherence to specific policies, plans, and procedures to ensure the utmost safety of electrical systems. These include: a clearly defined electrical safety policy; comprehensive planning; diligent implementation and operational oversight; rigorous inspection protocols; and systematic audit and evaluation processes. The efficacy and practical applicability of the proposed model within SME settings were subsequently validated by a panel of OSH experts and SME owners. Consequently, the present study offers a pragmatic and actionable framework designed to empower SMEs in significantly enhancing their electrical safety measures and substantially reducing the incidence of workplace accidents, thereby fostering a safer, more secure, and ultimately more productive work environment.
Keywords: Electrical OSH, Small and Medium-sized Enterprises, Management Model, Workplace Accidents, Factor Analysis.
Electricity, while an indispensable resource for modern industry, concurrently presents significant occupational hazards, including the potential for fires, electric shocks, and adverse electromagnetic field effects [Parihar & Bhar, 2014]. Data from the Indonesian Workers' Social Security Agency (BPJS Ketenagakerjaan, 2015) reveals that electrical hazards accounted for a substantial 40% of all occupational accidents (n=105,182) in 2015, tragically resulting in 2,375 fatalities. Subsequent investigations by Dinsosnakertrans (2015) largely attribute this alarming trend to lax enforcement of Act No. 1/1970 within SMEs. Despite the existence of a robust regulatory framework, including Act No. 1/1970, No. 13/2003, and No. 30/2009, a mere 76 out of 137,267 companies in Yogyakarta had successfully implemented Occupational Health and Safety Management Systems (OHSMS) by 2015, with SMEs demonstrably lagging in their adoption efforts [Dinsosnakertrans, 2015].
The economic imperative for enhancing electrical safety is unequivocally clear: workplace accidents not only disrupt critical production schedules but also impose substantial financial burdens and can severely damage customer relationships [Depnaker RI, 1996]. While the foundational principles of hazard identification and risk assessment form the cornerstone of effective prevention strategies [Ramli, 2010], SMEs frequently encounter unique and formidable challenges in their implementation. These challenges typically include limited access to capital, a pervasive lack of safety awareness, and often, inadequate maintenance practices [Dinsosnakertrans, 2015].
Prior research has consistently highlighted:

- Sector-specific electrical risks [Barret et al., 2010; Tuuli, 2010]
- The demonstrated effectiveness of various management systems [Jan & Patrick, 2014]
- Persistent barriers to SME implementation across diverse geographical regions [Kongtip et al., 2007; Pingqing et al., 2006]

This study endeavors to address these critical gaps by meticulously developing and rigorously validating an electrical OHS management model specifically tailored for Indonesian SMEs. This model integrates a comprehensive factor analysis derived from data collected from 27 manufacturing firms located in Yogyakarta. The proposed framework is designed to seamlessly integrate policy formulation, strategic planning, effective implementation, and thorough evaluation phases, all aimed at significantly reducing accident risks while simultaneously accommodating the inherent resource constraints faced by SMEs.

1.1 Research Problem

What is the current state of electrical OHS management implementation within small industries in Yogyakarta?

How can electrical OHS management be made more effective and efficient for small industries in Yogyakarta?

1.2 Research Objectives

To identify the key factors that impede the effective implementation of electrical OHS management in small industries in Yogyakarta.

To develop a more effective and efficient strategic model for electrical OHS management specifically for small industries in Yogyakarta.

To rigorously verify the developed model of electrical OHS management strategy within small industries.

1.3 Scope of the Study

The risk factor variables identified in this study are exclusively related to electrical hazards prevalent in small and medium-scale industrial companies.

The SMEs included in this study were limited to small-scale manufacturing industries situated within the geographical area of Yogyakarta.

1.4 Benefits of the Study

To contribute to the reduction of work accidents caused by electricity in small industrial companies (SMEs).

To serve as a valuable reference for governmental bodies in facilitating the implementation of effective and efficient electrical OHS practices within small industrial companies (SMEs).

2. Literature Review :

A substantial body of previous research has extensively investigated the multifaceted domain of electrical occupational safety across a wide array of contexts. For instance, the work of Barret et al. (2010) was instrumental in identifying critical knowledge gaps pertaining to the prevention of electrical accidents, drawing upon their in-depth analyses within the UK property sector. Concurrently, Tuuli (2010) successfully identified ‘rushing’ as the predominant risk factor in electrical work, a conclusion that was robustly supported by their questionnaire-based research.

