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The influence of Safety Culture on Safety Performance: The Mediating Role of the Safety Management System at Universal Plastic Factory PLC

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Abstract

This study examined the association between safety culture and safety performance, with the safety management system as a mediator, in Ethiopian plastic manufacturing. A quantitative, descriptive-correlational design was employed using cross-sectional data. The independent variable (safety culture), the mediator (safety management system), and the dependent variable (safety performance) were measured using scales adapted from Hajmohammad et al. (2014), McFadden et al. (2009), and Milijic et al. (2013) for safety culture, and Fernández-Muñiz et al. (2014) for safety management system and safety performance. A simple random sampling technique was used to select 123 employees from a population of 167 workers. Of these, 118 returned completed questionnaires, representing a 95.9% response rate. Data were analyzed using descriptive statistics, exploratory factor analysis, Pearson correlation, and multiple regression with Hayes' PROCESS Macro Model 4. Safety culture had a significant positive association with safety performance ($\beta = 0.505$, $p < 0.001$, $R^2 = 0.255$) and with the safety management system ($\beta = 0.484$, $p < 0.001$, $R^2 = 0.234$). The safety management system was significantly associated with safety performance ($\beta = 0.458$, $p < 0.001$, $R^2 = 0.210$). The indirect effect through the mediator was statistically significant (ab = 0.169, BootSE = 0.058, 95% CI [0.061, 0.287]), based on 5,000 bootstrap samples, confirming its mediating role.

Keywords: safety culture, safety performance, safety management system, mediation analysis, manufacturing industry

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Introduction

Occupational accidents and work-related diseases are a serious threat to people all over the world. They cause over 2300000 deaths worldwide every year, of which more than 350000 are occupational accidents, and over 2000000 deaths are related to work-related diseases (International Labour Organization [ILO], 2014). The industrial sector accounts for a disproportionate share of workplace occurrences, accounting for the majority of recorded accidents in many developing countries. Despite major technological advances and developments in preventive medicine, the ILO estimates that approximately 4% of global GDP is lost due to various direct and indirect costs such as compensation, medical expenses, property damage, lost earnings, and replacement training (World Health Organization [WHO], 1999).

In Ethiopia, occupational safety and health issues are extremely significant. Although safety culture-performance links are well established in developed economies, empirical evidence from Ethiopian manufacturing, particularly the plastic sector, remains scarce. Based on the information provided by the Ethiopian Ministry of Labor and Social Affairs (MOLSA, 2006), 66 establishments received reports of 1968 occupational accidents, among which 9 were fatal, and 1959 were non-fatal. The manufacturing industry was found to have the highest share of occupational accidents (56.05%), followed by the construction sector (22.25%), and agriculture, hunting, forestry, and fishing (20.58%).” These figures reflect broader national trends in the Ethiopian manufacturing sector. Table 1 summarizes the frequency and primary causes of accidents recorded at the Universal Plastic Factory PLC, Gerji, illustrating the localized need for enhanced safety culture and management systems (Ministry of Labour and Social Affairs [MOLSA], 2006).

Table 1

Number of accidents and causes at Universal Plastic Factory PLC, Gerji

Year (GC)	**Number: Types of Accidents**	
	Major	Minor
2017	3: Sever cut of thumb, falling down from height, slipping over stair	19: Finger cut, lower back pain, chemical splash to eye
2018	1: Electric shock	25: Finger cut, back lower pain, chemical splash to eye
2019	1: Sudden strike on head by a falling plastic crate	36: Finger cut, back lower pain, chemical splash to eye
2020	1: Serious lower back pain	26: Finger cut, back lower pain, chemical splash to eye
2021	0: None	13: Finger cut, back lower pain, chemical splash to eye

Source: Department of Quality, Health, Safety and Environment, Universal Plastic Factory PLC, Gerji, Addis Ababa, 2022

Despite Ethiopia's adoption of ILO Convention No. 155 on occupational safety and health in 1991 and the development of a national OSH policy in 2014, implementation issues remain at the company level (ILO). A lack of organizational-level policy declarations, along with inadequate awareness of current regulatory measures, remain key difficulties that must be addressed immediately (Kumie *et al*., 2010). Studies in Ethiopian industrial settings have found considerable occupational exposures and health concerns. Cotton dust concentrations in textile manufacturing were seventeen times higher than the US Occupational Safety and Health Administration's permissible exposure limits (Woldeyohannes *et al*., 1991). Respirable dust concentrations in cement manufacturing greatly surpassed the American Conference of Governmental Industrial Hygienists' recommended criteria, showing strong links between higher dust concentrations and respiratory symptoms (Zeleke *et al.,* 2011). Ergonomic risks, inadequate personal protective equipment use, and poor personal hygiene were identified as contributing factors to excessive exposures in the construction sector, with behavioral factors such as smoking and alcohol use serving as significant predictors of injury (Kifle *et al.,* 2014; Kumie *et al*., 2016).

Statement of the Problem and Research Gap

Occupational accidents and work-related diseases remain a serious global concern, causing over 2.3 million deaths annually, with the manufacturing sector bearing a disproportionate share of these incidents in developing countries (International Labour Organization [ILO], 2014). In Ethiopia, the manufacturing industry accounts for the highest share of reported occupational accidents (56.05%), followed by construction (22.25%) and agriculture (20.58%) (Ministry of Labour and Social Affairs [MOLSA], 2006). Despite this burden, empirical research on the organizational determinants of safety performance in Ethiopian manufacturing remains scarce.

International studies show that safety culture significantly predicts safety performance (Hajmohammad & Vachon, 2014; Fernández-Muñiz *et al*., 2014). Emerging evidence further suggests that safety management systems may function as a mediating mechanism through which safety culture influences safety performance (Fernández-Muñiz *et al.*, 2007; Wu *et al*., 2011). However, this mediated relationship has not been tested in the Ethiopian manufacturing context. In particular, no prior study has examined whether safety management systems mediate the relationship between safety culture and safety performance in Ethiopia's plastic manufacturing sector, characterized by high-risk production processes, heavy machinery, and chemical exposure.

Three specific gaps justify the present study. First, although the direct relationship between safety culture and safety performance is well documented internationally, no study has tested the mediating role of safety management systems in Ethiopia's plastic manufacturing sector. Existing Ethiopian studies have focused on occupational exposures and health outcomes (Kumie *et al.*, 2010; Woldeyohannes *et al*., 1991; Zeleke *et al*., 2011) rather than on the organizational mechanisms that link safety culture to safety performance. Second, this study is the first to apply Hayes' (2017) mediation framework using the PROCESS Macro Model 4 with bootstrapping to examine the safety culture–safety performance relationship in an Ethiopian industrial context. This methodological approach provides a more rigorous test of the indirect effect than the traditional Sobel test, which has been criticized for its low statistical power and reliance on normality assumptions (Hayes, 2017; MacKinnon *et al*., 1995). Third, the study provides a validated 13-item instrument (4 items for safety culture, 4 for safety management system, and 5 for safety performance) adapted from established international scales and validated for the Ethiopian industrial context. This instrument offers a practical tool for future researchers

and practitioners seeking to assess safety culture and safety performance in similar manufacturing settings.

By addressing these gaps, the present study contributes empirical evidence from a developing-economy context to the broader safety science literature. It extends existing theoretical models by demonstrating that safety management systems partially account for the relationship between safety culture and safety performance, and it provides a validated measurement instrument for future research. The findings are expected to inform organizational practice by identifying specific leverage points such as safety incentives, accountability mechanisms, and leadership commitment through which safety culture can translate into improved safety outcomes.

The specific objectives of this study are:

1. To examine the direct association between safety culture and safety performance.
2. To examine the association between safety culture and safety management systems.
3. To examine the association between safety management systems and safety performance.
4. To test whether safety management systems mediate the relationship between safety culture and safety performance.

Accordingly, the following hypotheses are proposed:

H1: Safety culture has a positive and significant influence on safety performance; **H2:** Safety culture significantly relates to the safety management system; **H3:** Safety management system significantly influences safety performance; **H4:** The combined association of safety culture and management system significantly predicts performance outcomes; and **H5:** Safety management system significantly mediates the relationship between safety culture and safety performance.

Operational Definitions

For the purposes of this study, the following key terms are defined as follows:

Safety Culture (SC) - Safety culture refers to the shared values, beliefs, attitudes, and behavioral norms about safety that are held collectively within an organization (Cooper, 2000; Turner *et al.,* 1989). In this study, safety culture was operationalized as employees' perceptions of management commitment to safety, employee involvement in safety, and peer reinforcement of safe behavior. The study measured it using a 4-item scale adapted

from Hajmohammad and Vachon (2014), McFadden *et al*. (2009), and Milijic *et al.* (2013), with responses recorded on a 5-point Likert scale (1 = Totally Disagree to 5 = Totally Agree). Higher scores indicate a stronger safety culture.

