Safety Climate and Safety Outcomes in Aircraft Maintenance: A Mediating Effect of Employee Turnover and Safety Motivation

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SAFETY CLIMATE AND SAFETY OUTCOMES IN AIRCRAFT MAINTENANCE: A MEDIATING EFFECT OF EMPLOYEE TURNOVER AND SAFETY MOTIVATION

by

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ABSTRACT

Aircraft maintenance is viewed as a critical safety component in general and military aviation industries, and thus it is crucial to identify the factors that may affect aircraft maintenance. Because the safety climate is considered as a leading indicator of safety performance and safety outcomes, this study utilized this safety climate approach to develop a model which can explain the relationships between employee turnover, safety motivation, self-reported unsafe acts, reporting unsafe behaviors, incidents, and injuries in the aviation maintenance environment. This study included a sample of 283 technicians in military aircraft maintenance units who participated in a cross-sectional random survey. Data collected were analyzed using Exploratory Factor Analysis (EFA) and Structural Equation Modeling (SEM) techniques. A structural model that fitted the data was developed which predicted 64% of the variance in employee turnover, 7% of the variance in safety motivation, 20% of the variance in unsafe acts, 41% of the variance in reporting unsafe behavior, and 21% of the variance in workplace injuries. The results indicate employees who report a perception of high turnover exhibit decreased safety motivation and increased unsafe acts which lead to higher levels of workplace injuries. The perception of safety climate was identified as an antecedent to safety performance and safety outcomes. Additionally, the effects of control variables such as age and education were tested. The implications for safety management in aircraft maintenance were also discussed. This study provides directions for future research on the turnover of aircraft maintenance technicians, safety performance, and safety outcomes.

This dissertation is dedicated to the loving memory of my beloved father: Salman Alnoaimi (August 21st, 2005). I hope that this achievement of mine completes the dream he had for me.

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TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

LIST OF ACRONYMS

AMT: Aircraft Maintenance Technician

AVE: Average Variance Extracted

CFA: Confirmatory Factor Analysis

CR: Construct Reliability

EFA: Exploratory Factor Analysis

HFACS: Human Factors Analysis and Classification System

HRO: High Reliability Organization

MES: Maintenance Environment Survey

ML: Maximum Likelihood

NTSB: National Transportation Safety Board

PAF: Principle Axis Factor

RBAF: Royal Bahraini Air Force

SEM: Structural Equation Modeling

SMS: Safety Management System

SPSS: Statistical Package for the Social Sciences

CHAPTER ONE: INTRODUCTION

1.1 Background

Ensuring high levels of safety remain a top issue to aviation. According to Shappell and Wiegmann (2000), 80% of all civil and military aviation accidents have been linked to human error. Specifically, 20% of all these accidents have been attributed to maintenance and inspection errors (Drury, 2001). Thus, aircraft maintenance plays an important role and is considered as a critical safety component in aviation industries. Research has also shown that aircraft maintenance-related accidents are approximately 6.5 times more likely to result in fatal events than aircraft accidents in general (Marais & Robichaud, 2012). Extensive analysis of these accidents has shown that they are deeply rooted in organizational factors. Therefore, it is crucial to identify which of these factors link together to influence safety outcomes.

Research, over the thirty years, has led to a consensus that safety climate has become an important foundation for organizational health and safety. Safety climate is considered to be a leading indicator of safety outcomes (Zohar, 2010). Studies on safety climate have utilized the importance of organizational factors as antecedents of error (e.g., Wiegmann, von Thaden, Mitchell, Sharma, & Zhang, 2003). The human error accident investigation schemes within the aviation take into account not only the role of organizational variables but also the individual variables (Shappell & Wiegmann, 1997). Furthermore, identifying errors causation has led researchers to examine the links among safety climate, individual variables and unsafe behaviors such as violations and errors in aircraft maintenance environment (Fogarty, 2004; 2005; Fogarty & Buikstra, 2008; Fogarty & Shaw, 2010; Park, Kang, & Son, 2012).

While accident investigations can provide a wealth of information to improve safety, accidents are fortunately rare. Incidents should be investigated in more depth (Marais & Robichaud, 2012). Ostroff, Kinicki, and Tamkins (2003) recommended that research of culture and climate on studying organizational and individual behavior should be continued to contribute more knowledge to the field of industrial and organizational psychology.

1.2 Problem Statement

There is an extensive literature to support a relationship between safety climate and safety outcomes in aircraft maintenance (Fogarty, 2004; 2005; Fogarty & Buikstra, 2008; Fogarty & Shaw, 2010; Park et al., 2012). However, there is limited investigation of the effect of safety motivation and employee turnover on this relationship.