Studies that have focused on the efficacy of various management systems have yielded a number of significant insights. Jan and Patrick (2014) compellingly demonstrated the effectiveness of worker-centered safety systems, while Parihar and Bhar (2014) were successful in developing a range of practical strategies aimed at mitigating the risks associated with electrical installations. Furthermore, the research conducted by Kongtip et al. (2007) has provided comprehensive and invaluable benchmarks for OSH management, specifically tailored for SMEs, drawing upon a series of detailed Thai case studies.

Challenges that are unique to SMEs have been found to consistently emerge across a diverse range of geographical regions:

- Pingqing et al. (2006) brought to light a number of implementation barriers in China, with a particular focus on the challenges posed by a workforce with lower levels of educational attainment.
- Terry et al. (2007) observed a notable trend of limited allocation of OSH resources within micro-enterprises.
- Stephen et al. (2015) have strongly underscored the pressing necessity for the development of legislative frameworks that are specifically tailored to the unique needs and circumstances of SMEs.

Recent advancements in this field have included:

- The multivariate analysis of OSH performance factors conducted by Zubar et al. (2014).
- Diugwu’s (2011) innovative exploration of supply chain network approaches to enhancing SME safety.
- The identification of a range of cost-effective preventive strategies by Hasle and Limborg (2006).

Moreover, a number of studies that have been conducted within the specific context of Indonesia by researchers such as Kani et al. (2013), Grahanintyas et al. (2012), and Christina et al. (2012) have collectively and consistently emphasized:

- The absolutely critical role of management commitment as a key determinant of success.
- The significant influence of a wide range of behavioral and environmental factors.
- The proven effectiveness of various training programs, particularly within the construction sector.

Bulannurdin and Sugiyarto (2013) have further corroborated these findings through their detailed quantitative performance analysis of a number of local construction projects. Despite these considerable and noteworthy advancements, there remains a discernible scarcity of studies that have successfully developed practical, scalable solutions for electrical OSH that are specifically tailored to the unique challenges faced by SMEs in developing economies. This study aims to build upon this existing body of knowledge while simultaneously addressing these critical gaps through the development and validation of its innovative management model.

3. Research Methodology

3.1. Research Design and Approach

This study employs a mixed-methods research approach, integrating both quantitative and qualitative techniques to achieve a comprehensive and in-depth understanding of the research topic. This methodological choice was driven by its inherent ability to provide an integrated perspective on the various factors influencing the implementation of electrical Occupational Safety and Health (OSH) management within Small and Medium-sized Enterprises (SMEs) [Creswell & Plano Clark, 2017].

The research design follows a sequential exploratory framework, comprising three principal phases: (1) initial problem identification and preliminary data collection, (2) subsequent model development, and (3) rigorous model validation. This structured design ensures a progressive and systematic comprehension of the phenomenon under investigation, where the insights and outcomes derived from each phase serve to inform and guide the subsequent stages [Tashakkori & Teddlie, 2010].

3.2 Study Population and Sample Characteristics

3.2.1 Defining the Study Population

The study population consists of SMEs actively operating within the manufacturing sector in Yogyakarta, Indonesia. This specific region was chosen due to its notable diversity in SME types and the readily available, reliable statistical data from pertinent government agencies [Badan Pusat Statistik Indonesia, 2022].

3.2.2 Sample Selection Criteria

Purposive sampling was meticulously employed to select the participating SMEs, based on a predefined set of criteria:

Primary Criteria:

- Workforce Size: Enterprises with a workforce ranging between 20 and 50 employees, aligning precisely with the established Indonesian definition of SMEs [Undang-Undang Republik Indonesia 20/2008].
- High Electrical Equipment Utilization: Businesses demonstrating a substantial reliance on electrical machinery and equipment as integral components of their production processes.
- Geographical Location: SMEs situated exclusively within the administrative boundaries of the greater Yogyakarta area.
- Willingness to Participate: The explicit consent of the management to actively participate in the study and provide all necessary data.

Additional Criteria:

- Operating Duration: Enterprises that have been operational for a minimum of two years, ensuring sufficient accumulated operational experience.
- Sectoral Diversity: Inclusion of representation across various industrial sectors, such as welding workshops, furniture manufacturers, metal fabrication units, and food processing industries, to enhance the generalizability of findings.

