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The Mediating Effect of Safety Culture on Safety Communication and Human Factor Accident at the Workplace

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Abstract

Rapid development in industrialization and global economy has contributed to the increased number of workplace injuries and accidents. Nowadays, with the advancement and the reliability of technology, accidents caused by equipment and machinery failures seem to be on decline. However, human element tends to feature as a significant contributor to workplace accidents: statistical reports and evidence indicate that around 80 to 90 percent of work-related accidents can be attributed to human factors. Meanwhile, effective safety communication is believed to play a vital role in human factor accidents at the workplace. Effective communication among the workers and leaders is believed to help in the attenuating the risk of human factor accidents. Against this background, this research examines 394 sets of questionnaires with 89.14% response rate from respondents of manufacturing companies in Negeri Sembilan, Malaysia. Based on the results, the interaction between safety communication and human factor accident is found to be significant. In addition, this study investigates the mediating effect of safety culture between safety communication and human factor accident. The results show that safety culture significantly mediates by the relation of safety communication and human factor accident.

Keywords: safety communication, human factor accident, safety culture, Swiss cheese model, safety, accident

1. Introduction

Industrialization alongside growing populations has resulted in an increase in occupational injuries, which is becoming a common occurrence (Arokiasamy & Krishnan, 1994; Rampal & Mohd Nizam, 2006). In Malaysia, statistics have revealed that our country has not been meeting the expectation of reducing the number of accidents despite the implementation of manifold safety policies and preventive actions. In this regard, the Social Security Organization of Malaysia (SOCSO) has announced the latest number of reported accidents to be as many as 63,557 cases in 2013, an increase of 2,005 cases or 3.26% from the 61,552 cases in 2012. Surprisingly, in every 10,000 such workers, 59 were involved in industrial accidents. The total benefits payment has increased by RM203.48 million or 10.17% to RM2, 203.49 million in 2013 from RM2, 000.01 million in 2012.

An accident is defined as an unforeseen and unplanned event (Alicia, 2009). In highly hazardous industries such as aviation, nuclear power plant, construction, and even manufacturing, the number of accidents is always leading among all other industries (Qureshi, 2007). However, Lyneis and Madnick (2008) argued that it is almost impossible to prevent accidents from happening in high-risk industries. The evidence shows that, each year, approximately 2 million workers are killed by job-related accidents and diseases and that 270 million of occupational accidents and 160 million of occupational diseases happen yearly worldwide (Abdul Rahim et al., 2011). Workplace accidents persist to be a quandary and a huge challenge to the management in the organization nowadays (Biggs et al., 2014). Therefore, to effectively avoid or prevent accidents from happening, the managerial personnel have devoted much effort to improving workplace safety at their working premises (Wu, 2007).

Occupational accidents and injuries have considerable impacts on individuals, their families and friends, and of course, their employers. Hence, organizations nowadays take more proactive ways to prevent accidents. Unfortunately, the increasing accident rate has gained attention from employers, who begin to proactively execute accident-preventing action. However, most of the workplace accidents are believed to happen due to behavioural factors (Kim et al., 2002). This is not merely the behaviour of front-line workers but also that of the management's towards safety issues. Nowadays, with the advancement and the reliability of technology, accidents caused by equipment and machinery failures seem to be decreasing (Hendy, 2003). Evidence indicates that around 80 to 90 percent of work-related accidents can be attributed to human factors (Reason, 1990a; Burton, 2007; Alicia, 2009) and it has been described as a major contributor to workplace accidents (Kariuki & Lowe, 2007). In other words, human factors, instead of machinery and hardware problems, are believed to be the main reason underlying the occurrence of accidents.

To date, insufficient amount of research has been conducted to investigate safety communication and its effects on workplace accidents and injuries (Kim et al., 2008; Lijie et al., 2012; Kaskutas et al., 2013). Safety communication is not merely a process of exchanging safety information at the workplace; it also concerns influencing employees' behaviour and attitudes towards safety. Geller (2005) suggested that an organization's safety status is determined by how safety is discussed and disseminated among the workers. Effective safety communication has been shown to affect specific employees' behaviours, for example, safety performance (Michael et al., 2006). However, miscommunication frequently occurs among the workers, especially between employees and the upper-level management (Mullen et al., 2011); this might be due to the neglect of constructive safety communication at the workplace, implying the absence of a good safety culture atmosphere in the organization (Conchie et al., 2013).

In addition, the safety culture has now become a major domain in safety management systems in many high-risk industries such as aviation, nuclear plant, medical line, railway, and of course including manufacturing industry (Reiman & Rollenhagen, 2014). Nowadays, the safety culture had been recognized as one of the major contributors to the accidents and injuries (Amirah et al., 2013). Hence, the managerial level is more likely to cultivate a positive safety culture in their organization in order to minimize accidents which could result in severe humanity and property loss. The safety culture has been described as employee safety participation, perceived risk and emergency response (Wu et al., 2010), common sets of value, behaviour, norms that affect safety performance (Adams, 2012). It is evident that the management has a core influence on safety culture which depends on the demonstration of a commitment to safety within the organization (Ek et al., 2007).