Safety Management System (SMS) - A safety management system refers to the formal, codified structures including policies, procedures, roles, responsibilities, training, communication, and audit mechanisms through which an organization manages safety (Mearns *et al*., 2003; Fernández-Muñiz *et al.*, 2014). In this study, SMS was operationalized as employees' perceptions of the formal safety structures in place at Universal Plastic Factory PLC, including safety feedback mechanisms, recognition of safe performance, safety incentives, and clear accountability. It was measured using a 4-item scale adapted from Fernández-Muñiz *et al.* (2014), with responses on a 5-point Likert scale. Higher scores indicate a more comprehensive safety management system.

Safety Performance (SP) - Safety performance refers to the observable outcomes of an organization's safety efforts, including both safety compliance (adherence to safety rules and procedures) and safety participation (engagement in safety-related activities) (Fernández-Muñiz *et al.,* 2014). In this study, safety performance was operationalized as employees' perceptions of the physical safety measures, protective equipment, safety signage, and the frequency and severity of accidents in the workplace. It was measured using a 5-item scale adapted from Fernández-Muñiz *et al.* (2014), with responses on a 5-point Likert scale. Higher scores indicate better safety performance.

Mediation - Mediation refers to a statistical relationship in which the effect of an independent variable (safety culture) on a dependent variable (safety performance) is transmitted, at least in part, through a third variable, the mediator (safety management system) (Hayes, 2017). In this study, mediation was tested using Hayes' (2017) PROCESS Macro Model 4 with bootstrapping (5,000 samples), and the indirect effect was considered significant if the 95% confidence interval did not include zero.

Occupational Safety and Health (OSH) - Occupational safety and health refers to the multidisciplinary field concerned with the prevention of work-related injuries, illnesses,

and fatalities, and the promotion of the physical, mental, and social well-being of workers (International Labour Organization [ILO], 2014).

Literature Review

Three theoretical perspectives inform the present study: Social Exchange Theory, Organizational Safety Theory, and the Resource-Based View of the Firm. Together, they provide the conceptual foundation for the hypothesized relationships among safety culture, safety management system, and safety performance.

Social Exchange Theory (Blau, 1964) posits that workplace relationships are governed by norms of reciprocity: when employees perceive that their organization cares about their well-being, they reciprocate with positive attitudes and behaviors. Applied to safety, this theory suggests that when employees perceive strong management commitment to safety, a core dimension of safety culture, they are more likely to comply with safety rules, participate in safety activities, and report hazards (Hajmohammad & Vachon, 2014). Social Exchange Theory thus explains why safety culture is expected to be positively associated with safety performance (H1).

Organizational Safety Theory (Reason, 1997) distinguishes between person factors (individual unsafe acts) and organizational factors (latent conditions such as inadequate procedures, poor communication, and insufficient training). Reason argued that organizational factors, not individual errors, are the primary causes of accidents in complex systems. This perspective provides the rationale for examining safety management systems as a formal organizational mechanism: safety management systems represent the codified structures through which organizations address latent conditions (Mearns *et al*., 2003). Organizational Safety Theory thus grounds the expected association between safety management systems and safety performance (H3).

The Resource-Based View (Barney, 1991) holds that intangible organizational resources such as shared values, norms, and culture shape the development of formal capabilities, which in turn produce performance outcomes. Applied to safety, the resource-based view implies that an organization's safety culture shapes the comprehensiveness and effectiveness of the safety management system it develops, which is subsequently associated with safety performance (Fernández-Muñiz *et al.*, 2007; Wu *et al.*, 2011). This perspective provides the theoretical basis for the hypothesized sequential relationship: culture → system → performance (H2 and H4).

Empirical Evidence and Hypothesis Development

H1: Safety Culture and Safety Performance

A substantial body of empirical research has established a positive association between safety culture and safety performance. In a study of 251 Canadian manufacturing facilities, Hajmohammad and Vachon (2014) found that safety culture was positively associated with safety performance, mediated by safety practices and procedures. Similarly, in a study of 455 Spanish enterprises, Fernández-Muñiz *et al*. (2014) reported that safety culture, operationalized as safety leadership and management commitment, was significantly related to safety performance. More recently, Uddin *et al.* (2021) found consistent results in Ethiopian manufacturing industries, reporting strong associations between cultural safety attitudes and organizational safety outcomes.

However, some studies have reported weaker or more complex relationships. For example, Mearns *et al.* (2003) found that safety climate was associated with safety performance in offshore environments, but the strength of the relationship varied by job role and organizational level. These inconsistent findings suggest that the culture-performance link may be indirect, motivating the examination of mediating mechanisms.

H2: Safety Culture and Safety Management System

Safety culture is a key driver of safety management system implementation and effectiveness. Wu *et al.* (2011) found that establishing a safety culture is a critical prerequisite for implementing safety management systems in petrochemical industries. Similarly, Beauvais *et al.* (2019) and Kim *et al.* (2019) reported that safety culture motivates organizations to adopt more comprehensive safety management practices. Fernández-Muñiz *et al.* (2007) found that management commitment to safety was positively associated with the adoption of safety management systems in Spanish enterprises.

These findings are consistent with the resource-based view: organizations that prioritize safety values tend to allocate resources to formal safety structures. However, the strength of this association may vary by industry and regulatory context, and no study has tested it in the Ethiopian plastic manufacturing sector.

H3: Safety Management System and Safety Performance

A substantial body of research has demonstrated that safety management systems are positively associated with safety performance. Bottani *et al.* (2009) found that firms with formal safety management systems outperformed those without them across multiple safety indicators. Hong *et al.* (2018) reported similar findings in the Malaysian manufacturing sector, showing that internal control and critical success factors within safety management systems were associated with improved safety performance. Fernández-Muñiz *et al.* (2014) found that safety management systems, including planning, policy, training, and communication, were significantly related to safety performance in Spanish firms.

Some studies reported that the effectiveness of safety management systems depends on the extent to which they are integrated with organizational culture. For example, Sorensen (2002) argued that codified safety systems are necessary but not sufficient for superior safety outcomes; their effectiveness depends on employee engagement and cultural support.

H4: Mediating Role of Safety Management System

Several studies have examined the safety management system as a mediating mechanism in the culture-performance relationship. Hajmohammad and Vachon (2014) found that safety practices and procedures mediated the link between safety culture and safety performance at the organizational level. Fernández-Muñiz *et al.* (2007) found that safety management systems mediated the association between management commitment to safety and safety performance in Spanish enterprises. McFadden *et al.* (2009) reported similar mediating effects in healthcare organizations.

These findings suggest that safety culture is associated with safety performance both directly and indirectly through the formal structures and processes of the safety management system.

However, the proportion of the total effect mediated may vary across contexts, and no study has tested this mediation model in Ethiopia's manufacturing sector.

Safety Culture vs. Safety Climate

A critical conceptual distinction must be made between safety culture and safety climate. Safety culture refers to the underlying shared values, beliefs, and assumptions

about safety that guide behavior within an organization (Cooper, 2000; Turner *et al.*, 1989). It is relatively stable, deeply embedded, and difficult to change. Safety climate, by contrast, refers to employees' shared perceptions of safety at a given point in time (Zohar, 1980). It is more surface-level, measurable through surveys, and subject to change.

The present study measures safety culture at the organizational level, focusing on management commitment, employee involvement, and peer reinforcement. Some studies cited in this review (e.g., Mearns *et al.*, 2003; Wu *et al.*, 2011) used measures of safety climate. These studies are cited as supporting evidence because climate and culture are conceptually related and often used interchangeably in the applied safety literature (Cooper, 2000). However, the present study explicitly adopts the culture perspective and acknowledges that the two constructs are not identical.

Conceptual Framework

The conceptual framework for this study (Figure 1) illustrates the hypothesized relationships between the variables. In this model, safety culture serves as the independent variable, while safety performance is the primary dependent variable to be explained. Furthermore, the model specifies the safety management system as a mediating variable, meaning that safety culture is hypothesized to be associated with safety performance both directly and indirectly through the safety management system. This specification is grounded in the resource-based view of the firm (Barney, 1991) and prior empirical evidence (Fernández-Muñiz *et al.*, 2007; Wu *et al*., 2011).