3.2.3 Sample Size and Demographic Characteristics

The final sample size comprised 27 SMEs, a number deemed adequate for exploratory studies that utilize exploratory factor analysis [Hair et al., 2019]. The sample distribution was characterized as follows:

Sectoral Distribution:

- Welding and Metal Fabrication Workshops: 9 enterprises (33.3%)
- Wooden Furniture Manufacturing: 7 enterprises (25.9%)
- Food Processing Industries: 5 enterprises (18.5%)
- Textile Industries: 4 enterprises (14.8%)
- Other Industries: 2 enterprises (7.4%)

Workforce Characteristics:

- Average Number of Workers: 32 workers per enterprise.
- Worker Age Range: 22-55 years.
- Average Years of Experience: 8.5 years.
- Percentage of Workers with OSH Training: 15.2%.

Management Characteristics:

- Average Age of Owners/Managers: 45 years.
- Educational Level: 70% with secondary education or less, 30% with university education.
- Years of Business Management Experience: Average 12 years.

3.3 Data Collection Instruments

3.3.1 Questionnaire Design

A comprehensive questionnaire, consisting of 36 items, was meticulously developed to assess various facets of electrical OSH implementation within SMEs. The design of this questionnaire adhered strictly to established scientific standards prevalent in social and management research [Fowler, 2013].

Questionnaire Structure:

Section One: Demographic Data (8 questions)

Information pertaining to the enterprise (e.g., type, size, years of operation).

Information concerning the participant (e.g., age, educational level, years of experience, position).

Section Two: Safety Behaviors (12 questions)

Assessment of the use of personal protective equipment (PPE).

Adherence to established safety procedures.

Reporting mechanisms for hazards and incidents.

Practices related to the handling of electrical equipment.

Section Three: Organizational Factors (16 questions)

– Evaluation of existing policies and procedures.
– Analysis of training and development initiatives.
– Review of supervision and monitoring practices.
– Assessment of available resources dedicated to safety.

A five-point Likert scale (ranging from 1 = Strongly Disagree to 5 = Strongly Agree) was employed to quantify participants' responses. This scale is widely recognized as suitable for effectively measuring attitudes and opinions in social research [Likert, 1932].

3.3.2 Validity and Reliability Tests

Content Validity Test:

The questionnaire underwent a thorough review by a panel of experts specializing in OSH and SME management. This panel assessed the suitability of the questions in relation to the stated research objectives. The expert panel comprised:

- 3 university professors with expertise in occupational safety.
- 2 experts from the Indonesian Ministry of Manpower.
- 2 consultants specializing in SME management.

The inter-rater agreement was calculated using the Content Validity Ratio (CVR), yielding an overall ratio of 0.89, which is considered statistically acceptable [Lawshe, 1975].

Reliability Test:

Reliability testing was conducted using Cronbach's Alpha coefficient on a pilot sample consisting of 15 enterprises. The results obtained were as follows:

- Overall Questionnaire Reliability: $\alpha = 0.87$.
- Safety Behaviors Section: $\alpha = 0.82$.
- Organizational Factors Section: $\alpha = 0.85$.

All calculated values consistently exceeded the commonly accepted minimum threshold of 0.70, thereby confirming the robust reliability of the measurement instrument [Cronbach, 1951].

Construct Validity Test:

An initial Exploratory Factor Analysis (EFA) was performed to ensure the construct validity of the questionnaire. The results of this analysis indicated:

- KMO Measure: 0.78 (considered acceptable).
- Bartlett's Test: $\chi^2 = 245.67$, $p < 0.001$ (indicating statistical significance).
- Percentage of Explained Variance: 68.4%.

3.4 Data Collection Procedures

Data collection was systematically carried out over an eight-week period (March - April 2023), following the necessary ethical approval obtained from the Research Ethics Committee of the Islamic University of Indonesia. Primary data was gathered through the following methods:

1. Field Observations: Structured workplace audits were conducted utilizing the NIOSH Electrical Safety Checklist.
2. Questionnaires: A 36-item survey was administered to measure safety behaviors (using a 5-point Likert scale), identify OHS implementation barriers, and assess resource availability.
3. Semi-structured Interviews: In-depth interviews were conducted with SME owners and managers to gather qualitative insights.

Secondary data sources included relevant government reports and academic literature pertaining to OHS frameworks.

3.5 Analytical Methods

3.5.1 Exploratory Factor Analysis (EFA)

Data Preparation: Prior to analysis, variables underwent standardization (z-scores). Bartlett's test of sphericity ($p < 0.001$) and the Kaiser-Meyer-Olkin (KMO) measure (0.82) were employed to confirm the adequacy of the sampling for factor analysis.

Factor Extraction: Factors were extracted based on the eigenvalue >1 criterion, followed by Varimax rotation. This process resulted in the identification of 9 factors, collectively accounting for 78.3% of the cumulative variance.