2. Literature Review

2.1 Human Factor Accident

The human factor has been considered to be the primary cause of accidents in high-risk industries (Qureshi, 2007; M Ćorović & Djurovic, 2013; Wang et al., 2013). Tracing back to previous years, human factors often contributed to the occurrence of accidents. In 1912, the largest and luxurious ship, Titanic, which was dubbed the "unsinkable ship", did sink by hitting an iceberg on its maiden voyage (Geraldi et al., 2010), in which over 1300 passengers perished. One of the factors that led to the tragedy is the human factor (Labib & Read, 2013). The concept of human factor has received widespread attentions because of two of the major industrial catastrophes: the ground crash between two large aircrafts in Tenerife in 1977 with a total of 583 fatalities and the nuclear accident on Three Mile Island in 1979, which released radioactive gases and iodine into the environment (Chen et al., 2013). Both disasters have been recognized to be due to inadequate training and human factor failures as disclosed in investigations. Traditionally, the human factor is defined as the contact between man and machine, poor workplace and equipment design or other elements of a system (Gordon, 1998; Wogalter et al., 2001; Zink, 2006; Schönbeck et al., 2010; Rahimi & Rausand, 2013) as well as the factors that influence people and their behaviour in safety issues (Vogt et al., 2010). In past decades, it has been believed that the human factor does not merely involve human unsafe characteristics but also encompasses the design of workplace, task and tools while recognizing the restraint of individual's physical and psychological abilities (Abdelhamid & Everet, 2000).

Recently, the trend of human factor accident has changed; formerly used concept of human factor accident concept is now being extended by researchers. Few scholars have been able to convince that the human factor can be described as interaction among human and elements of organization (Zink, 2006; Einarsson & Brynjarsson, 2008). Attention has been focused more on the individual factor and organizational factor which contribute to human factor accidents at the workplace (Schönbeck et al., 2010; Skogdalen & Vinnem, 2011; Wang et al., 2011; Arfena Deah et al., 2014). Kariuki and Lowe (2007) have defined human factor accident as organizational and job factors, human and individual characteristics which influence behavior and work in the way they can affect safety at the workplace. In the study by Mearns et al. (2001), the individual and organizational factors have been recognized as two dominant factors affecting safety at the workplace. Individual factors such as the worker's competence , level of pressure, and self-motivation level are believed to influence safety at the workplace (Arfena Deah, 2013) Meanwhile, decision errors, skill-based errors, perceptual errors and violation are also categorized under individual factors (Thomas, 2003; Li et al., 2008). Besides, contributory organizational factors include insufficient safety training, poor communication among workers, inadequate safety procedures and safety policies, inappropriate arrangement for evacuation procedures, and safety management failures (Mearns et al., 2001).

The human factor has gained much attention after the accident of Three Mile Island nuclear power plant disaster in 1979 (Sutton, 2015). Since then, research on the human factor has concentrated on man-machine relationships and concerned human performance (Einarsson & Brynjarsson, 2008). The concept of human factor accident can be traced back to 1977. In earlier stages, the human factor is treated as the interaction of human capabilities and limitation of products and the workplace environment. Based on these characteristics, Farrell (1977) has developed the human factor theory based on a chain of human factors that cause accidents (Hosseinian & Torghabeh, 2012). The theory includes three main components: overload, improper response, and improper activity; this theory emphasizes more on incompatibilities of human which lead to an accident (Abdelhamid & Everett, 2000).

Therefore, in relation to the conceptualization of human factor in earlier years, Hetherington et al. (2006) has proposed six dimensions of the human factor: situation awareness, decision making, fatigue, automation, communication health and stress, and teamwork. Similarly, O'Connor (2011) has introduced four dimensions of the human factor, namely personal stress, stress of others, communication, and command responsibility. However, in recent years, the trend of human factor has turned the points to the failure made by individuals (Howell et al., 2002) and elements of organizational operation system (Burke et al., 2011; Arfena Deah et al., 2014). Therefore, researchers nowadays tend to put their attention to Swiss Cheese Model (SCM) proposed by Reason (1990a). Investigating both latent and active failures which have been treated as key components in the model has become a popular topic in human factor research. This model has directed the attention towards the individual and organizational factors which may lead to failures (Fox & Ziegler, 2007). This undeniably has become another extension of the widely accepted human factor theory.

Based on the SCM, human factor studies are more likely to focus their attention on individual and organizational factor in human factor accidents (Schönbeck et al., 2010; Skogdalen & Vinnem, 2011; Wang et al., 2011; Arfena Deah et al., 2014). Wang et al. (2011) have assessed the contribution of individual and organizational factors to accidents using theHuman Factor Analysis and Classification System (HFACS) and Bayesian Network (BN). Besides, Schönbeck et al. (2010) created a new approach to address individual and organizational factors that affect the performance of both safety instrumented systems and safety integrity. Arfena Deah et al. (2014) have also suggested that human factors in shipping safety can be categorized into the organizational factor, group factor, and individual factor. In this study, Reason's SCM will be focused on for better elucidation of the concept of human factor accidents. Meanwhile, two main elements from SCM – active failure and latent failure – will be discussed next.