Safety motivation is considered as a determinant of safety performance (Campbell, 1990) and its influence has been used only in non-related aircraft maintenance studies (e.g., Chen & Chen, 2014; Neal & Griffin, 2006; Neal, Griffin, & Hart, 2000). On the other hand, studies of the effect of employee turnover have mainly focused on employee replacement cost, lower productivity, and other organizational performance (Allen, Bryant, & Vardaman, 2010; Dess & Shaw, 2001; Hancock, Allen, Bosco, McDaniel, & Pierce, 2013). Therefore, an empirical research is needed to address this important gap by examining the mediating effect of safety motivation and employee turnover on the relationship between safety climate and safety outcomes in an aircraft maintenance environment.

1.3 Research Objectives

The main objective of this study is to develop a model which can explain the relationships between safety climate, employee turnover, safety motivation, self-reported unsafe acts, reporting unsafe behaviors, and self-reported workplace incidents and injuries in the aviation maintenance environment. The model also tests the mediating roles of employee turnover and safety motivation on perceived safety climate and safety outcomes. Another study objective is to gain a better understanding of the maintenance technician's perception on safety within Royal Bahraini Air Force (RBAF). This study also examines the effects of age and education level on the research model constructs.

1.4 Research Hypotheses

In this research, the following hypotheses were proposed to test the structural relationships among the model constructs: A full details of the predication of these hypotheses are discussed in Chapter Two.

H1: Perceived safety climate has a direct effect on self-reported incidents and injuries.

H2: A self-reported unsafe act has a direct effect on self-reported incidents and injuries.

H3: A self-reported unsafe act has a direct effect on reporting unsafe behaviors.

H4: Perceived safety climate has a direct effect on reporting unsafe behaviors.

H5: Perceived safety climate has a direct effect on employee turnover.

H6: Employee turnover has a direct effect on safety motivation.

H7: Employee turnover has a direct effect on self-reported unsafe acts.

H8: Employee turnover will mediate the relationship between safety climate and self-reported unsafe acts.

H9: Perceived safety climate has a direct effect on safety motivation.

H10: Safety motivation has a direct effect on self-reported unsafe acts.

H11: Safety motivation has a direct effect on reporting unsafe behaviors.

H12: Safety motivation will mediate the relationship between safety climate and self-reported unsafe acts.

The next chapter provides a literature review of aviation maintenance and inspection tasks, human error in aviation maintenance, and human error models. Additionally, the concept of organizational culture and organizational climate, and the safety climate concept and its empirical development have been discussed. Research methodology is discussed in Chapter Three. Research findings are covered in Chapter Four, followed by discussion, conclusion, study significance, implications, limitations, and suggestions for future research in Chapter Five. Finally, appendices that provide supplemental information are also added to this study.

CHAPTER TWO: LITERATURE REVIEW

An in-depth literature review is conducted during the preparation of this work. At the beginning, the aviation maintenance and inspection tasks are presented. Next, an overview of human error in aviation maintenance is covered. In addition, human error causation models are further discussed. The chapter finishes by discussing the concept of organizational culture and organizational climate, the safety climate concept and its empirical development, and literature relating to the study variables and research hypotheses.

2.1 Aviation Maintenance and Inspection Tasks

Maintenance in general can be defined as a set of activities to repair and maintain equipment to a specified operating condition and consistent with cost effective, conform to safety, and environmental regulations (Pintelon & Gelders, 1992). The quality of maintenance tasks can be significantly affected by organizational cultural conceptions such as the better culture is, the lower chance of violations (Aju kumar & Gandhi, 2011). These conceptions made industries to realize the importance of maintenance and human error reduction (Reason, 1990; Shenoy & Bhadury, 1998) and especially after major accidents occurred. For example, some of the worst accidents in industrial history are the 1984 Bhopal Disaster of leakage of Methyl Isocyanite (MIC) in Bhopal in India and the 1986 Chernobyl Disaster in Ukraine. They were both caused by poor maintenance of the safety systems.

Safety is defined as " management of risk within a value that is acceptable to the society" (Patankar & Taylor, 2004). Patankar and Taylor (2004) define a maintenance action to be safe by aircraft maintenance technician (AMT) when:

1. AMT is qualified to perform the job.
2. AMT uses approved and appropriate data, tools, and procedures.
3. AMT does not exceed his physical capacity while performing the job.
4. AMT never signs off a job that he does not perform.
5. AMT never leaves any job with incomplete documentation.

Safety of aviation maintenance and inspection tasks depends on minimizing error in all facets of the system. This system is a complex one with many interrelated human and machine components, in which individuals perform varied tasks in an environment with time pressures, stress, fatigue, and sometimes difficult ambient conditions such as temperature and humidity. Chang and Wang (2010) explain AMTs work settings such as core capacity of the AMTs themselves, interactions with other technicians, and working on software and hardware technologies. In addition, AMTs perform many different maintenance tasks on different types of aircraft during working hours that can be either late at night or early morning.