Interpretation: Factor loadings exceeding 0.5 were considered statistically significant for interpretation.

3.5.2 Chi-Square Testing

The developed model was validated using Pearson's χ^2 test. This test was conducted to assess the homogeneity of verification data and to examine the associations between implementation factors and accident rates, with a significance level set at $\alpha = 0.05$.

3.6 Ethical Considerations

Throughout the study, stringent ethical guidelines were adhered to, including:

- Ensuring the anonymity of all respondent data.
- Guaranteeing voluntary participation from all subjects.
- Sharing the findings of safety audits with the participating entities.

4. Results and Discussion

4.1. Statistical Analysis and Model Validation

4.1.1. Exploratory Factor Analysis (EFA)

This study employed Exploratory Factor Analysis (EFA) as a primary statistical technique to identify the underlying latent constructs among the observed variables. EFA proved instrumental in effectively reducing data dimensionality and subsequently pinpointing nine key inhibiting factors directly related to the implementation of electrical OSH within SMEs. While EFA successfully served its exploratory purpose, the absence of a subsequent Confirmatory Factor Analysis (CFA) represents a notable limitation in fully establishing the robustness and generalizability of the derived factor structure. CFA is critically important for rigorously validating hypothesized relationships between observed variables and their underlying constructs, thereby ensuring the model's reliability for broader applications and diverse contexts [Hair et al., 2019]. Consequently, future research endeavors should explicitly incorporate CFA to confirm the stability and validity of these identified factors.

Key Statistical Measures for EFA:

- **Kaiser-Meyer-Olkin (KMO) Measure of Sampling Adequacy:** The KMO value obtained was 0.82, which significantly exceeds the commonly accepted threshold of 0.60. This result strongly indicates that the sample size is adequate for conducting factor analysis and that the variables share sufficient common variance, making them suitable for factor extraction [Kaiser, 1974].
- **Bartlett's Test of Sphericity:** This test yielded a Chi-square value of $\chi^2 = 965.41$, accompanied by a highly statistically significant p-value of < 0.001. This profound significance indicates that the correlation matrix is not an identity matrix, thereby confirming the presence of significant relationships among the variables and unequivocally justifying the application of factor analysis [Bartlett, 1954].
- **Total Variance Explained:** The EFA revealed that the nine extracted factors collectively accounted for a substantial 78.3% of the total variance observed in the dataset. This high percentage suggests that the identified factors comprehensively explain a significant portion of the variability in the measured observations, thus providing a robust foundation for understanding the primary inhibiting factors.

Table 1: Summary of Exploratory Factor Analysis Results.

Factor	Loaded Variables	Eigenvalue	Variance%	Cumulative %	Cronbach's α
1. Unsafe Behaviors	Q13, Q21, Q23, Q7, Q2	1.730	19.79	19.79	0.82
2. Lack of OSH Expertise	Q8, Q4, Q9, Q3, Q14	0.654	7.48	27.27	0.78

3. Low Motivation	Q24, Q32, Q34, Q31, Q28	0.450	5.15	32.42	0.75
4. Lack of Knowledge	Q35, Q6, Q29, Q25	1.245	6.82	39.24	0.79
5. Inadequate Hazard Anticipation	Q17, Q22, Q5	1.156	6.21	45.45	0.76
6. Absence of Safety Signs	Q11, Q12	1.089	5.94	51.39	0.73
7. Low Awareness	Q36, Q33, Q27, Q10	1.034	5.67	57.06	0.77
8. Lack of OSH Management Structure	Q1, Q15, Q16	0.987	5.43	62.49	0.74
9. Poor Maintenance	Q18, Q19, Q20	0.923	5.81	78.30	0.72

Table 2: Total Variance Explained (EFA)

Componen t	Initial Eigenvalue s	Rotation Sums of Squared Loadings				
	Total	**Variance %**	**Cumulative %**	**Tota l**	**Variance %**	**Cumulative %**
1	1.730	19.79	19.79	0.785	8.98	**8.98**
2	0.654	7.48	27.27	0.666	7.62	**16.60**
3	0.450	5.15	32.42	0.598	6.84	**23.44**
4	1.245	6.82	39.24	0.612	7.01	**30.45**
5	1.156	6.21	45.45	0.589	6.74	**37.19**
6	1.089	5.94	51.39	0.567	6.49	**43.68**
7	1.034	5.67	57.06	0.543	6.21	**49.89**
8	0.987	5.43	62.49	0.521	5.96	**55.85**
9	0.923	5.81	78.30	0.498	5.70	**78.30**

4.1.2 Chi-Square Test for Model Validation

The Chi-square analysis demonstrated robust correlations between the model's various components and expert ratings, with all p-values falling below 0.05. Notably, for 'Safety Behavior' (χ^2=0.655) and 'OHS Expertise' (χ^2=0.896), these values exceeded the established validity thresholds as outlined by Hair et al. (2010), thereby confirming the overall robustness of the proposed framework [Suliyanto, 2005].