2.1.1 The Swiss Cheese Model

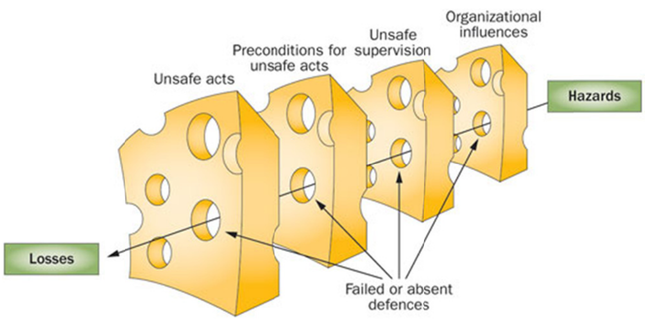

Figure 1. Reason's Swiss Cheese Model

Reason's Swiss Cheese Model (SCM) has established the basics of analyzing the underlying causes of accidents and has become one of the examples of modern accident models. It is known as a metaphor of accidents proposed by Reason (1990a) to explain the occurrence of human factors, risk analysis and risk management in safety which is widely used especially in high-risk industries (Perneger, 2005). Reason (2000) proposed that defences and barriers have accounted for an important role in high-technology system. Those defences could be engineered, directly by individuals, or depending on systems and managerial controls. Hence, the model proposes four layers of defence, namely organizational influence, unsafe supervision, precondition for unsafe acts, and unsafe acts (Shappell & Wiegmann, 2000; Wiegmann & Shappell, 2001; Wu et al., 2009). It hypothesizes that each slice of the cheese represents one layer of defence or barrier in a complex system and that the holes on and the gaps between the cheese slices represent the failures and errors (active and latent) at the human level of the system. However, in the ideal world, the defensive layers should be intact. Unfortunately, in reality, defence insufficiency always happens as the hole on the slice of Swiss cheese (Reason, 2013).

However, failures of individuals do not occur solely but with the influence of other organizational factors (McFarlane, 1993; Mearns et al., 2001). Various potential causes of human factor accidents have been proposed. For instance, Abdul Rahim et al. (2008) believed that the combination of unsafe act and unsafe conditions is the root cause of accidents. Meanwhile, Fox and Ziegler (2007) believed that accidents happened due to systemic factors while human elements are but a part of it. In general, the SCM explains the aetiologies of human factor accidents using latent failures and active failures.

An active failure refers to unsafe acts at the "sharp end", which is more noticeable in an accident (Drury, 2000; Wu et al., 2009). Jeffs (2010) has described an active failure as "the error at the point of contact between human and some aspects of the larger environment or system interface". Unsafe acts are mostly committed by individuals in the form of decision errors (improper acts, misdiagnosed problem), skill-based errors (poor procedure, inappropriate use of equipment), perceptual errors (misjudgement, visual illusion), and violation (violated training rules, practicing unauthorized actions and approaches) (Reason, 1990b; Thomas, 2003; Li et al, 2008). Generally, an active failure refers to the errors committed by front-line personnel which in turn contribute to immediate result of mishaps (Cowan, 2009). According to Jeffs (2010), active failures have been further categorized into three types: slips, lapses, and mistakes. Slips refer to failures in the execution of an action as planned; lapses refer to omission to execute actions as planned due to failure of memory; while mistakes refer to errors of judgment, of diagnosis, or of application of procedure.

Meanwhile, Rivera et al. (2013) firmly believed that most accidents happened due to the reliability of operation system and operator's error. However, besides deeply investigating human behaviour and error orientation, recent safety research has focused more on identifying organizational systemic problems rather than merely examining individual failures (Thomas, 2003). As for mentioned, the SCM has demonstrated a complex organizational system with the highlights of latent and active failures that are most probably invisible or unforeseen in an organization. Latent failures play a crucial role in human factor accidents. A latent failure has been defined as the hidden causes of accidents and usually exists long before an accident occurs (Drury, 2000; Cowan, 2009).

Latent failures in the SCM consists of three main categories: organizational influence (resource management, organizational climate, organizational process), unsafe supervision (inadequate supervision, planned inappropriate operation, failure to correct a known problem, supervisory violation), and preconditions of unsafe acts (physical and technological environment, adverse mental and psychological state, crew resource management, personal readiness) (Reason, 1990b; Wiegmann & Shappell, 2001; Li et al., 2008; Wu et al., 2009). According to Reason (1990a), accidents involve both active failures and latent failures. However, after the breakthrough of the accident, active failures are the one invariably investigated by the management but latent failures are neglected (Syed Mohamed & Ideris, 2012). Although hard to predict, latent failures actually can be identified before accidents happen by closely monitoring the "vital signs" of the systems (Reason, 2013). Li et al. (2008) believed that most latent failures are related to the management and authoritarian structure. Similarly, Rivera et al. (2013) identified possible factors which result in the formation of latent failures: organizational culture, management decisions, design of procedures, and deficiencies of training.