The model system of aviation maintenance and inspection developed by Latorella and Drury (1992) contains four components: personnel, equipment, documentation, and task requirements. These components are subject to constraints of physical and the social environment or organizational environment. The interaction of the task with the human and the environment are the basis of most human errors.

2.2 Human Error in Aviation Maintenance

The typical definition of human error in maintenance and inspection refers to the activities of the inspector or repair person. Human error is the failure to achieve an intended outcome beyond the influence of random occurrence (Reason, 1990). Reason divided errors into three types; slips and lapses are failures of intended actions, while mistakes are failures of these intended actions to achieve the desired consequences. Reason distinguished between error and violation, while errors are related to the individual's cognitive process, violations are related to a social environment in which behavior is governed by operating procedures, recommended practice, rules, or standards. Hobbs and Williamson (2003) determined the contributing factors that associated with the types of errors in aircraft maintenance. For example, they found links between rule violations and time pressure and between memory lapses and fatigue.

An Australian aircraft maintenance study shows that 30.1% of errors that led to aircraft incidents were memory lapses and these errors had threatened the aircrafts safety. On the other hand, slips were the most common error that injured maintenance technicians. In addition, 19.3% of aircraft incidents and 25.7% of worker safety incidents were caused by violations (Reason & Hobbs, 2003).

Many aviation accidents were caused by maintenance errors which involved human factors. Therefore, these factors must be detected earlier to minimize accidents or workplace injuries. Additionally, general organizational characteristics influence performance at the individual level. Maintenance technicians' errors result from a series of contributing factors and these factors are under management control and, therefore, can be managed (Rankin, Hibit, Allen, & Sargent, 2000).

The concurrent trends of increased maintenance and inspection workload, and diminished maintenance personnel with generic human erring tendencies seem to forecast increasing safety issues associated with human errors in maintenance and inspection (Latorella & Prabhu, 2000). These maintenance-related errors can be described as immediate observable effect on aircraft equipment, ultimate effects on flight missions (incidents/accidents), and secondary effects on the organization productivity (Latorella & Prabhu, 2000). For example, 33% of all military aviation equipment malfunctions found to be resulted from poor prior maintenance or improperly applied maintenance procedures (Ruffner, 1990).

Another example failure of maintenance that provided cases of catastrophic is Alaska Airlines Flight 261 accident that occurred on January 31st, 2000. This flight suffered "a loss of airplane pitch control resulting from failure of the horizontal stabilizer trim system jackscrew assembly's acme nut threads" (Aviation Safety Network, 2002). According to the National Transportation Safety Board (NTSB), the thread failure was due to excessive wear which resulted from a missed or inadequately performance of lubrication since the last time that the task had been done. All of the 88 people onboard were lost as the plane crashed into the deep water. Later, NTSB revealed that this failure was compounded by poor maintenance from mechanics and neglecting from airlines managers, inspectors, and supervisors of keeping track of this procedure. This accident illuminates a poor safety climate which leads to the unsafe acts and conditions.

According to Reason (1990), the above maintenance error was considered to be as a latent error whose presence provoked the active failure from the pilot which led directly to the accident. Latorella and Prabhu (2000) have reviewed both reactive and proactive methods of error detection, and methods for controlling human errors in aviation maintenance. Wenner and Drury (2000) have studied the relationships between the hazard patterns and latent failures. They developed strategies by identifying the latent failures that common to different hazard patterns in order to prevent any upcoming damages.

2.3 Human Error Models in Aviation

Over the past decades, research of human factors has been increasingly concerned with developing tools for managing workforce unsafe acts. High reliability organizations (HRO) offer important models that constitute a resilient system. Such a system has safe practices which it enables the organization to withstand its operational dangers and to achieve its objectives (Reason, 2000). Previous investigation analysis have revealed that accidents are frequently repeating in the same sequence of events that played out many times before (Shappell & Wiegmann, 2009). Reason and Hobbs (2003) have also argued that earlier when they explained the error-inducing situations. They mentioned that “the maintenance error problem can be managed in the same way that any well-defined business risk can be managed”. What remains to be addressed are those accidents attributable to human error that jeopardize the aviation safety. The current aviation accident records reveal that 70% to 80% of all aviation accidents are at least partially attributable to human error (Shappell & Wiegmann, 2009).

The SHEL model that developed by Edwards (1988) provides an overview of the aviation ergonomics or systems perspective. SHEL describes four basic components of the interaction between human and machine to improve the system performance. These components are Software, Hardware, Environment, and Liveware. This model was recommended by the International Civil Aviation Organization (ICAO) in 1993 to be used as a framework in the investigation of aviation accidents (Wiegmann & Shappell, 2003).