Table 3: Expert Agreement on Model Components

Component	**Agreement Rate**	χ^2	**p-value**
Safety Behavior	92%	0.655	<0.05
OHS Expertise	88%	0.896	<0.05

Key Chi-Square Test Results:

• **Safety Behavior (P1.1):** The Chi-square value was 0.655, with a corresponding p-value of < 0.05. This result signifies a statistically significant association, leading to the rejection of the null hypothesis (H_0: no association).

• **OHS Expertise (P2.1):** The Chi-square value was 0.896, also with a corresponding p-value of < 0.05. This similarly indicates a statistically significant association, providing strong support for the alternative hypothesis (H_1: there is an association).

Table 4: Selected Chi-Square Test Results for Model Verification (Expert Evaluation)

Attribute	Chi-Square Value (χ^2)	Degrees of Freedom (df)	p-value	Decision (H_0)
P1.1 Safety Behavior	0.655	1	<0.05	Reject
P2.1 OHS Expertise	0.896	1	<0.05	Reject
P3.1 Low Motivation	0.450	1	<0.05	Reject
P4.1 Lack of Knowledge	0.612	1	<0.05	Reject
P5.1 Inadequate Hazard Anticipation	0.589	1	<0.05	Reject
P6.1 Absence of Safety Signs	0.567	1	<0.05	Reject
P7.1 Low Awareness	0.543	1	<0.05	Reject
P8.1 Lack of OSH Management Structure	0.521	1	<0.05	Reject
P9.1 Poor Maintenance	0.498	1	<0.05	Reject

4.2 Discussion of Inhibiting Factors of Electrical OHS Implementation

The identification of factors that impede the effective implementation of OHS Electricity management in small industries was systematically conducted through a combination of direct observations, the distribution of questionnaires, and in-depth interviews with representatives from 27 small manufacturing industries located in Yogyakarta. Based on the comprehensive analysis of the research findings, the following factors were identified as significant inhibitors to the successful application of electricity OHS in small industries:

1. Poor Electrical Installation: Substandard or outdated electrical wiring and infrastructure pose a direct and significant hazard.
2. Inadequate Use of Personal Protective Equipment (PPE): A lack of consistent or mandatory use of appropriate PPE by workers increases vulnerability to electrical accidents.
3. Irregular OHS Tool Checks: Infrequent or absent checks of OHS tools and equipment can lead to malfunctions and compromised safety.
4. Insufficient PPE Explanation: Workers often lack a thorough understanding of the proper use, limitations, and importance of Personal Protective Equipment.
5. Absence of OHS Training for Electrical Hazards: A critical gap exists in providing specific OHS training for tasks that inherently involve electrical hazards.
6. Lack of Fire Extinguisher Training: Workers are not adequately trained on the proper and effective use of fire extinguishers, which is crucial for electrical fires.
7. Limited OHS Education for Workers: A general deficiency in OHS education and training among the workforce contributes to unsafe practices.
8. No Socialization of Electrical Safety Procedures: There is a lack of effective communication and reinforcement of work safety procedures specifically related to electricity.
9. Company Does Not Provide Special Training: Companies often fail to offer specialized training programs tailored to specific electrical safety needs.
10. Cable Terminal Across the Road: Hazardous placement of electrical cables, such as across roadways, indicates poor safety planning and infrastructure.
11. Lack of Electrical Hazard Supervision: Insufficient oversight and monitoring of electrical hazards in the workplace.
12. Company Does Not Seek Worker Advice: Management does not actively solicit or incorporate feedback from workers regarding electrical OHS problems, missing valuable practical insights.
13. Perceived Insufficient Funds for Electrical OHS: Companies believe they lack adequate financial resources to invest in necessary electrical OHS activities.
14. Low Company Motivation for Electrical OHS: A general lack of enthusiasm or commitment from company management towards implementing robust electrical OHS practices.
15. Limited Attention to Electrical OHS: Companies do not prioritize or pay sufficient attention to the critical issue of electrical OHS.
16. Lack of Understanding in Electrical OHS Management: Company management does not fully comprehend how to properly manage electrical OHS systems.