The SCM has been developed to widen the focus on the human factor. It is likely that the human factor has encompassed the interaction between individual, group, and organizational elements, which become co-contributors to accidents (Gordon, 1998). According to the SCM, disasters are characterized by a series of continuous failures rather than a single large failure. Latent failures in the organization have threatened the result of active failures (Ternov & Akselsson, 2005). Based on the researches, latent failure also stresses on some terms of mental fatigue, poor communication (Shappell & Wiegmann, 2000), organizational processes, task and environmental conditions, individual unsafe acts and failed defences (Slud et al., 1988).

2.2 Safety Communication

Communication is the way people convey thoughts, express feelings and deliver information and knowledge with one another (Cigularov et al., 2010). However, with the term "safety", communication becomes a tool that helps employers manage safety issues and ensure that members in an organization stay away from potential hazards and accidents (Alsamadani et al., 2012). Safety communication is not merely a process of giving and receiving safety information at the workplace; it helps to influence employees' behaviour and attitudes towards safety. Geller (2005) claimed that an organization's safety status is determined by how safety is discussed and disseminated. It is evident that effective safety communication affects specific employees' behaviour, for example, safety performance (Michael et al., 2006). However, miscommunication among the workers, especially between employees and the upper-level management, frequently occurs (Mullen et al., 2011) and this might be due to the neglect of constructive safety communications at the workplace, implying that a good safety culture atmosphere does not exist in the organization (Conchie et al., 2013).

Safety communication breakdowns have not only reduced the possibility of workers to take appropriate actions at the critical moments and but also caused safety performance to deteriorate (Michael et al., 2006; Kines et al., 2010; Maxfield et al., 2011). According to Maxfield et al. (2011), communication breakdown can be categorized as honest mistakes and not discussable. Honest mistakes including poor handwriting, confusing labels, difficult accents, and language barriers which endanger people. Therefore, it results in the continuation of unsafe acts at the workplace. (Alsamadani et al.,2012). Although evidence showed that communication breakdown directly relates to the safety of the human beings (Lesch, 2005; Buckley, 2010; Donahue et al., 2012), there is still a lack of attention devoted to safety communication at the workplace (Laughry, 2006; Kines et al., 2010).

The importance of communication is valued once the employees perceive an open safety communication at the workplace (Neal et al., 2000). The lack of safety communication will probably lead to inadvertent hazards to the workers in the organization. Chen and Chen (2013) believed that upward safety communication is a crucial element to avoid adverse safety events in the organization. As the result, effective communication between the manager and workers about safety issues has become an important safety intervention at the workplace (Clarke, 2006). In fact, frequent discussion on safety is an essential way to acknowledge employees' safety commitment at the workplace (Fruhen et al., 2013). Besides, the management's safety commitment has become a highlighted concern where visible commitment from management helps to raise safety awareness among the workers at the workplace (Preece & Stocking, 1999).

In general, safety communication has been defined as a process of communication regarding safety-related issues and problems (Laughery, 2006). In this study, the researcher has believed that safety communication is a major component which could significantly influence the occurrence of accidents. In addition, safety communication is believed to predict human safety behaviour at the workplace (Kaskutas et al., 2013). Thus, the researcher has the interest to examine the degree of safety communication which could affect the unsafe behaviour of the workers at the workplace.

2.3 Safety Culture

Despite the considerable literature published on safety culture (O'Toole, 2002; Guldenmund, 2007; Mearns et al,. 2013; Biggs et al., 2013), the concept of safety culture remains nebulous due to the complexity of the concept itself, even though it has been used extensively for years (Choudhry et al., 2007; Biggs et al., 2013). The concepts of safety culture and of safety climate are considered to overlap and relevant to each other (Fruhen et al., 2013). Guldenmund (2000) has described safety culture concept as ill-defined whereas Cooper (2002) has described the safety culture as a means to reduce accidents and the inherent risks associated with routine operations. Although inconclusive opinions still exist, there appears to be some agreement that what the term "safety culture" can refer to. In recent years, the safety culture has been defined as the basic assumption (Mariscal et al., 2012) of an informed culture (Reason, 2000a), beliefs, attitudes, perceptions and values shared in relation to safety (Ek et al., 2007). Nowadays, the safety culture is more likely to be described as an enduring value (Sumwalt, 2012).

Despite difficulties to reach a consensus on the general definition of the safety culture, there have still been attempts to explain the concept of the safety culture (Richter & Koch, 2004; Parker et al., 2006; Wang & Liu, 2012; Frazier et al., 2013). Clarke (1998) believed that the culture is built upon essential elements which are beliefs and attitudes of employees, is shared among employees and becomes a norm to practice in day-to-day behaviour. In other hand, Kao et al. (2009) have suggested that the safety culture is composed of management commitment and various work-environment factors. Mearns et al. (2013) has recently defined the safety culture to signify employees' attitudes about an organization's approaches to safety, their perceptions of risk, their beliefs on responding to and controlling risk, and their engagement in safety activities.