Rationale for the Mediation Model

The decision to model the safety management system as a mediator rather than as a moderator, a component of safety culture, or a parallel predictor rests on four theoretical arguments. First, safety culture and safety management system are conceptually distinct: safety culture refers to the informal, values-based shared beliefs and assumptions about safety (Cooper, 2000; Turner *et al*., 1989), while safety management system refers to the formal, codified structures such as policies, procedures, roles, training, and audit mechanisms through which safety is managed (Mearns *et al.*, 2003; Fernández-Muñiz *et al.*, 2014). Because one is values-based and the other is structure-based, they cannot be treated as components of a single construct. Second, theory specifies a directional sequence from culture to system to performance. The resource-based view holds that

intangible organizational resources such as shared safety values shape the development of formal organizational capabilities, which in turn produce performance outcomes (Barney, 1991). Applied to safety, this logic implies that an organization's safety culture shapes the comprehensiveness of its safety management system, which subsequently associated with safety performance (Paul & Maiti, 2007). Third, mediation is more defensible than moderation because the proposed mediator is itself an outcome of the independent variable: organizations that prioritize safety values tend to establish more comprehensive safety management structures (Fernández-Muñiz *et al.*, 2007; Wu *et al*., 2011). A moderator, by contrast, would not be caused by the predictor. Fourth, the safety management system is not a parallel predictor of safety performance, because prior evidence shows that safety culture motivates the implementation of safety management systems (Beauvais *et al*., 2019; Kim *et al*., 2019), which in turn influence safety performance (Hajmohammad & Vachon, 2014). This sequential logic, culture → system → performance, is the defining feature of mediation.

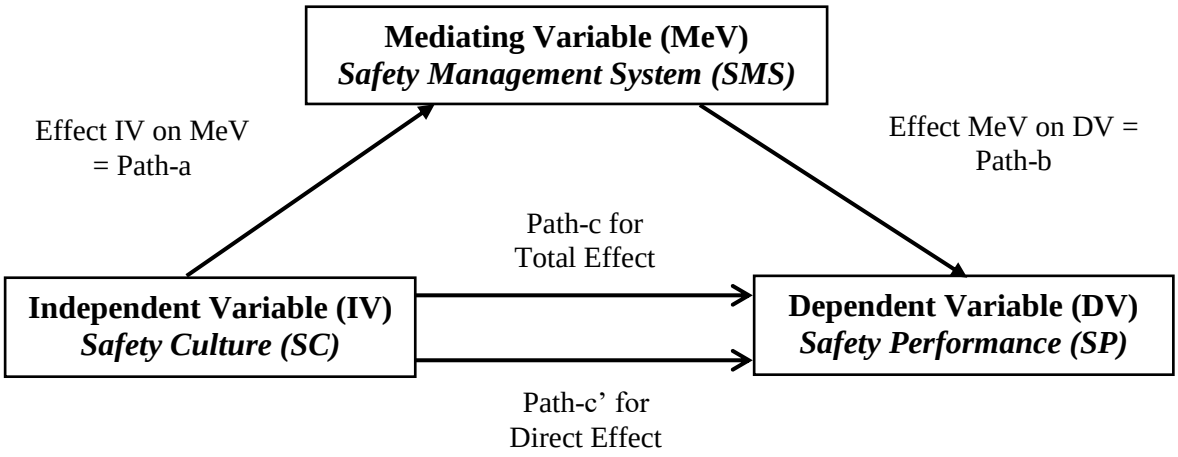
The study uses a cross-sectional design, which cannot establish temporal sequence among the variables. While the mediation model is theoretically justified, the cross-sectional data cannot empirically resolve whether safety culture precedes the safety management system, whether the reverse is true, or whether the relationship is reciprocal. Paul and Maiti (2007) explicitly noted the possibility of reciprocal relationships between cultural and systematic elements of organizational safety. This limitation is acknowledged, and longitudinal or experimental designs are recommended for future research to establish causal ordering.

The hypothesized relationships are summarized in Figure 1. The model specifies:
A direct path from safety culture to safety performance **(H1)**
A path from safety culture to safety management system **(H2)**
A path from safety management system to safety performance **(H3)**
An indirect path from safety culture to safety performance through the safety management system (H4)

The mediation analysis follows the Hayes (2017) framework using the PROCESS Macro Model 4 with bootstrapping, which provides a more rigorous test of the indirect effect than the traditional Sobel test (MacKinnon et al., 1995).

Figure 1

Conceptual model for safety management system mediates between safety culture and safety performance



Methods

This study employed a descriptive-correlational design using cross-sectional data. The cross-sectional design means that data were collected at a single point in time. The descriptive component was used to summarize demographic characteristics and variable distributions, while the correlational component was used to examine associations among safety culture, safety management system, and safety performance.

This design is appropriate for the study's objectives for three reasons. First, the study tests directional hypotheses about associations among variables, which requires quantitative measurement and inferential statistics. Second, the mediation model specifies a sequential relationship (culture → system → performance) that can be tested statistically using the Hayes (2017) PROCESS Macro Model 4. Third, the descriptive component provides a profile of the study context, an Ethiopian plastic manufacturing firm, which contributes to the interpretation of the findings.

A quantitative approach was selected because the study required numerical data on standardized scales, statistical estimation of associations, and formal hypothesis testing. Data were collected through closed-ended questionnaire items, allowing for the quantification of variables and the statistical examination of relationships among the constructs studied (Kothari, 2004).

The descriptive component aided in the systematic analysis of variable relationships, whilst the correlational design allowed for the statistical identification of the correlations between safety culture and organizational safety performance (Kothari, 2004). A quantitative research approach was used to gather and evaluate numerical data via closed-ended questions, allowing for the quantification of variables and interpretation of statistical correlations between the constructs studied.

Sample and Sampling Procedure

Population

The target population for this study consisted of all 167 employees of Universal Plastic Factory PLC, located in Gerji, Addis Ababa, Ethiopia. This population included employees across all departments (production, quality, safety, store/supply chain/procurement, human resources, finance, marketing/sales, and maintenance) and all job levels (machine operators, engineers, safety officers, managers, supervisors/team leaders, technicians, and administrative staff). Employees were included if they had at least one year of work experience at the factory, which ensured sufficient familiarity with the organization's safety culture and safety management system. The population size was confirmed by the Human Resources Department of Universal Plastic Factory PLC in May 2022.

Sample Size Determination

The sample size was determined using Taro Yamane's formula (Yamane, 1967), which is widely applied in social science research for finite populations at a 95% confidence level and a 5% precision level. The formula is: $n = \frac{N}{1+N(e)^2}$, where n is the required sample size, N is the population size (167), and e is the level of precision (0.05) . Applying this formula to a population of 167 employees yielded a sample size of approximately 118. This sample size exceeds the minimum requirement for multiple regression analysis, which is N > 50 + 8m, where m is the number of predictors (Tabachnick & Fidell, 2001). With two predictors (safety culture and safety management system), the minimum required sample is 66. The obtained sample of 118 is therefore more than adequate for the planned statistical analyses.

Sampling Technique

A simple random sampling technique was used to select participants. Each of the 167 employees on the HR roster was assigned a unique number, and a random selection was made to identify 123 participants. This method ensures that every employee has an equal probability of selection. All 167 employees on the HR roster had at least one year of work experience, so the inclusion criterion did not restrict the sampling frame and did not affect the random selection procedure.

Although the population of 167 is relatively small, sampling was necessary for three practical reasons. First, the factory operates on a continuous production schedule with shift-based work, which limits the number of employees available at any given time. Second, resource and time constraints prevented the researcher from administering questionnaires to the entire workforce within the study period. Third, the Yamane (1967) formula provides a statistically justified sample size that is representative of the population. The sample of 118 represents 70.6% of the total population, which is a high coverage rate for survey research.

Data Collection and Response Rate

Questionnaires were administered to 123 employees. Of these, 118 completed questionnaires were returned, representing a response rate of 95.9%. The final sample therefore consisted of 118 respondents. The response rate is consistent with the high participation rates typically observed in face-to-face survey administration within a single organization (Saunders *et al*., 2009).

Population Characteristics

The target population consisted of 167 employees of Universal Plastic Factory PLC. The sample of 118 respondents represented 70.6% of the population, a high coverage rate for survey research. The characteristics of both the population and the sample are presented in Table 5.

Data Collection Instrument

Primary data were gathered using a structured, self-administered questionnaire. The questionnaire was developed by adapting established instruments from safety management research (Makhamara & Simiyu, 2016). It consisted of four sections: (a) demographic information, (b) safety culture, (c) safety management system, and (d)

safety performance. All construct items were measured on a five-point Likert scale ranging from 1 (Totally Disagree) to 5 (Totally Agree). The five-point format was chosen for its simplicity, efficiency, neutral response option, low margin of error, and consistency with accepted benchmarks in survey research (Joshi *et al.*, 2015).

Safety Culture Scale

Safety culture was measured using 8 items adapted from three established sources: Hajmohammad and Vachon (2014), McFadden *et al.* (2009), and Milijic *et al.* (2013). The items examined safety culture at the organizational level, focusing on management commitment to safety, employee involvement, peer reinforcement of safe behavior, and adherence to safety rules. These dimensions are closely aligned with the theoretical criteria of safety culture identified by Cooper (2000).