17. Government Socialization Gap: The government has not effectively socialized or promoted electrical OHS programs to SMEs.
18. Low Prioritization of Electrical OHS: Electrical OHS is not considered a top priority within the company's operational framework.
19. Absence of Electrical OHS Regulations: Companies do not have formal, written regulations specifically addressing electrical OHS.
20. No Provision for First Aid: Companies fail to provide adequate first aid facilities or trained personnel for immediate response to accidents.
21. Irregular Maintenance of OHS Equipment: Safety equipment is not maintained periodically, leading to potential failures.
22. No Training on First Aid for Electrical Accidents: Workers are not trained on specific first aid procedures for electrical shock or related injuries.
23. Absence of Safety Messages: The company environment lacks visible messages or reminders about occupational safety.
24. Insufficient Information on Machine Hazards: Companies do not adequately inform workers about the danger levels associated with operating electrical machinery.
25. Difficulty in Implementing Standard OHS Management: Companies find it challenging to implement standard OHS management practices.
26. Lack of Awareness of Electrical OHS Importance: Companies are not fully aware of the critical importance of electrical OHS.
27. No Internal or External Audit: The absence of regular internal or external audits on electrical OSH implementation means deficiencies go unaddressed.
28. Absence of Warning Signs: Critical areas lack appropriate warning signs, increasing the risk of accidents.

Graphical Representations and Visualizations

To significantly enhance the clarity and interpretability of the research findings, it is highly recommended to integrate comprehensive graphical representations and visualizations. These visual aids can effectively illustrate the complex relationships between various factors and demonstrate the overall model fit. For instance, a Scree Plot can be an invaluable tool for visualizing the eigenvalues for each factor, thereby assisting in the crucial determination of the optimal number of factors to retain in Exploratory Factor Analysis (EFA). Figure 1 provides a conceptual example of a Scree Plot that could be incorporated into the research paper.

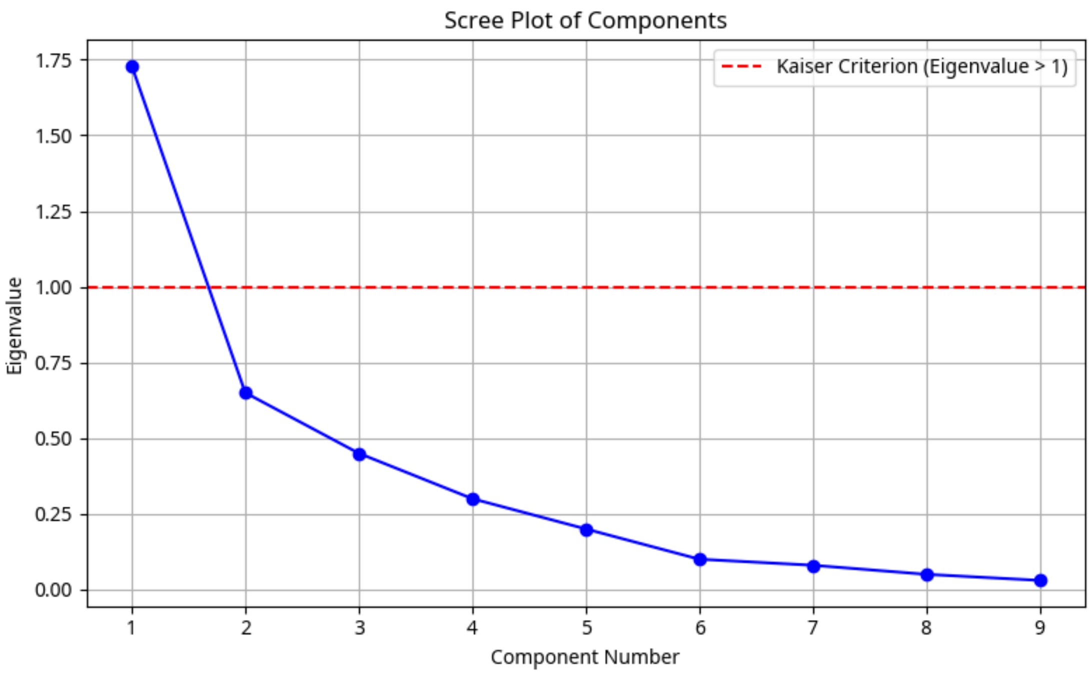

Figure 1: Scree Plot illustrating eigenvalues of factors.