The safety culture is always a particular topic to the management of organization. It has brought about manifold implications on safety outcomes and safety performance (Yule et al., 2007). Research has indicated that safety culture contribute to mitigated risk through the involvement of all employees in the organization (Taylor, 2010). However, good safety culture does not have to perform with zero mistakes, but the openness of the problems to be discussed and responded in time, according to Reiman & Oedewald (2002). In the same study, it has also been pointed out that some of the criteria offer good safety culture, one of which is the visible commitment of the management towards safety. Managers play a critical role in promoting safety culture (French & Geller, 2008). They are responsible for instilling strong safety awareness to their workers, brief them the way to handle emergencies and minimize risks in the workplace (William, 2008).

3. Hypotheses

Previous research supports the association of safety communication with human factor accidents. The well-known Piper Alpha disaster, an occupational accident in 1988, has been found to be mainly attributed to communication failures of the on-shore manager (Paté−Cornell, 1993; Hendershot, 2013). Since then, a significant body of research exists in support of safety communication in attenuating accidents in working environment. Alsamadani et al. (2012) have found that open safety communication across all organizational levels enhances safety in the construction sector by lowering accident rates. Cigularov et al. (2009) revealed that open safety communication plays a vital role in occupational safety. Brondino et al. (2012) have indicated that concentrating on enhancing safety communication could effectively improve safety performance and hence reduce accident rates. However, to date, scarce research has been devoted to the interaction of safety communication and human factor accidents. Therefore, this study aims to elucidate the effect of safety communication on human factor accidents, with a specific focus on the Malaysian manufacturing industry.

Moreover, Haber and Allentuck (1996) have reported that, human performance such as human reliability and human system integration are intimately influenced by the safety culture in the organization. Recently, interaction between safety culture and human factor accidents has been discerned from Berg (2013)'s study. In the review of the maritime safety in the framework of safety culture and human factor, Berg concluded that the lack of positive safety culture had affected human factor accidents in the maritime industry. Furthermore, Bridges and Tew (2010) have indicated that safety culture is one of the potential elements that influence human factor accidents. In their study, safety culture has become an element which could manipulate human factor accidents at the workplace. Besides, safety culture in the Human Factor Investigation Tool model proposed by Flin et al. (2013) was identified as one of the potential threats highly related to human factor accidents at the workplace. Thus, this research proposes hypotheses as below:

H1: There is an effect of safety communication on human factor accidents.

H2: There is an effect of safety communication on safety culture.

H3: Safety culture will mediate the relationship between safety communication and human factor accidents.

4. Research Method

This is a non-experimental study whereby the interference of researcher is minimal in order to create unbiased findings. The purpose of this study is descriptive and correlation research. This study aims to elucidate the relationship between two variables of interest i.e. safety communication and human factor accidents. A cross-sectional study was adapted in this research; all data would be gathered one point in time. The population of this study focused on front-line operators from the manufacturing companies located in Johor, Malaysia. At least 300 questionnaires were distributed to the targeted respondents. Safety communication was examined using the Safety Communication Scale by Hofmann and Stetzer (1998) while human factor accidents were measured by using the Human Factor Questionnaire by Arfena Deah et al. (2014). All collected data were analyzed using the Statistical Package of Social Science (SPSS) version 18.0 and Amos 16.0 software.

4.1 Measures of Model Fitness

Factor analysis was used to examine the construct validity. Through Confirmatory Factor Analysis (CFA), the data were tested for the fit of the measurement, to evaluate the psychometric properties of existing measurements and examine the method effects (Harrington, 2008, Masud et al, 2014). To examine the construct validity using CFA, the measurement model needs to be analyzed in order to observe the indicators representing latent variables (Kline, 2010). For a structural equation modeller, there are three types of fitness, namely absolute fit, incremental fit and parsimonious fit, that need to be achieved in order to determine the extent to which a model fit to the data. Either the Root Mean Square of Error Approximation (RMSEA) or Goodness of Fit Index (GFI) are two values commonly adapted to reflect a model's absolute fit (Hooper et al., 2008; Awang, 2012; Awang, 2014). As for incremental fit, the Comparative Fit Index (CFI) should be monitored whereas, as for parsimonious fit, the Chi Square/Degrees of Freedom (Chisq/df) will be the indicator of model fit to the data.