The original reliability and validity of the source scales were as follows. Hajmohammad and Vachon (2014) reported a Cronbach's alpha of .89 for their safety culture measure in a study of 251 Canadian manufacturing facilities and demonstrated convergent validity through factor analysis. McFadden *et al.* (2009) reported a Cronbach's alpha of .91 for their safety culture scale in a study of 238 U.S. hospitals, with all items loading above .60 on a single factor. Milijic *et al.* (2013) reported a Cronbach's alpha of .86 for their safety climate questionnaire in a study of 463 Serbian industrial workers, with factor analysis confirming a clear dimensional structure. These reliabilities exceed the commonly accepted threshold of .70 (Nunnally & Bernstein, 1994), supporting their use in the present study.

Safety Management System Scale

The safety management system was measured using 5 items adapted from Fernández-Muñiz *et al.* (2014). These items were drawn from a 29-item instrument that originally covered six dimensions: planning, policy, training, communication, incentives, and control. The five items selected for this study focused on safety feedback mechanisms, recognition of safe performance, safety incentives, clear accountability, and management emphasis on safety, the dimensions most relevant to the Ethiopian manufacturing context.

The original reliability and validity of the source scale were as follows. Fernández-Muñiz *et al.* (2014) reported a Cronbach's alpha of .88 for the full safety

management system scale in a study of 455 Spanish enterprises. Confirmatory factor analysis confirmed a clear six-factor structure with acceptable fit indices (CFI = .92, RMSEA = .06). The scale demonstrated convergent validity through significant correlations with safety performance measures and discriminant validity through low correlations with unrelated constructs. These psychometric properties support the use of the adapted items in the present study.

Safety Performance Scale

Safety performance was measured using 7 items adapted from Fernández-Muñiz *et al.* (2014). The items assessed employees' perceptions of physical safety measures (machinery safeguards, electrical safety, ventilation), availability of personal protective equipment, safety signage, and the frequency and severity of workplace accidents.

The original reliability and validity of the source scale were as follows. Fernández-Muñiz *et al.* (2014) reported a Cronbach's alpha of .86 for their safety performance scale in a study of 455 Spanish enterprises. Factor analysis confirmed a unidimensional structure with all items loading above .55. The scale demonstrated convergent validity through its significant relationship with safety management system measures and discriminant validity through its distinct factor structure. These psychometric properties support using the adapted items in the present study.

Summary of Scales

Table 2 summarizes the source, number of items, and original reliability of each scale:

Table 2

Summary of Measurement Scales

Construct	Source	Items in Original Scale	Items Adapted	Original Cronbach's Alpha
Safety Culture (SC)	Hajmohammad & Vachon (2014); McFadden *et al.* (2009); Milijic *et al.* (2013)	8, 5, 6	8	.89, .91, .86
Safety Management System (SMS)	Fernández-Muñiz *et al.* (2014)	29	5	.88
Safety Performance (SP)	Fernández-Muñiz *et al.* (2014)	7	7	.86

The final number of items after reliability and validity testing in the present study was 4 for SC, 4 for SMS, and 5 for SP (see Results).

Data Collection Procedure

Questionnaires were administered to participants face-to-face to allow clarification of any confusing items and to ensure that all items are answered. This approach could maximize the response rate and minimize errors due to participants' willingness to cooperate (Saunders *et al*., 2009). The questionnaire was pilot tested among ten employees working in the production department to identify any flaws and evaluate the instrument's face validity. To minimize potential response bias and ensure data consistency, the distribution and retrieval process was finalized within a single week, with non-respondents replaced by contacting new employees from the population to guarantee the goal sample size of 118 completed questionnaires was met.

Data were collected by the researcher with two trained data collection assistants over two weeks (May 1-15, 2022) at the factory premises during working hours. Each questionnaire took 15-20 minutes. Non-respondents were replaced within the same week.

Data analysis

The data were analyzed using IBM SPSS Statistics version 24 in several stages (Zikmund *et al.,* 2010). The first step used descriptive statistics such as frequencies, percentages, means, and standard deviations to examine the frequency distributions of demographic variables. Cronbach's alpha was used to assess internal consistency reliability. Values of .70 or above were considered acceptable, consistent with standard practice in social science research (Nunnally & Bernstein, 1994; Pallant, 2020).

Pearson's correlation analysis was used to examine the data for the presence of bivariate correlations and multicollinearity, and to evaluate the strength and direction of relationships among variables. According to Hair et al. (2014), no independent variables can have a value of $r > 0.90$. In addition, the authors used Cohen's (1988) criteria to determine the correlation strength, which are as follows: small ($r = 0.10 - 0.29$), medium ($r = 0.30 - 0.49$), and large ($r = 0.50 - 1.0$).

Multiple linear regression was used to determine the extent to which safety culture (X_1) and safety management system (X_2) predicted safety performance (Y). The regression equation is: Safety Performance = 1.051 + 0.464(Safety Culture) + 0.267(Safety Management System).

The Hayes' (2017) Process macro version 4.0 was employed to calculate regression analysis, which includes mediators and variables. Specifically, model 4 was applied to determine whether the safety management system mediated the relationship between safety culture and performance. Accordingly, mediation analysis consists of the following four steps: "(1) the independent variable significantly predicts the mediator; (2) the independent variable also predicts the outcome variable; (3) the mediator significantly predicts the outcome variable; and (4) the association of the independent variable on the outcome variable is reduced when the mediator is entered into the model" (MacKinnon *et al.*, 1995, p. 22).

Common Method Bias

Because all three constructs were measured using the same questionnaire, at the same time, from the same respondents, common method bias was a potential concern. Harman's single-factor test was conducted to assess this. The results showed that the first factor accounted for 43.98% of the variance, which is below the 50% threshold, suggesting that common method bias is not a serious concern (Podsakoff *et al*., 2003).

However, it is acknowledged that Harman's test is a relatively weak diagnostic, and future research should use stronger tests such as the marker variable technique or a full collinearity assessment.

Validity and reliability Assessment

Preliminary scale refinement used inter-item correlation (IIC) and corrected item-total correlation (CITC) to identify items that did not meet threshold criteria. Initially, the measurement scales consisted of eight items for safety culture (SC), five items for safety management system (SMS), and seven items for safety performance (SP). Following CITC analysis, four SC items, one SMS item, and two SP items were removed because their corrected item-total correlations fell below the threshold of .30, indicating that they did not contribute adequately to the internal consistency of their respective scales. The final scales therefore contained four SC items, four SMS items, and five SP items, resulting in a total of 13 items. The removal of items may reduce content validity, as the retained items may not fully capture all dimensions of the original constructs. This limitation is addressed in the Limitations section, and future research should validate the shortened scales with larger samples.

Internal consistency reliability was then assessed using Cronbach's alpha coefficient. According to Nunnally and Bernstein (1994), values of .70 or above indicate acceptable internal consistency. In this study, all scales met this criterion. Cronbach's alpha was highest for safety performance ($\alpha = .871$), followed by safety culture ($\alpha = .843$) and safety management system ($\alpha = .762$). These values indicate good to excellent internal consistency reliability for all three scales.

To assess construct validity, an Exploratory Factor Analysis (EFA) was performed using Principal Component Analysis (PCA) with Varimax rotation. PCA was selected as a data-reduction technique to identify the underlying factor structure and compute composite scores for subsequent regression analysis (Hair *et al*., 2014). The suitability of the data for factor analysis was assessed using the Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy and Bartlett's test of sphericity. The KMO value was 0.815, which exceeds the recommended minimum of 0.50, indicating that the sample size was adequate for factor analysis (Kaiser & Rice, 1974). Bartlett's test of sphericity was statistically significant ($\chi^2 = 879.718$, $df = 78$, $p < .001$), confirming that the correlation matrix was not an identity matrix and that factor analysis was appropriate.

Factors were extracted based on eigenvalues greater than 1.0, and items were retained if they had factor loadings of .50 or above and communalities of .50 or above (Hair *et al*., 2014). Three factors were extracted, explaining 68.10% of the total variance. In particular, safety performance explained the largest proportion of variance (43.98%), followed by safety culture (13.25%) and safety management system (10.87%). All items loaded on their intended factors without cross-loadings exceeding .40, providing preliminary evidence of convergent and discriminant validity. Factor loadings ranged from .595 to .844, and communalities ranged from .595 to .844, meeting the minimum criteria.