Another model is the four P's of flight deck operations that developed by Degani and Wiener (1994). This model is focused on the interaction of philosophy of management, policies, procedures, and practices of aircrew for operations on the flight deck. All of these factors act together to enhance flight safety. In addition, the Reason's Swiss cheese model of accidents causation (1990) provides a comprehensive theory of human error. This model has four components: organizational influences, unsafe supervision, precondition for unsafe acts, and unsafe acts. According to Reason, if there are breakdowns in the interactions among these components, accidents might occur. On other way, these failures transfer through the holes within the layers of the system.

The Human Factors Analysis and Classification System (HFACS) model was developed by Wiegmann and Shappell (2001a) to understand the underlying causal factors that led to aviation accidents in the United States Navy. The HFACS framework was based on Reason's (1990) Swiss cheese model. The development of HFACS was driven by the increasing problems of human performance. The Federal Aviation Administration (FAA) has employed HFACS to identify human factors in commercial and general aviation (Wiegmann & Shappell, 2001a).

Accident investigators have used HFACS framework as a guide to identify failures within the organization and to identify where hazards have arisen historically within the entire system in order to prevent them from reoccurring.

Wiegmann and Shappell (2001b) claim that the HFACS framework links the gap between theory and practice by providing safety professionals with a theoretically based tool for identifying and classifying the human errors in aviation mishaps. The framework of the HFACS model has been used intensively in investigating aviation accidents (Dambier & Hinkelbein, 2006; Gaur, 2005; Shappell et al., 2007). Li and Harris (2006) suggest that active failures are supported by latent conditions in the organization and the HFACS framework was proven to be a useful tool for guiding accident investigations and developing accident prevention plans.

Krulak (2004) has proposed the HFACS Maintenance Extension (ME) which was adapted for maintenance-related mishaps. This taxonomy which was discussed by a number of studies (Krulak, 2004; Rashid, Place, & Braithwaite, 2010) was derived from the operational HFACS program for flight crews. HFACS-ME is an accident analysis system that is designed to deeply analyze human factors' influence on aviation maintenance. It describes the present errors and the latent supervisory, maintainer, and working conditions that cause unsafe maintainer acts. Krulak (2004) examined 1016 aircraft mishaps between 1996 and 2000 using information from the Maintenance Error Information Management System (MEIMS) web-based database. These mishaps were categorized using HFACS-ME. The third level factors of inadequate supervision, attention/memory errors, and judgment/decision errors were, respectively, involved in 80%, 51%, and 52% of the whole population of mishaps studied.

Rashid et al. (2010) introduced an organized list of specific failures resembling each of the HFACS-ME taxonomy third order categories. They concluded that a large proportion of accidents and incidents were caused by factors that were deeply rooted within organizational and managerial levels. Moreover, individual maintainer erroneous acts gained major scores of such causal factors. In addition, Rashid, Place, and Braithwaite (2013) were able to predict and provide guidance for future intervention of maintenance errors. They show that the scenarios for aviation maintenance errors initiation, occurrence, and further propagation are infinite. Thus, they concluded that only eliminating the basic root causes of errors will lead the way for a successful error-free performance.

2.4 Organizational Culture and Organizational Climate

Organizational culture and climate are each about understanding psychological phenomena in organizations despite the fact that they have been studied in different disciplines (Ostroff et al., 2003). Schneider, Ehrhart, and Macey (2013) have observed that organizational climate and organizational culture are two alternative constructs for conceptualizing the description and experience of people in their workplace.

The construct of organizational climate preceded the construct of organizational culture. The former was introduced in the 1960s and dominated early research on human organizational environments and then, the latter became a popular issue for study during the 1980s (Ostroff et al., 2003; Schneider et al., 2013). Culture and climate are both used in organizations to identify the environment that affects the behavior of people. Reichers and Schneider (1990) believe that both climate and culture are important concepts for organizations because in combination they identify and may prospectively predict human behavior. Ostroff et al. (2003, p 579) argue that,

> "The social and symbolic processes associated with the emergence of organizational culture and climate influence both individual and group behaviors, including turnover, job satisfaction, job performance, safety, and service quality".

The climate construct has been focused on measuring individuals' perceptions about their organizations' practices and procedures, rather than beliefs, values, or norms that shared by groups of people (Schneider, 1975; Trice & Beyer, 1993). Typically, organizational climate describes aspects of an organization's current state and thus it is regarded as a narrower concept than organizational culture (Glendon & Stanton, 2000) or it refers to psychological environments in which individuals' behaviors occurred (Trice & Beyer, 1993). Climate is also shared perceptions of organizational policies, practices, and procedures (Reichers & Schneider, 1990). On the other hand, organizational culture includes shared meanings, assumptions, and underlying values (Schein, 2004). Schein (2004) also defined organizational culture as a way of perceiving and thinking, and learned responses to the group's problems. Schneider (1990) has concluded that climate should be studied as a construct that includes the strategic focus of the organization's goals. This strategic focus needs to be the target of climate assessment for the management.