Table 1. Cut-Off values of model fitness

Fit Indices	Indicator
Root Mean Square Approximately (RMSEA)	< 0.08
Goodness of Fit Index (GFI)	> 0.90
Comparative Fit Index (CFI)	> 0.90
Chi Square / Degrees of Freedom (Chisq/df)	< 5.0

Source: Awang (2012, p. 49)

The model-fitness indices of each variable are shown in Table 1. Based on the cut-off value in Table 2, the GFI values should be considered to be greater than 0.9. However, in this study, the GFI of human factor accidents is around 0.9, it is still at an acceptance level and relatively close to the required value. Yim and Shin (2014) and Bae (2008) argued that a value of GFI less than 0.9 does not necessarily indicate poor fit for a given model. In this study, the value of the GFI is more than 0.8 and less than 0.9 (Human factor accident: GFI = 0.869). Such a value more than 0.8 can be considered acceptable (Hair et al., 2010) because the role of the GFI has not been considered to be the only priority in the fit statistic of the model (Bae, 2008).

Table 2. Model fitness of each measurement model

	Final Model		
Indices	Human Factor Accident	Safety Communication	Safety Culture
RMSEA	0.078	0.066	0.079
CFI	0.910	0.993	0.954
Chisq/df	3.417	2.714	3.435

The structural model for this study is shown in Figure 2. Fitness indices for this model have achieved a good fit (Absolute fit: RMSEA = 0.075; Incremental fit: CFI = 0.849; Parsimonious fit: Chisq/df = 3.234). All fitness indexes satisfy the required level, and this evidence supported that this model fit to its data reasonably well. Hence, this model is appropriate to be adapted in this study to carry out hypothesis testing using path analysis.

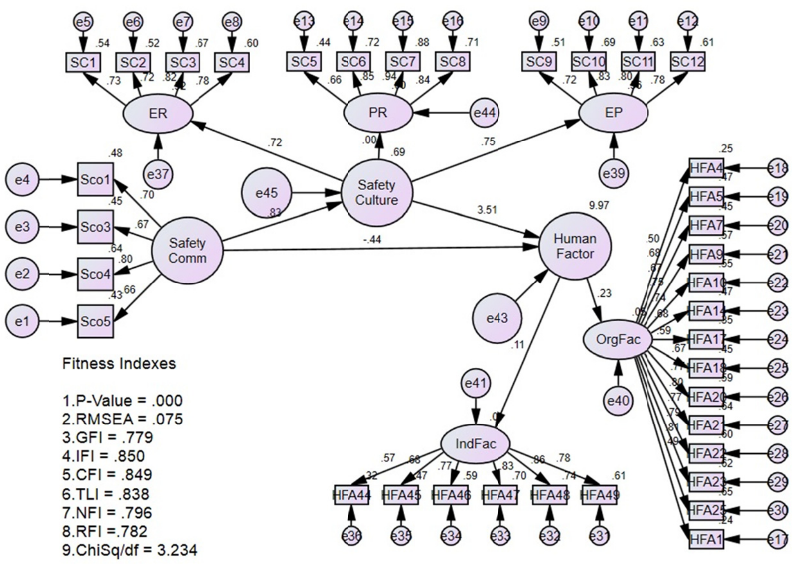

Figure 2. Structural Model

Table 3. Model fitness of structural model

Indexes	Structural Model
RMSEA	0.075
CFI	0.849
Chisq/df	3.234

4.2 Hypothesis Testing

4.2.1 Hypothesis 1: There Is an Effect of Safety Communication on Human Factor Accidents

In order to answer the first research question of this study, the direct effect of the construct relationship between safety communication and human factor accidents has been analyzed. The AMOS output suggests that all fitness indices have achieved the required level (RMSEA = 0.076; GFI = 0.849; CFI = 0.891; Chisq/df = 3.296). Based on the result outlined in Table 4, the direct effect between safety communication and human factor accidents is significant with the beta estimate value 0.292 and *p*-value less than 0.001. The regression weight estimate 0.292 has a standard error of 0.037. This explains the effect that when safety communication rises by 1, the human factor accidents accordingly rise by 0.292. By dividing the regression weight estimate by its standard error, the critical ratio of this model will be 7.816 ($z = 0.292 / 0.037 = 7.816$); the probability of obtaining a critical ratio 7.816 is less than 0.001. Thus, the regression weight for safety communication in predicting human factor accidents is significantly different from zero at the 0.001 level. Hence, there is evidence that hypothesis 1 is supported.

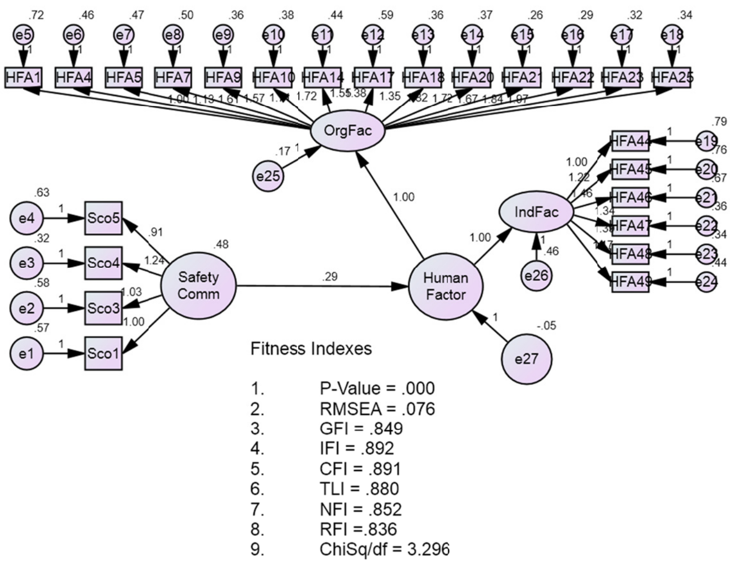

Figure 3. Regression weight of the effect of safety communication and human factor accidents