However, it is acknowledged that PCA is primarily a data-reduction procedure rather than a latent factor model, and that EFA alone cannot fully confirm construct validity (Hair *et al.*, 2014). Confirmatory Factor Analysis (CFA) was not conducted in this study. This is acknowledged as a limitation, and CFA with a larger, independent sample is recommended for future research to confirm the factor structure and to establish convergent and discriminant validity through standardized factor loadings, Composite Reliability (CR), Average Variance Extracted (AVE), and the Heterotrait-Monotrait (HTMT) ratio.

Table 3 presents the reliability results for the final 13-item scale. The corrected item-total correlations ranged from .529 to .845, all exceeding the threshold of .30. Cronbach's alpha values were .809 for safety culture, .762 for safety management system, and .871 for safety performance, all exceeding the recommended minimum of .70 (Nunnally & Bernstein, 1994).

Table 3

Reliability test for SC, SMS, and SP

Items	SMID	SVID	CITC	CAID	Alpha
Safety Culture (SC)					
SC2	19.59	8.773	0.651	0.815	0.809
SC3	19.40	7.592	0.732	0.794	
SC4	19.42	7.751	0.698	0.802	
SC5	19.28	8.511	0.546	0.833	
Safety Management System (SMS)					
SMS2	11.01	5.137	0.529	0.722	0.762
SMS3	11.51	4.150	0.578	0.708	
SMS4	10.87	4.796	0.621	0.673	
SMS5	10.82	5.532	0.553	0.717	
Safety Performance (SP)					
SP1	15.44	7.377	0.739	0.834	0.871
SP2	15.54	7.156	0.673	0.851	
SP3	15.69	6.354	0.845	0.804	
SP4	15.47	7.875	0.668	0.851	
SP5	15.22	8.122	0.577	0.871	

Note(s): SMID= Scale Mean if Item Deleted, SVID=Scale Variance if Item Deleted, CITC=Corrected Item-Total Correlation, CAID=Cronbach's Alpha if Item Deleted

Source: Computation (SPSS-24) based on data gathered from the author's fieldwork, 2022

Table 4 presents the rotated component matrix for the final 13-item scale. All items loaded on their intended factors with loadings ranging from .595 to .844, and communalities from .529 to .832, meeting the minimum criterion of .50 (Hair *et al.*, 2014). No cross-loadings exceeded .40. The three factors explained 68.10% of the total variance.

Table 4

Rotated component matrix for SC, SMS, and SP

Item Code	Factor Loading			Communalities
	1	**2**	**3**	**> 0.5**
Safety Performance (SP)				
SP4	0.840			0.736
SP3	0.813			0.832
SP5	0.787			0.672
SP1	0.714			0.684
SP2	0.618			0.642
Safety Management System (SMS)				
SMS3		0.831		0.728
SMS4		0.752		0.584
SMS5		0.621		0.626
SMS2		0.613		0.529
Safety Culture (SC)				
SC4			0.844	0.766
SC5			0.828	0.725
SC3			0.631	0.724
SC2			0.595	0.605
Alpha	0.871	0.762	0.809	>0.7
Eigenvalues	5.718	1.723	1.413	>0.7
% Variance	43.982	13.251	10.870	
Cumulative %	43.982	57.233	68.102	>50%

Note(s):

- KMO and Bartlett's Test: Kaiser-Meyer-Olkin Measure of Sampling Adequacy=0.815>0.5
- Bartlett's Test of Sphericity: Approx. Chi-Square=879.718, Degree of freedom (df)=78, Significance (Sig.) =0.000
- Extraction Method: Principal component analysis
- Rotated Method: Varimax with Kaiser normalization

Source: Computation (SPSS-24) based on data gathered from the author's fieldwork, 2022

Ethical Considerations

This study was conducted in accordance with established ethical standards for research involving human participants. A formal letter of cooperation was issued by the Office of Students' Affairs and Alumni Services at Unity University and was submitted to Universal Plastic Factory PLC and the Ministry of Labour and Social Affairs to obtain permission for data collection.

Participation in the study was entirely voluntary. All participants were informed of the purpose of the study, the expected time commitment, and their right to withdraw at any time without penalty.

Confidentiality and anonymity were assured. No personal identifying information (such as names, employee identification numbers, or contact details) was collected. Completed questionnaires were stored securely and were accessible only to the researcher. Data were reported only in aggregate form, and no individual responses can be identified in this manuscript.

The study did not involve any harmful procedures, deception, or risks to participants' physical or psychological well-being. The questionnaire items focused on perceptions of workplace safety, which posed no foreseeable harm to participants.

Results

This study examined the association between safety culture and safety performance at Universal Plastic Factory PLC in Addis Ababa, with the safety management system as a mediator. Five-point Likert scale questionnaires were administered to 123 respondents, and 118 questionnaires were returned, representing a response rate of 95.9%. The final sample consisted of 118 respondents. After ensuring that all the data met the required assumptions for this study, five hypotheses were tested using multiple regression analysis procedures with SPSS version 24.

The demographic profile shows respondents' demographic information. The respondents who participated in this study were mainly males (78.8%, n = 93) and females (21.2%, n = 25). In terms of age distribution, most of the respondents (83.9%, n = 99) were in the age bracket of 26-35 years, followed by those aged 36-45 years (10.2%, n = 12). On the other hand, 5.1% (n = 9%) of the respondents were aged 18-25 years, while 0.8% (n = 1%) were over 46 years. In terms of educational qualification, 89.8% (n =

106%) of the respondents had a higher secondary/diploma/TVET certificate, and 10.2% (n = 12) had a bachelor's degree.

As far as the work experience of the respondents is concerned, the highest proportion of the respondents (47.5%, n = 56) had 5-8 years of experience, followed by those with 9-12 years of work experience (36.4%, n = 43). On the contrary, 10.2% (n = 12) of the respondents had 1-4 years of work experience, while 5.9% (n = 7) of them had more than 13 years of work experience. Summary of the respondents' demographic information is presented in Table 5 below.

Table 5

Respondents' profiles, N=118

Item	Respondent Characteristics	Frequency	Percent
Sex	Male	93	78.8
	Female	25	21.2
Age (Years)	18-25 years	9	7.6
	26-35 years	96	81.3
	36-45 years	12	10.2
	Above 46 years	1	0.8
Educational Status	Higher Secondary/ Diploma/ TVET	106	89.8
	First Degree	12	10.2
Job position	Machine Operator	10	8.5
	Safety Officer	1	0.8
	Manager	3	2.5
	Supervisor/ Team Leader	2	1.7
	Technician Maintenance	1	0.8
	Others (Factory workers, Security guards, Loading & unloading workers, Store workers)	101	85.6
Department	Production	99	83.9
	Quality	1	0.8
	Store/ Supply Chain / Procurement	2	1.7
	Human Resource	10	8.5

	Finance	3	2.5
	Marketing/Sales	1	0.8
	Maintenance	2	1.7
Work Experience (Years)	1-4 years	12	10.2
	5-8 years	56	47.5
	9-12 years	43	36.4
	Above 13 years	7	5.9
Training	ISO	6	5.1
	Safety Meeting	111	94.1
	No Training	1	0.8

Note. ISO = International Organization for Standardization; TVET = Technical and Vocational Education and Training.

Source: Computation (SPSS-24) based on data gathered from the author's fieldwork, 2022

Descriptive statistics

The mean scores (M) for all variables exceeded the midpoint of the five-point Likert scale, suggesting that respondents had a high degree of agreement. Specifically, the overall mean score (M) for safety culture was 3.93 (SD = 0.703), with the item "Employees encourage each other to report any safety concerns they might have" having the highest score (M = 4.08, SD = 0.786). In turn, the overall mean score (M) for the safety management system was 3.69 (SD = 0.921), with the item "Site managers and field personnel place importance on safety" having the highest score (M = 3.92, SD = 0.758). Finally, the overall mean score (M) for safety performance was 3.86 $\alpha = 0.826$, with the item "Company establishes safety and health labels/signage/symbols in the workplace" having the highest score (M = 4.12, SD = 0.753). Thus, it can be concluded that all mean scores were in the range of 3.41 - 4.20, suggesting a high degree of agreement.

Correlation Analysis

Relationship Between Safety Culture and Safety Performance (H1)

H1: Safety culture is positively associated with safety performance.

Pearson correlation analysis revealed a positive and statistically significant association between safety culture and safety performance ($r = .505$, $p < .01$). This was the strongest

bivariate association among the study variables, indicating that employees who perceived a stronger safety culture also reported higher safety performance.

Simple linear regression was used to test H1. The model was statistically significant, $F(1, 116) = 39.682$, $p < .001$, and safety culture accounted for 25.5% of the variance in safety performance ($R^2 = .255$). The standardized regression coefficient was $\beta = .505$ ($t = 6.299$, $p < .001$), indicating a moderate-to-strong positive association. H1 was supported.