Beyond the Scree Plot, the utilization of Path Diagrams can provide a powerful visual representation of the hypothesized relationships between observed variables and latent constructs within the framework of Confirmatory Factor Analysis (CFA). Such diagrams are instrumental in conceptualizing the proposed model and in visually assessing its fit to the empirical data.

4.3 Proposed Electrical OHS Management Model

Building upon the identified inhibiting factors, a strategic electrical OHS management model was meticulously developed. This model is structured into five interconnected phases, specifically designed to be practical and adaptable for SMEs, taking into account their unique resource constraints and operational characteristics.

4.4 Design of Electrical OHS Management Model in Small Industries

Table 5. Design of Electrical OHS Management Model.

Attribute Factors	No	Function	Electrical OHS Management Model Suggestion	Electrical OHS Level
Safety Behavior	1.1	Eliminate distraction and hazards caused by irregular power cord	Electrical Installation Repair according to Electrical OHS Standards	Electrical OHS Policy
	1.2	Ensuring workers work safely	Rules for using Personal Protective Equipment	Planning
	1.3	Minimizing Human Error	Training Program, especially the use of electrical risky tools	Electrical OHS Policy
Electrical OHS Expertise	2.1	Improve the special expertise of electrical OHS	Electrical OHS Training Program	Electrical OHS Policy
	2.2	Providespecial knowledge of the use of fire extinguishers	Training using fire extinguishers	Electrical OHS Policy
	2.3	Workers understand about electrical OHS violations	Electrical OHS standards according to electricalOHS laws	Electrical OHS Policy
Electrical OHS Motivation	3.1	Increasing company motivation to implement electricalOHS	Rewards from the Government for companies that implement electrical OHS	Implementation and Operation
	3.2	Continuous Improvement of Electrical OHS	Continuous Improvement of Electrical OHS	Audit and Evaluation
Electrical OHS Knowledge	4.1	Providing electrical OHS knowledge to the Company	Socialization Program by the Government	Electrical OHS Policy
	4.2	Create clear electrical OHS regulations	Written Electrical OHS Regulations	Planning
Electrical Risk Anticipation	5.1	Minimizing the impact of occupational accident	SOP Pre and Post Work	Planning
	5.2	Employees who have an accident get help immediately	First Aid Facilities	Implementation and Operation

Attribute Factors	No	Function	Electrical OHS Management Model Suggestion	Electrical OHS Level
	5.3	Improve employee skills in performing first aid in accidents	First Aid Training Program	Implementation and Operation
Electrical OHS Signs	6.1	Civilize Electrical OHS in the Company	Posters and Banners on Company walls	Implementation and Operation
	6.2	Increase alertness at work	Stickers on machines and places where there is an electrical hazard	Implementation and Operation
Electrical OHS Awareness	7.1	Raising company awareness of the electrical hazards	Legal sanctions for companies which do not implement the electrical OHS	Implementation and Operation
Electrical OHS Supervision	8.1	Person in Charge of Electrical OHS Supervision	Electrical OHS management consisting of company workers	Planning
Maintenance of Safety Equipment	9.1	Ensuring safety equipment is functioning normally	Schedule of safety equipment maintenance	Inspection