After reviewing articles in three of the top empirical journals in industrial/organizational psychology from 2000 to 2012, Schneider et al. (2013) concluded that the focus in the industrial/organizational psychology research literature has been shifted toward organizational climate rather than organizational culture.

Research on organizational culture uses qualitative approaches that conduct on participants' observation and through interviews. In their review on the content of organizational culture, Ostroff and colleagues (2003) have summarized that most researchers either use quantitative surveys to evaluate espoused values and beliefs or conduct qualitative analysis to evaluate the deeper layers of organizational culture. Furthermore, they conclude that researchers should use multiple methods to assess organizational culture. The increased use of qualitative methods in the study of organizational climate may result in richer and more useful descriptions of organizations (Reichers & Schneider 1990).

Figure 1 represents a heuristic model for providing a conceptual framework of culture and climate. It shows that organizational culture can affect organizational structure and practices which in turn provide the context for climate perceptions. In addition, psychological climate can be influenced by individuals' values and social cognitive processes. Therefore, an organizational climate is likely to emerge when these climate perceptions are shared across an organization's employees.

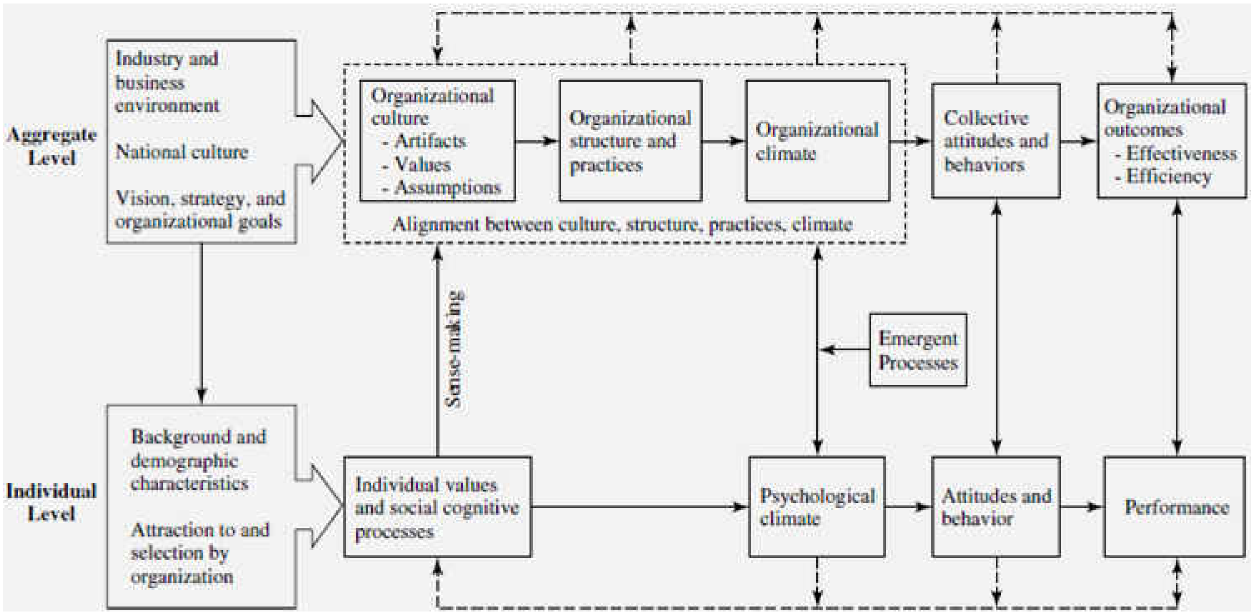

Figure 1: Multi-level model of organizational culture and climate
Source: Adopted from Ostroff et al, (2003)

Jones and James (1979) explain both individual and aggregate perceptions of the work environment for researchers. Individual perception is the psychological climate in which researchers should develop measures to address task and role elements as well as social and interpersonal characteristics. On the other hand, to aggregate such perceptions, researchers should draw inferences about organizations. Not only committed to the above, but researchers also need to develop an empirical assessment for both perceptions to determine whether individual and situational factors describe work environment conditions.

In their extensive review from previous studies, Jones and James (1979) have set measurement factors for psychological climate and they are as follows:

1. Job characteristics such as challenge, job pressures, role ambiguity, and role conflict.
2. Workgroup and social environment characteristics such as cooperation, friendliness, and pride.
3. Organizational characteristics with relatively direct ties to individual experience such as management awareness of employees' needs and fairness of the reward process.
4. Leadership (supervision) behaviors such as support, goal emphasis, and trust.

Schneider (1975) introduces the concept of the impact of climate perceptions on behaviors as environmental information that individuals need so they know the behaviors required by the organization. These behaviors will help them maintain a homeostatic balance with their environment. Based on his review of organizational climate, Schneider (1975) has outlined the way the climate construct is conceptualized by different researchers as a:

1. Dependent variable: understanding of the causes of climate perceptions.
2. Independent variable: a cause of attitudes or behaviors.
3. Mediating variable: between organizational behavior and individual behavior.