Relationship Between Safety Culture and Safety Management System (H2)

H2: Safety culture is positively associated with the safety management system. Pearson correlation analysis revealed a positive and statistically significant association between safety culture and safety management system ($r = .484$, $p < .01$), indicating that employees who perceived a stronger safety culture also reported a more comprehensive safety management system.

Simple linear regression was used to test H2. The model was statistically significant, $F(1, 116) = 35.414$, $p < .001$, and safety culture accounted for 23.4% of the variance in the safety management system ($R^2 = .234$). The standardized regression coefficient was $\beta = .484$ ($t = 5.951$, $p < .001$), indicating a moderate positive association. H2 was supported.

Relationship Between Safety Management System and Safety Performance (H3)

H3: Safety management system is positively associated with safety performance. Pearson correlation analysis revealed a positive and statistically significant association between safety management system and safety performance ($r = .458$, $p < .01$), indicating that employees who perceived a more comprehensive safety management system also reported higher safety performance.

Simple linear regression was used to test H3. The model was statistically significant, $F(1, 116) = 30.803$, $p < .001$, and safety management system accounted for 21.0% of the variance in safety performance ($R^2 = .210$). The standardized regression coefficient was $\beta = .458$ ($t = 5.550$, $p < .001$), indicating a moderate positive association. H3 was supported.

Mediating Role of Safety Management System (H4)

H4: Safety management system mediates the association between safety culture and safety performance.

To test H4, the Hayes (2017) PROCESS Macro Model 4 was used with 5,000 bootstrap samples. The total effect of safety culture on safety performance was statistically significant (B = 0.633, t = 6.299, p < .001), as was the direct effect after controlling for safety management system (B = 0.464, t = 4.193, p < .001). The indirect effect of safety culture on safety performance through safety management system was also statistically significant (ab = 0.169, BootSE = 0.058, 95% CI [0.061, 0.287]). Because the confidence interval did not include zero, the indirect effect was confirmed. The indirect pathway accounted for approximately 26.7% of the total effect (VAF = 26.7%). H4 was supported.

The bivariate correlation results for all study variables are displayed in Table 6.

Table 6

Correlations analysis of SC, SMS, and SP, N=118

Variables	**SC**	**SMS**	**SP**
Safety Culture (SC)	1		
Safety Management System (SMS)	0.484** 0.000	1	
Safety Performance (SP)	0.505** 0.000	0.458** 0.000	1

Note: **. Correlation is significant at the 0.01 level (2 tailed).

Source: Computation (SPSS-24) based on data gathered from author's field work, 2022

Regression Assumptions

Four hypotheses were tested using multiple regression analysis procedures with SPSS version 24 and Hayes' (2017) PROCESS Macro Model 4. The regression assumptions were tested before hypothesis testing and are reported in the regression assumptions subsection below.

Sample Size Adequacy

The study sample size (N = 118) exceeded the minimum sample size recommended by Tabachnick and Fidell (2001): N > 50 + 8m, where m is the number of predictors. With two predictors (safety culture and safety management system), the minimum required sample was 66. The obtained sample of 118 is therefore more than adequate for multiple regression analysis. Assumption met.

Multicollinearity

Multicollinearity was assessed using two indicators: Variance Inflation Factor (VIF) and tolerance. According to Hair *et al.* (2014), VIF values should be below 10, and tolerance values should be above 0.10. The results showed VIF values ranging from 1.000 to 1.305, and tolerance values ranging from 0.766 to 1.000. These values are well within the acceptable range, indicating no multicollinearity among the predictors. Assumption met.

Normality

Normality was assessed through three methods. First, skewness and kurtosis values were examined. Skewness values ranged from -0.536 to -0.784, and kurtosis values ranged from -0.038 to -0.341. These values are within the suggested limits of ±1, indicating approximately normal distributions. Second, probability-probability (P-P) plots were inspected and showed that the residuals closely followed the diagonal line, providing additional evidence of normality. Third, histograms of residuals were examined and showed approximately normal distributions. Assumption met.

Homoscedasticity

Homoscedasticity was assessed by plotting the standardized residuals against the standardized predicted values. The scatterplot showed that residuals were randomly distributed with no clear pattern or clustering trend, indicating that the assumption of homoscedasticity was satisfied. Assumption met.

Independence of Residuals

The independence of residuals was tested using the Durbin-Watson statistic. According to Field (2018), Durbin-Watson values between 1.50 and 2.50 are considered acceptable. The Durbin-Watson values for the regression models in this study ranged

from 1.651 to 1.850, which fall within the acceptable range, indicating no autocorrelation of residuals. Assumption met.

Linearity

Linearity was assessed by examining scatterplots of the relationships between each predictor and the outcome variable. The scatterplots showed linear relationships with no evidence of curvilinear patterns, supporting the assumption of linearity. Assumption met.

Table 7

Summary of Regression Assumption Testing

Assumption	Method of Testing	Results	Tenability
Sample size adequacy	Tabachnick & Fidell (2001) formula	N = 118 > 66	Met
Multicollinearity	VIF and tolerance	VIF = 1.000-1.305; Tolerance = .766–1.000	Met
Normality	Skewness, kurtosis, P-P plots, histograms	Skewness = -0.536 to -0.784; Kurtosis = -0.038 to -0.341	Met
Homoscedasticity	Residual scatterplots	Random distribution, no pattern	Met
Independence of residuals	Durbin-Watson	1.651–1.850	Met
Linearity	Scatterplots of predictor-outcome relationships	Linear patterns	Met

VIF = Variance Inflation Factor. All assumptions were tested prior to hypothesis testing.

Hypothesis Test Results

Hypothesis 1 investigated the direct association between safety culture and performance. Safety culture accounted for 25.5% of the variance in safety performance (R^2 =.255, F = 39.682, p <.001, β =.505, t = 6.299, p <.001). The association magnitude was assessed as large, which supports the acceptability of H1.

Hypothesis 2 looked at the relationship between safety culture and the safety management system. The study found a substantial positive effect (β =.484, t = 5.951, p <.001), with safety culture accounting for 23.4% of the variance in the safety management system (R^2 =.234, F = 35.414, p <.001), supporting the hypothesis (H2).

Hypothesis 3 investigated the association of the safety management system on safety performance. The analysis found a substantial positive effect (β =.458, t = 5.550, p <.001), with the safety management system explaining 21.0% of the variance in safety performance (R^2 =.210, F = 30.803, p <.001), supporting the acceptance of H3.

Hypothesis 4 investigated the combined association of safety culture and safety management system on safety performance using multiple regression analysis.

The model explains 31.5% of the variance in the safety performance outcome, with R^2 being .315 (p<.001, F = 26.432), while the influence of all three variables involved was statistically significant. Indeed, β was found to be .370 for safety culture (p<.001, t = 4.193) and .279 for the safety management system (p=.002, t = 3.166). The regression equation for the model was SP = 1.051 + 0.464 (SC) + 0.267 (SMS), which confirmed H4 since both predictors were positive and statistically significant.

Hypothesis 5 was formulated about the mediation role of the safety management system in the relationship between safety culture and safety performance. Hypothesis 5 investigated the role of the safety management system as a mediating factor in the link between safety culture and performance. Following the Hayes (2017) mediation framework, the indirect effect was calculated at 0.169. The significance of this association was verified using a bootstrapping procedure with 5,000 samples. Since the resulting confidence intervals did not include zero, H5 was supported, suggesting that safety management systems mediate the relationship between safety culture and safety performance. Safety culture had a substantial direct effect on safety performance, even after controlling for the safety management system (β =.370, p <.001), indicating partial rather than full mediation.

This finding supported the acceptability of H5, suggesting that the safety management system partially mediates the safety culture-safety performance relationship. The statistical results for all five hypotheses, including path coefficients (β), t-values, and R^2 values, are synthesized in Table 9. The table presents a summary of the hypothesis testing results. All four hypotheses were supported. Safety culture was positively associated with safety performance (H1), safety culture was positively associated with the

safety management system (H2), the safety management system was positively associated with safety performance (H3), and the safety management system mediated the association between safety culture and safety performance (H4).

Table 8

Results of Hypothesis Testing

Hypothesis	Path	B	SE	β	t	p	R^2	F	Result
H1	SC → SP	0.633	0.101	.505	6.299	< .001	.255	39.682	Supported
H2	SC → SMS	0.635	0.107	.484	5.951	< .001	.234	35.412	Supported
H3	SMS → SP	0.438	0.079	.458	5.550	< .001	.210	30.804	Supported
H4 (Direct)	SC → SP (controlling SMS)	0.464	0.111	.370	4.193	< .001	.315	26.395	Supported
H4 (Indirect)	SC → SMS → SP	0.169	0.058	—	—	—	—	—	Supported

Note. SC = Safety Culture; SMS = Safety Management System; SP = Safety Performance. B = unstandardized coefficient; SE = standard error; β = standardized coefficient.