Table 4. Direct effect on safety communication and human factor accidents

			Beta Estimate	S.E.	C.R.	p-Value
Human Factor Accidents	<---	Safety Communication	0.292	0.037	7.816	***
Result			Significant			

*** p-Value < 0.001

4.2.2 Hypothesis 2: There Is an Effect of Safety Communication on Safety Culture

In order to answer the second research question, the direct effect of the construct relationship between safety communication and safety culture needs to be analyzed. The AMOS output suggests that all fitness indices have achieved the acceptable level (RMSEA = 0.105; GFI = 0.846; CFI = 0.877; Chisq/df = 5.333). Based on the result outlined in Table 5, the direct effect between safety communication and safety culture is significant with the beta estimate value 0.550 and *p*-value less than 0.001. The regression weight estimate 0.550 has a standard error of 0.067. This explains the effect that when safety communication rises by 1, safety culture accordingly rises by 0.550. By dividing the regression weight estimate by its standard error, the critical ratio of this model will be 8.209 (z = 0.550 / 0.067 = 8.209); the probability of getting a critical ratio 8.209 is less than 0.001. Thus, the regression weight for safety communication in predicting safety culture is significantly different from zero at the 0.001 level. Hence, there is evidence that hypothesis 2 is supported.

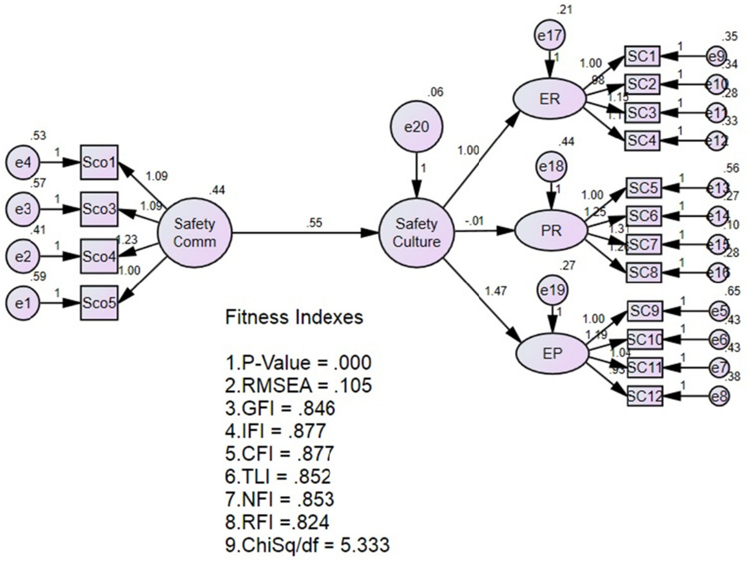

Figure 4. Regression weight of the effect of safety communication on safety culture

Table 5. Direct effect on safety communication and safety culture

			Beta Estimate	S.E.	C.R.	p-Value
Safety Culture	<---	Safety Communication	0.550	0.067	8.209	***
Result			Significant			

*** p-Value < 0.001

4.2.3 Hypothesis 3: Safety Culture Will Mediate the Relationship between Safety Communication and Human Factor Accidents

Based on the result outlined in Table 4, the direct effect between safety communication and human factor accidents is significant (Beta estimate = 0.550; P-value < 0.001). When the mediator (safety culture) enters into the model, the value of the beta estimate is expected to decrease, indicating that mediation effect exists in the model. Based on the AMOS output, all fitness indices have achieved the acceptable level (RMSEA = 0.075; GFI = 0.779; CFI = 0.849; Chisq/df = 3.235). As indicated in Table 6, the beta estimate value for direct effect of safety communication to human factor accidents declines from 0.292 to -0.056 after the mediating variable has been inserted. The relationship between safety communication and human factor accidents has become insignificant (P-value = 0.584) while the direct effect of safety communication and safety culture (beta estimate = 0.722; p-value < 0.001) and the relationship between safety culture and human factor accidents (Beta estimate = 0.490; P-value < 0.001) are found to be significant. To ensure mediation effect, the indirect value must be higher than the direct effect (Awang, 2014). The indirect effect value is 0.354 (0.722 × 0.490), which is higher than the direct effect estimate of -0.056. Thus, it can be concluded that safety culture does significantly mediate the relationship between safety communication and human factor accidents. Full mediation has existed since the direct effect is no longer significant after the mediating variable has been placed into the model. Hence, there is evidence that hypothesis 3 is supported