The managerial climate as described by McGregor (1960) is about Theories X and Y. For example, telling people what to do successfully and administering their rewards and punishments are tactics of control to procedures that Theory X emphasis on. On the other hand, Theory Y is about the nature of relationships with the surrounding environment that encourages commitment to organizational objectives. For example, if employees are lazy, unwilling to take responsibilities, intransigent, and uncooperative, Theory Y implies that the causes lie in management's methods of control.

2.5 Safety Culture and Safety Climate

In recent years, many safety studies have emphasized on the effect of organizational factors on safety climate. The terms safety culture and safety climate are defined below:

2.5.1 Safety Culture

Beliefs and values of health and safety in organization culture emerged the safety culture subset (Clarke, 1999). In the development of a positive safety culture study, Clarke (1999) suggests that different shared perceptions of safety among managers, supervisors, and employees will negatively influence staff-management communications, confidence in management and commitment to safety. The safety culture influences the employees' behavior on perceiving what is expected from them such as norms regarding acceptable behaviors (Clarke, 1996).

Safety culture operates at different levels and through various mechanisms. It can be noticeable at such levels of behaviorally, psychologically, and socially, and through mechanisms such as values, attitudes, beliefs, and normative behaviors. For example, the impact of the safety management system (SMS) on safety outcomes in aircraft maintenance organization is likely to be mediated by safety culture (McDonald, Corrigan, Daly, & Cromie, 2000).

2.5.2 Safety Climate

It appears to be increasing consensus about the nature of safety climate concept (Table 1), even though researchers have not provided one definitive description (Wills, Watson, & Biggs, 2006). However, the definition of safety climate has been generally accepted as a snapshot of workforce perceptions of safety (Flin, Mearns, O'Connor, & Bryden, 2000).

The study's of Zohar (1980) has been the origin of safety climate studies. Zohar (1980) constructed a 40-item questionnaire to measure safety climate in industrial organizations. This safety climate has served as a useful tool in understanding the effect of employees' perception of workplace safety on their occupational behavior. Then, safety climate has been studied through different industries such as chemical (Bosak, Coetsee, & Cullinane, 2013), automobile (Clarke, 2006), aviation maintenance (Fogarty & Shaw, 2010), and grain (Seo, 2005).

Safety climate has been used as an antecedent of safety performance, accidents, and injuries at workplace in many studies. Research has supported the role of safety climate as an alternative safety performance indicator (Guldenmund, 2000; Neal, Griffin, & Hart, 2000) and unsafe work behavior predictor (Seo, 2005). Neal et al. (2000) suggest that a specific climate for safety is more strongly related to safety performance than organizational climate. Varonen and Mattila (2000) have reported that safety climate is correlated with the accident rate such as the better it is, the lower the accident rate for the organization. In addition, researchers used empirical and cross-level studies that have shown relationships between safety climate and job satisfaction (Johnson & McIntye, 1998), and safety climate and emotional exhaustion in term of stress symptoms and fatigue (Feldt, Kinnunen, & Mauno, 2000).

Psychological safety climate has been used to help in explaining workers' safety behaviors (Bosak et al., 2013; Larsson, Pousette, & Törner, 2008; Morrow et al., 2010). Organization-level and group-level climates are globally aligned, and subunits (groups) safety climate mediates the effect of organizational safety climate on employee safety behavior (Zohar & Luria, 2005). However, Baba and his colleagues (Baba, Tourigny, Wang, & Liu, 2009) have showed that perceived safety climate and individual performance did not correlate significantly. They mentioned that the impact of safety climate on individual performance is moderated by personal characteristics and psychological factors.

Table 1 Definitions of safety climate

Reference	**Safety Climate**
Zohar (1980)	"A summary of molar perceptions that employees share about their work environments".
Brown & Holmes (1986)	"A set of perceptions or beliefs held by an individual and/or group about a particular entity".
Dedobbeleer & Béland (1991)	"Molar perceptions people have of their work settings".
Niskanen (1994)	"A set of attributes that can be perceived about particular work organizations and which may be induced by the policies and practices that those organizations impose upon their workers and supervisors".
Williamson, Feyer, Cairns, & Biancotti (1997)	"Safety climate is a summary concept describing the safety ethic in an organization or workplace which is reflected in employees' beliefs about safety".
Neal et al. (2000)	"A specific form of organizational climate which describes individual perceptions of the value of safety in the work environment".
Wills et al. (2006)	"Represents employees' perceptions about organizational support, especially toward safety".

Source: modified from Guldenmund (2000)

2.6 Literature Relating to Study Variables

The study variables were classified into four groups as follows: latent variables of safety climate, mediator variables of employee turnover and safety motivation, dimensions of safety performance, and dimensions of safety outcomes.