For H4, the direct effect is the effect of SC on SP controlling for SMS; the indirect effect is the effect of SC on SP through SMS. The indirect effect was tested using 5,000 bootstrap samples; the 95% bias-corrected confidence interval was [0.061, 0.287], which does not include zero. All reported p-values are two-tailed. Durbin-Watson values ranged from 1.651 to 1.850. VIF values ranged from 1.000 to 1.305.

Summary

All five research assumptions were empirically supported. Safety culture emerged as the most powerful predictor of safety performance, followed by the safety management system. The mediating analysis found that the safety management system is an important mechanism for contributing to safety performance, accounting for almost one-quarter of the total effect.

These findings emphasize the interconnectedness of organizational safety dimensions and the significance of creating both cultural and systematic methods to improve workplace safety outcomes. The final model, illustrating the significant direct and indirect paths, is shown in Figure 2.

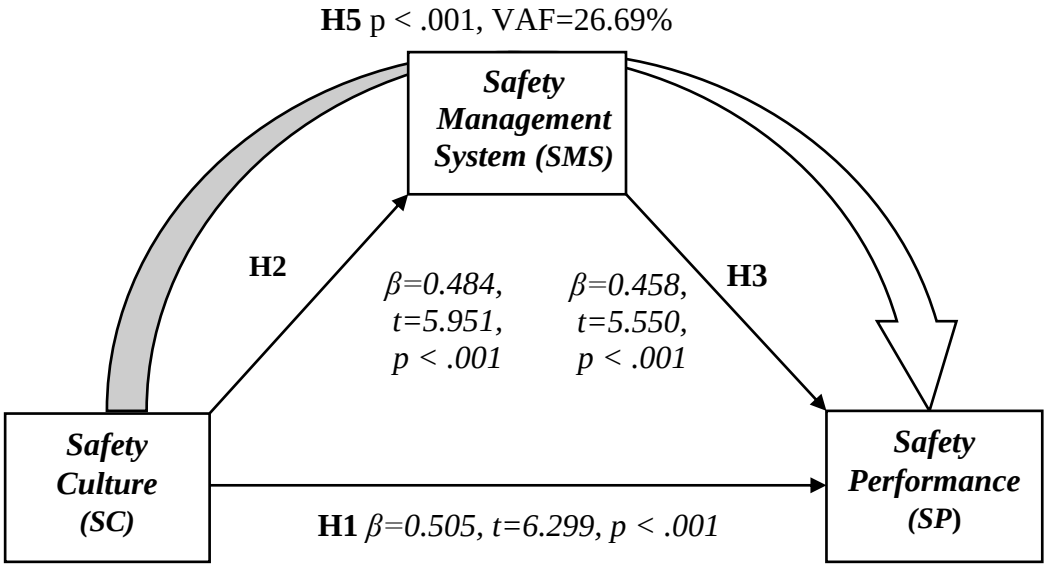


Figure 2: Final model for safety management system mediates between safety culture and safety performance

Discussion

This study looked at the association of safety culture with safety performance, with safety management systems serving as a mediating factor at Universal Plastic Factory PLC in Addis Ababa. The findings provide strong empirical support for the linked nature of organizational safety characteristics, as well as substantial theoretical and practical implications for manufacturing firms in developing countries.

Interpretation of Direct Effects

This investigation's most striking finding is the substantial positive association between safety culture and safety performance (r =.505, p <.01; β =.505). This finding is consistent with Uddin et al.'s (2021) research in Ethiopian manufacturing industries, which also found strong relationships between safety culture and organizational safety outcomes. According to Cohen's (2013) research, safety culture has a significant

association with safety performance, accounting for around one-quarter of the variance (R^2 =.255). This finding suggests that employees who are most concerned about organizational safety are likely to report more incidents and feel safer at work. In particular, they are more likely to respond positively to management's concern and encouragement and provide feedback if something is hazardous.

This conclusion has theoretical implications that go beyond a simple statistical connection. It indicates that safety culture is a fundamental organizational quality that impacts employee cognition, attitudes, and workplace safety actions. Employees at Universal Plastic Factory who scored high on the item "Employees encourage each other to report any safety concerns they might have" (M = 4.08) showed that they held each other accountable for safety-related issues, which suggests the presence of horizontal social association mechanisms that complement top-down safety management approaches and contribute to the establishment of a virtuous cycle.

Safety Culture and Safety Management System Integration

The correlation between safety culture and safety management system (r =.484, p <.01; β =.484) indicates that corporate safety values are reflected in formalized structures and processes. This finding is consistent with Paul and Maiti's (2007) concept of reciprocal impacts between cultural and systematic elements of organizational safety. Organizations with strong safety cultures generate more comprehensive and effective management systems to carry out their safety commitments. This interpretation underscores the role of safety culture as a necessary precursor that incentivizes the rigorous implementation of safety protocols.

The fact that safety culture explains 23.4% of the variance in the outcome of safety management systems suggests that the two areas of human activity are partially overlapping. According to Fernández-Muñiz *et al.* (2007), safety culture plays an essential role in management system development; however, other influential factors should be considered. Therefore, organizations should not rely solely on cultivating safety culture to achieve the goal of systematic safety management; they should also invest efforts in developing management systems' organizational aspects.

The Association Between Safety Management System and Safety Performance

The positive link between safety management system and safety performance (r =.458, p <.01; β =.458) supports Sorensen's (2002) argument that codified safety systems play a vital role in generating superior safety results.

Safety management system provides a framework for embodying safety values in day-to-day operations. According to the descriptive statistics, it is evident that "Site managers and field personnel place importance on safety" (M = 3.92) is the key SMS Dimension, which indicates that management involvement in the system is greatest at the site level and is an essential component of achieving safety performance.

This link has significant practical significance. Organizations can enhance safety performance by improving specific features within management systems. These features include responsibility allocation, rewards for good behaviors, safety incentive system, and leadership commitment. The survey identified the lowest safety management system priority for the organization as a result of the low score on the item "My company often offers safety incentives" (M = 3.23).

Mediation Mechanism: Central Contribution

This study's most conceptually significant contribution is its demonstration that safety management system mediates the association between safety culture and safety performance (VAF = 26.69%). This study builds on Fernández-Muñiz *et al.'s* (2014) research in the food and beverage sector, giving empirical support in the plastics manufacturing context of a developing economy. The mediation model demonstrates that safety culture has an association with performance via both direct and indirect pathways, with formal management system structures accounting for roughly one-quarter of the effect.

This mediation mechanism sheds light on the process by which abstract cultural values are translated into concrete safety results. Safety culture is a set of attitudes, values, and conventions of thinking about the importance of safety, which are formed within the framework of a particular corporate culture (Cooper, 2000; Turner *et al.*, 1989). The characteristics of the safety culture define the system of codified management, which includes policies, procedures, training, accountability, and audit mechanisms.

These systemic features, in turn, have a direct association with safety behaviors and outcomes. Safety culture has a direct effect on safety performance (β =.370 when controlling for the safety management system. The persistence of a significant direct

effect after controlling for the safety management system suggests that safety culture is associated with safety performance through pathways beyond the formal management system. Possible mechanisms such as proactive peer intervention, informal safety communication, and internalized safety motivation may account for this direct pathway, but these mechanisms were not measured in the present study. Future research should explicitly examine these potential mediators.

Comparative Analysis of Existing Literature

The findings align with current theoretical frameworks while expanding their applicability to new circumstances. First, alignment with Uddin *et al.* (2021) demonstrates that connections observed in Western economies remain strong in Ethiopian manufacturing settings, implying cross-cultural stability of safety notions. Second, support for Paul and Maiti's (2007) reciprocal relationship model emphasizes the two-way nature of culture-system interactions. Third, the positive association observed between safety management system and safety performance is consistent with Sorensen's (2002) argument that formal safety systems are associated with superior safety outcomes. While this study was conducted in a single Ethiopian manufacturing enterprise and cannot establish generalizability, the findings provide preliminary evidence that the system-performance linkage may also hold in developing-economy manufacturing contexts. Similarly, the significant indirect effect observed in this study is consistent with Fernández-Muñiz *et al.*'s (2014) mediation model, offering supporting evidence from an African industrial setting. By applying the Hayes (2017) method, this study confirms that the safety management system acts as a significant bridge between culture and performance.

However, the indirect pathway through the safety management system accounted for approximately 26.7% of the total effect. This difference may be explained by certain specifics or particularities of the industrial environment in Ethiopia, such as resource limits, regulatory frameworks, or organizational maturity levels, which affect the relative strength of official vs. informal safety procedures.