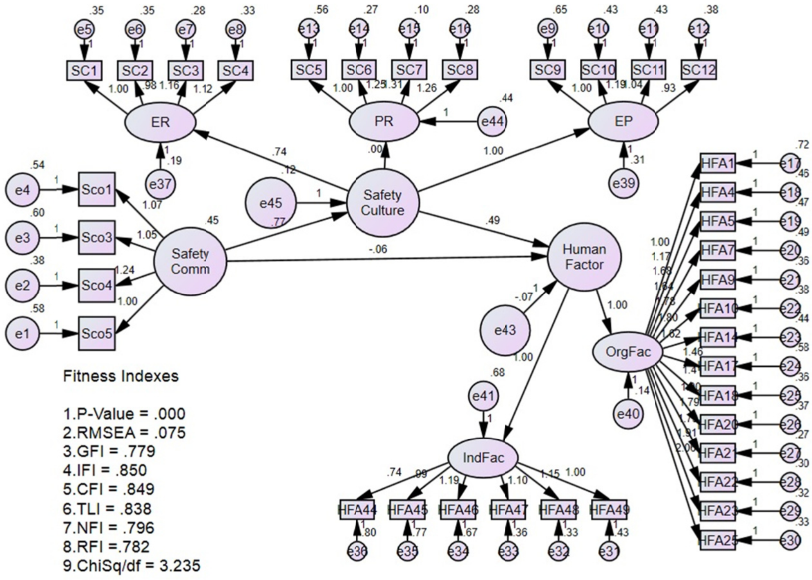

Figure 5. Regression weight of mediation model

Table 6. Regression weights of mediation

			Beta Estimate	S.E.	C.R.	p-Value
Safety Culture	←	Safety Communication	0.722	0.086	8.958	***
Human Factor Accidents	←	Safety Culture	0.490	0.134	3.663	***
Human Factor Accidents	←	Safety Communication	-0.056	0.103	-0.548	0.584
Result			Full Mediation			

*** p-Value < 0.001

5. Limitations and Recommendations for Future Studies

There are certain unavoidable restrictions of this study that are worth highlighting in this section. In terms of the choice of industry, this study focused on only the manufacturing industry front-line operators from the sector were chosen based on the directory published by the Federation and Malaysian Manufacturer (FMM)]. The findings herein may hence not be generalized to companies from other sectors of the manufacturing industry and other industries. It is recommended that future research on human factor accidents be carried out on other sectors and other industries in Malaysia. In terms of the choice of geographical site, this study was carried out in Negeri Sembilan, Malaysia. Based on the statistical report from the Social Security Organization (SOCSO) in 2013, one-quarter of accidents are from the manufacturing industry, with the highest number being reported in Negeri Sembilan. It is recommended that future research consider conducting their study in other areas of Malaysia.

The measurement of variables of this study could be restricted by the self-reporting method in the quantitative survey. For example, the measurement of safety communication perception of the workers is potentially limited by reliance on the self-reporting method. Feedback from the respondents is completely based on their opinions and not being influenced by the researcher. In this study, safety communication was measured by examining respondents' perceptions on their willingness to communicate safety-related issues with their superiors at the workplace. However, the willingness of respondents' to communicate with their leaders could also be examined by direct observation. Safety communication measures using the self-reporting method may be restricted by respondents who are fearful to tell the truth in real-life situations. Direct observation is suggested for future research examining respondents' perception and behaviour on the measurement of interest.

In addition, the current study involved only production workers. In the context of this study, front-line operators have been chosen as respondents to complete the questionnaire. Consequently, the findings might not be generalized to those not from the production department. Besides, not only is the perception of front-line workers important, but the opinions of managerial level are also essential and crucial to be taken into the consideration in a study on human factor accidents. The managerial level which usually are responsible for proposing and implementing safety rules and procedures might have different perspectives on safety in the organization. Their concerns about safety towards front-line workers might be varied due to different considerations. Hence, further research could be carried out by focusing managerial level at the workplace based on their perceptions and perspectives.

6. Discussion and Conclusion

Based on the literature review, it is believed that the occurrence of human factor accidents can be attributed to two dominant factors: the individual factor and the organizational factor. Unsafe acts and underlying hazards within the operating system of the company are believed to cause workplace accidents. Meanwhile, within the extent of this literature review, this study has found that effective safety communication would more or less affect the occurrence of human factor accidents at the workplace. In most circumstances, to ensure workers could work safely, it is necessary for safety information to be effectively disseminated among everyone in the organization. Feedbacks from the front-line workers are essential to the management level for further safety improvement in future. However, cultivating a positive safety culture at the workplace seems to be an important task to the management level. The importance of a safety culture is often overlooked by the workers. One contribution of this study is the concern of safety culture in the organization mediates the interaction between safety communication with human factor accident. Therefore, this study has confirmed not only the significant interaction between safety communication and human factor accident but also the mediating effect of safety culture between safety the two in the Malaysian manufacturing industry. This study has contributed to the attribute of safety culture as a critical mediator between safety communication and human factor accidents.

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