2.6.1 Determining Safety Climate Dimensions

Employees can experience safety climate in their workplaces. Their perceptions reflect the level to which they consider that safety is valued within the organization. On other word, the patterns of behavior that support safety should form climate for safety (Patterson et al., 2005). What to study in climate research depends upon the objectives of the study. Safety climate can be made up by a large range of factors (Guldenmund, 2007). The researcher decides about which variables to be included based on selection research-type considerations. Schneider (1975) reveals in his literature review that many climate researchers have evaluated the specific climate in which they were interested rather than attempting to develop some omnibus measure. It is possible that the safety climate dimensions within one industry may not work well in another industry (Vinodkumar & Bhasi, 2009).

According to Griffin and Neal (2000), the safety climate can be identified as a higher order factor by using specific first-order dimensions which reflect employee perceptions of safety-related factors (e.g. policies, procedures, and rewards) in the work environment. Moreover, the above authors suggest using this higher order factor for the purpose of determining the effect of safety climate on safety outcomes and using the first-order factors for other purposes. Therefore, several safety climate studies were reviewed to determine those first-order factors that constitute safety climate that are applicable for an aircraft maintenance environment.

Flin et al. (2000) have reviewed 18 published reports of safety climate surveys and examined 18 dimensions that were used to assess safety climate. They have found that the most three typically assessed dimensions were related to management/supervision, safety system, and risk. According to O'Connor, O'Dea, Kennedy, & Buttrey (2011), management/supervision factor was in all of the aviation safety climate questionnaires. Fogarty (2004) used five variables to measure safety climate in aircraft maintenance facility; supervision, safety focus, recognition, feedback, and training. Park et al. (2012) used the same variables as Fogarty (2004) in determining safety climate in aircraft maintenance unit. However, they replaced both recognition and feedback with communication and coworker support. Their decision was based on that the former variables have negative effects on other employees who have not been rewarded especially in military organization. In addition, Zohar and Luria (2005) used 16 items to measure the group-level safety climate. These items cover three content themes: Active Practices (Monitoring, Controlling), Proactive Practices (Instructing, Guiding), and Declarative Practices (Declaring, Informing). The contents of these items are mostly similar to those in Fogarty (2004) and Park et al. (2012).

As a result, a combination of all safety climate first-order factors from Fogarty (2004) and Park et al. (2012) studies was used in this research except that communication and feedback were combined under one factor similar to that study of Vinodkumar and Bhasi (2010). Thus, this study adopted the safety climate as the measured construct with a proposed set of first-order factors contained supervision, safety focus, safety communication and feedback, recognition, coworker support for safety, and training. These factor are discussed as follow:

2.6.1.1 Supervision

Management/supervision is a measurement of an organization's safety climate that relates to perceptions of management attitudes and behaviors with respect to safety. Generally, it is measured by respondents' satisfaction with supervision in relation to safety or through how employees experience support and understanding from their supervisors. This recognizes the key role of the perception of the first-line supervisor to safety. Subordinates with high-quality supervisor relations had more positive climate perceptions than those with low-quality relations (Kozlowski & Doherty, 1989). Management support for safety can take the form of managers and supervisors (Thompson, Hilton, & Witt, 1998). Managers have to lead and create a climate for attitude and culture change. They have to adopt a coaching stance and offer a role model (Ball & Procter, 1994). Perceptions of managers' safety commitment by workers would have a significant effect on their safety behavior in which they are more likely to report any incidents (Clarke, 1996). Furthermore, management commitment to safety was found to be negatively related to employee's risk behavior (Bosak et al., 2013).

In a superior-subordinate relationship, behavior and attitude of the superior correlate both with high productivity and with the morale of subordinates (McGregor, 1960). Supervisors demonstrate safety concerns to the shop floor more directly than managers (Kozlowski & Doherty, 1989). Supervisors appear to influence safety by influencing the fairness through the interaction with employees, thus leading to employee impressions of supervisors' safety concerns (Thompson et al., 1998).

In their recent research on safety climate, Zohar and Luria (2005) revealed meaningful sub-units (groups) variation in a single organization, attributable to supervisory discretion in implementing formal procedures regarding safety versus workload. They judged that top managers are concerned with establishing procedures (tactical guidelines) to implement the organization's policy (strategic goals) whereas supervisors' practices are to execute and direct these procedures. The intensity with which supervisors respond to safety issues establishes the expectancy valence associated with safe or unsafe behaviors. As a result, the relationship between group-level climate and safe behaviors should be positive within the subunits (Zohar, 2000). In addition, hierarchical level of the leaders has a different effect on the relationships between leaderships and safety and this is due to the increased distance between leaders and shop-floor employees (Zohar, 2002).