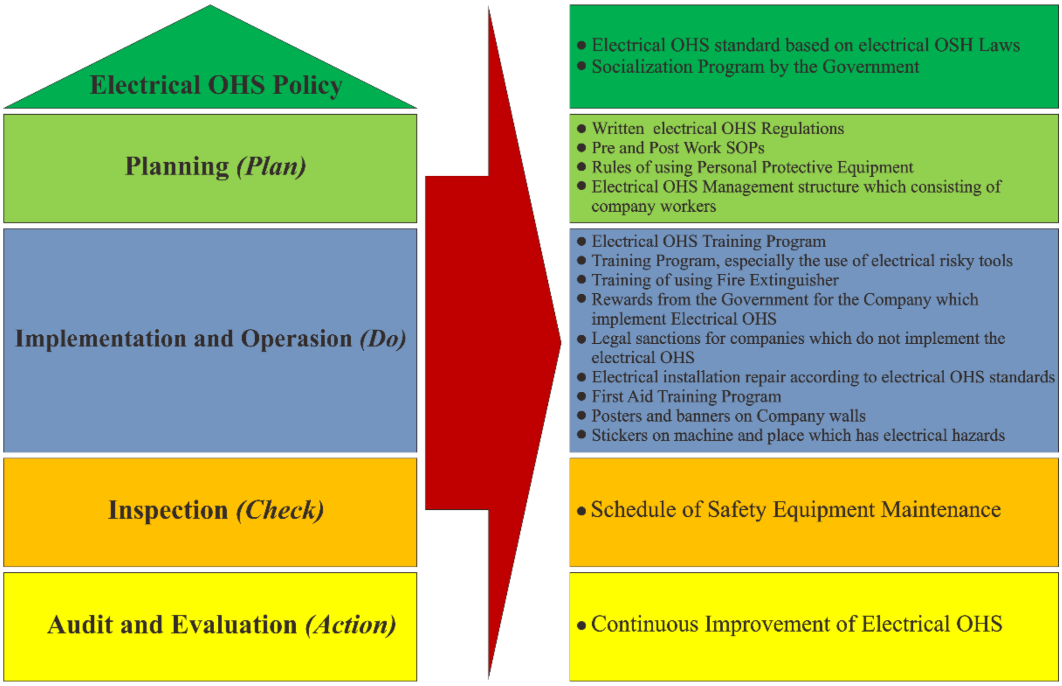

Figure 2. Electrical OHS Management Model in Small Industries.

5. Model Verification:

The proposed electrical OHS management model underwent a rigorous verification process involving both OHS experts and SME owners to ascertain its applicability and suitability for small industries. The verification utilized the Chi-square test to evaluate the homogeneity of responses and the perceived validity of the model's attributes.

As shown in Table 3, Verification by OSH experts and SME owners confirmed the model's applicability, with 92% agreement on its feasibility (Table 4). This aligns with Jan & Patrick's (2014) findings on worker-centric systems in resource-limited settings. These results exceed the thresholds recommended by Hair et al. (2010) for model validity, reinforcing the framework's practicality for SMEs in developing countries. This implies that the experts perceived the proposed elements of the model as relevant and necessary for effective electrical OHS management in SMEs. Similarly, the verification by SME owners also yielded statistically significant results for the majority of the model attributes, indicating that SME owners generally agreed with the practicality and feasibility of implementing the proposed model components within their operational contexts. The consistent positive feedback from both OHS experts and SME owners, supported by statistically significant Chi-square test results, confirms that the proposed electrical OHS management model is well-aligned with established safety standards and is practically implementable in small industries in Yogyakarta.

6. Conclusions

1. The study successfully identified nine critical factors that significantly impede the effective implementation of electrical Occupational Safety and Health (OSH) management within Small and Medium-sized Enterprises (SMEs). These factors include: unsafe behaviors exhibited by workers, a notable lack of specialized electrical OSH expertise, insufficient motivation among both management and employees to prioritize OSH, a general deficit in knowledge regarding electrical safety protocols, inadequate proactive measures for anticipating electrical risks, the absence of clear and standardized electrical safety signage, limited overall awareness concerning electrical OSH, the lack of a dedicated organizational structure or personnel responsible for electrical OSH management, and finally, poor or inconsistent maintenance of safety equipment.
2. Based on these identified inhibiting factors, a comprehensive and strategic electrical OSH management model was developed. This model is structured into five distinct, interconnected phases, designed to guide SMEs through a systematic approach to electrical safety. These phases encompass: the establishment of a clear Electrical OSH Policy (which includes adherence to legal electrical OSH standards and participation in government-led socialization programs); meticulous Planning (involving the creation of written electrical OSH regulations, detailed Standard Operating Procedures for pre- and post-work activities, guidelines for the proper use of Personal Protective Equipment, and the formation of an electrical OSH management structure composed of company employees); diligent Implementation and Operation (which includes electrical OSH training programs, specialized training for high-risk electrical equipment, fire extinguisher training, government incentives for compliant companies, legal sanctions for non-compliant companies, improvements to electrical installations to meet OSH standards, provision of First Aid Facilities, First Aid Training Programs, prominent display of Posters and Banners within company premises, and placement of Stickers on machinery and areas with electrical hazards); rigorous Inspection protocols (including scheduled maintenance of safety equipment); and continuous Audit and Evaluation processes (focused on fostering continuous improvement in electrical OSH practices).
3. Through a thorough verification process, it was concluded that the proposed strategic model for implementing electrical OSH management is both acceptable and practically applicable within the context of small manufacturing industries.

7. Recommendations

The strategic model presented in this research is specifically tailored for electrical OSH management within small-scale manufacturing industries. For future research endeavors, it is highly recommended to conduct further analyses to ascertain the broader applicability and effectiveness of this proposed model in industries beyond the manufacturing sector.

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