Theoretical and Practical Contributions

This study contributes to safety science theory by providing preliminary evidence for an integrated model linking safety culture, safety management system, and safety

performance in a developing-economy manufacturing context. Although the findings are based on a single Ethiopian enterprise and require replication, they extend the applicability of existing theoretical frameworks beyond Western industrial settings. Furthermore, the findings challenge linear models which suggest that safety culture influences performance solely through formal management systems. The findings suggest that organizations should establish both cultural foundations and systematic structures to ensure long-term safety performance.

The results have substantial implications for practice. The results suggest that in order to improve safety performance, an organization should focus on both developing a safety-conscious cultures through leadership commitment, employee involvement, and peer reinforcement mechanisms, while also strengthening formal management system through clear accountability, recognition programs, comprehensive training, and visible leadership actions. The regression equation (SP = 1.051 + 0.464SC + 0.267SMS) indicates that for every one-unit increase in safety culture, there would be a 0.464-unit increase in safety performance, holding the safety management system constant.

Organizations that make progress on both dimensions at the same time benefit from the complementary consequences. Fernández-Muñiz *et al.* (2007) found that the safety management system facilitates legislative compliance. This study extends that observation by showing that the safety management systems as measured through employee perceptions of safety feedback, recognition, incentives, and accountability, were positively associated with safety performance. These findings suggest that formal safety structures may serve as one mechanism through which organizational safety values relate to safety outcomes, although the specific roles of regulatory frameworks and intrinsic motivation were not examined in this study and warrant future investigation.

Implications and Recommendations

This study contributes to safety science theory in three ways. First, it provides preliminary evidence for an integrated model linking safety culture, safety management system, and safety performance in a developing-economy manufacturing context. While the findings are based on a single Ethiopian enterprise and require replication, they suggest that existing theoretical frameworks may be applicable beyond Western industrial settings. Second, the findings support the resource-based view of the firm (Barney, 1991) by demonstrating that an intangible organizational resource, safety culture, is associated

with the development of formal organizational capabilities (safety management system), which in turn relate to performance outcomes. Third, the study responds to Paul and Maiti's (2007) call for research on the interplay between cultural and systematic elements of organizational safety by providing evidence from an African manufacturing context.

The findings have three practical implications for manufacturing organizations in Ethiopia and similar contexts. First, organizations should invest in both cultural and structural aspects of safety rather than relying on one alone. The results indicate that safety culture and safety management system each contribute uniquely to safety performance. Second, managers should prioritize visible leadership commitment to safety, as this was the highest-rated item in the safety culture scale. Third, the low score on the safety incentives item (M = 3.23) identifies a specific leverage point: improving incentive schemes may strengthen the safety management system and, in turn, safety performance.

Based on the findings, four recommendations are made for Universal Plastic Factory PLC and similar manufacturing organizations. First, the organization should strengthen safety incentives by developing and implementing a formal safety incentive program that recognizes employees, supervisors, and managers for safe behavior and safety improvement suggestions. Second, senior management should maintain visible leadership commitment to safety through regular safety walkthroughs, participation in safety meetings, and public recognition of safety achievements. Third, safety accountability should be clarified by documenting safety responsibilities clearly at every organizational level, with regular performance reviews that include safety indicators. Fourth, safety communication should be enhanced by strengthening upward feedback channels so that employee concerns reach management and receive documented responses.

Recommendations for Future Research

Four directions are recommended for future research. First, longitudinal designs should be used to establish temporal ordering among safety culture, safety management system, and safety performance. Second, Confirmatory Factor Analysis (CFA) should be conducted with a larger, independent sample to confirm the factor structure of the 13-item instrument. Third, objective safety outcomes such as accident frequency, injury rates, and lost-time injuries should be incorporated alongside perceptual measures to reduce

common method bias. Fourth, the model should be replicated across multiple manufacturing sectors (textiles, food processing, petrochemicals, and automotive assembly) and across different African countries to test the generalizability of the findings.

Conclusion & Limitations

This study examined the association between safety culture and safety performance, with safety management system as a mediating variable, at Universal Plastic Factory PLC in Addis Ababa, Ethiopia.

The first hypothesis, that safety culture is positively associated with safety performance, was supported. Safety culture accounted for 25.5% of the variance in safety performance ($R^2 = .255$), with a standardized coefficient of $\beta = .505$ ($t = 6.299$, $p < .001$). This indicates that employees who perceive a stronger safety culture also report higher safety performance. Theoretically, this supports Social Exchange Theory (Blau, 1964), which holds that employees reciprocate organizational care with positive safety behaviors.

The second hypothesis, that safety culture is positively associated with safety management system, was supported. Safety culture accounted for 23.4% of the variance in safety management system ($R^2 = .234$), with $\beta = .484$ ($t = 5.951$, $p < .001$). This indicates that organizations with stronger safety cultures tend to develop more comprehensive safety management systems, consistent with the resource-based view (Barney, 1991).

The third hypothesis, that the safety management system is positively associated with safety performance, was supported. The safety management system accounted for 21.0% of the variance in safety performance ($R^2 = .210$), with $\beta = .458$ ($t = 5.550$, $p < .001$). This supports Organizational Safety Theory (Reason, 1997), which holds that formal organizational structures address latent conditions that contribute to accidents.

The fourth hypothesis, that the safety management system mediates the association between safety culture and safety performance, was also supported. The indirect effect was statistically significant (ab = 0.169, BootSE = 0.058, 95% CI [0.061, 0.287]), based on 5,000 bootstrap samples. The indirect pathway accounted for approximately 26.7% of the total effect. However, the direct effect remained significant after controlling for the safety management system (B = 0.464, $p < .001$), indicating that

safety culture is associated with safety performance through pathways beyond the formal management system.

Taken together, these findings demonstrate that safety culture and safety management system are not competing explanations for safety performance but complementary mechanisms. Safety culture operates both directly through informal peer reinforcement, internalized safety values, and proactive hazard reporting and indirectly through the formal structures of the safety management system. This integrated model advances safety science theory by empirically validating the sequential relationship of culture, system, and performance in a developing-economy manufacturing context, a relationship previously tested primarily in Western industrial settings.

Several limitations should be acknowledged when interpreting these findings.

The study was conducted in a single plastic manufacturing enterprise in Addis Ababa, which provides in-depth contextual insight but limits generalizability to other manufacturing sectors, geographical contexts, or organizational configurations.

The cross-sectional design prevents the establishment of temporal ordering among safety culture, safety management system, and safety performance, meaning the data cannot resolve whether safety culture precedes the safety management system, whether the reverse is true, or whether the relationship is reciprocal.

The use of a single questionnaire administered at one point in time raises the possibility of common method bias. Although Harman's single-factor test indicated that common method bias was not a serious concern (first factor = 43.98%, below the 50% threshold), this test is not definitive. Future research should use multi-source data, temporally separated measures, or stronger statistical tests, such as the marker variable technique, to address this limitation.

Additionally, the safety performance measure captured perceptions of safety practices rather than objective outcomes such as accident frequency, injury rates, or lost-time injuries, which may create conceptual overlap with the safety culture and safety management system measures.

Data were also collected face-to-face within a single workplace, which may have introduced social desirability bias, as employees may have been reluctant to criticize management, safety procedures, or incentives; this could partly explain the relatively high mean scores across all three constructs (SC = 3.93; SMS = 3.69; SP = 3.86).

The final scales contained a reduced number of items (4 SC, 4 SMS, 5 SP = 13 items) following CITC analysis, and while the final scales demonstrated acceptable reliability (.809, .762, and .871) and a clear three-factor structure, the removal of four SC items, one SMS item, and two SP items may reduce content validity, as the retained items may not capture all dimensions of the original constructs.

Furthermore, Exploratory Factor Analysis using Principal Component Analysis was conducted to provide preliminary evidence of construct validity, but PCA is primarily a data-reduction procedure rather than a latent factor model, and EFA alone cannot confirm construct validity; Confirmatory Factor Analysis was not conducted. The mediation analysis used 5,000 bootstrap samples, the minimum recommendation of Hayes (2017) and is widely used in published research, though 10,000 or more samples may provide more stable estimates. Data were collected in 2022, and the factory's accident records cover 2017-2021; although the factory's organizational structure and safety management system have not undergone fundamental change since data collection, the findings should be interpreted in light of this timeframe.

Finally, the study did not measure regulatory frameworks, intrinsic safety motivation, safety climate, managerial commitment as a separate construct, safety knowledge, or participatory safety behaviors, all of which may confound or moderate the observed relationships and should be examined in future research. Future studies should therefore employ longitudinal designs to establish temporal ordering, conduct Confirmatory Factor Analysis with larger independent samples, incorporate objective safety outcomes and multi-source data, and use 10,000 or more bootstrap samples to confirm the robustness of the mediation findings.

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