2.6.1.2 Safety Focus

Safety focus is an organization commitment to safety. More specifically, it is about aspects of the organization's safety management system such as safety policies and safety equipment. However, in this study, it has been used as employees' satisfaction and attitudes toward workplace safety. For example, if safety issues are repeatedly ignored or made contingent on maintenance workload, maintenance technicians will infer low safety priority, leading them to assess that shortcut procedure is more likely to be supported than safe behavior.

2.6.1.3 Safety Communication and Feedback

Communication is about sharing of information throughout the organization. In aviation maintenance, a good communication may be considered as a foundation for organization successful (Taylor, 2000). According to Endsley and Robertson (2000), management needs to provide maintenance technicians not only with knowledge, but also with the skills and abilities to effectively communicate their knowledge in order to complete their tasks efficiently. In many cases, communication and coordination break down when maintenance technicians make unspoken assumptions and poor communication to confirm the situation (Reason & Hobbs, 2003).

It has been empirically shown that communication is an important factor of safety climate (DeJoy, Schaffer, Wilson, Vandenberg, & Butts, 2004). O'connr et al. (2011) indentified safety communication to be a factor of safety climate that is particularly relevant to aviation. In addition to the importance of communication, safety communication may be considered as a challenge in the aviation industry than other industries and this due to the less ability of engagement in direct communication among air traffic control, maintenance, pilots, and other parties. Johnson and McIntye (1998) have found that communication was strongly associated with scores on job satisfaction. Their data were collected from 8,126 employees in a large government service agency.

2.6.1.4 Recognition

The process of employee recognition can promote safe behaviors and reduce unsafe behaviors at work. Employees feel that their work is valued when their good work is recognized.

Thus, they will have a positive organizational climate and will be more satisfied and motivated to improve their safety at workplace. Therefore, organizations should work on recognizing their employees to increase their sense of achievement for their work well done. In addition, this recognition is meant to encourage more of their actions and to reinforce their positive behavior that need to be repeated.

2.6.1.5 Coworker Support for Safety

Pettersen and Aase (2008) shows that the support a technician gets from colleagues is important for safe work practices in aviation line maintenance. Coworker can influence safety-related communication (Tucker, Chmiel, Turner, Hershcovis, & Stride, 2008), safety regulations (Laurence, 2005), and risk-taking behavior at work (Westaby & Lowe, 2005).

2.6.1.6 Training

Training refers to the adequacy of training for the job and the extent to which management concerns with developing employees' technical skills, knowledge, and qualifications. Cooper and Phillips (2004) demonstrated that employee perception toward the importance of safety training when measuring safety climate factor was highly predictive of actual safety behaviors.

2.6.2 Determining of Employee Turnover Dimensions

There are two types of employee turnover, voluntary and involuntary. However, the focus of this research is on the voluntary one. Voluntary turnover is "an employee's decision to terminate the employment relationship" (Dess & Shaw, 2001). According to Sheehan (1993), if an employee is dissatisfied and leaves the job for a better position elsewhere, this may reflect negatively on the remaining employees. More specifically, employee turnover may influence the remaining employees' attitudes and behaviors toward their jobs and thus, affect their productivity.

The three best predictors of employee turnover are job satisfaction, organizational commitment, and turnover intention (Allen et al., 2010, Griffeth, Hom, & Gaertner, 2000; Maertz & Campion, 1998). In addition, according to Mor Barak (2001), the best predictors of intention to leave are job satisfaction, organizational commitment, and burnout (emotional exhaustion). However, on the other side, the pay level was found to be a weak predictor of individual turnover decisions (Allen et al., 2010; Griffeth et al., 2000).

Many studies have used turnover intention instead of actual turnover as an outcome variable. On the other hand, Vandenberg and Nelson (1999) suggest that other measures besides turnover intention should be included in the process of predicting turnover. Therefore, job satisfaction, organizational commitment, turnover intention, and emotional exhaustion have been used as predictors of employee turnover in this study.

2.6.2.1 Job Satisfaction

Job satisfaction research focuses on the individual's evaluation of organizational practices and procedures or the outcomes attained from organizational participation (Schneider, 1975). Employees who report high scores on job satisfaction tend to report that they receive fair recognition for job performance and valuable job-related feedback (Johnson & McIntye, 1998). For example, research has shown that employee perceptions of co-worker involvement and supervisory support can reduce stress and increase job satisfaction (Babin & Boles, 1996; Hombrados-Mendieta & Cosano-Rivas, 2013).

It has been proposed that organizational productivity was achieved by employees' satisfaction through attaining their physical and emotional needs (Ostroff et al., 2003). The negative performance-turnover relationship is stronger in organizations when reward contingency exists (Griffeth et al., 2000; Williams & Livingstone, 1994). This could be explained by that reward contingency influences turnover through employee satisfaction (Wells & Muchinsky, 1985). A positive safety climate is likely to increase employees' satisfaction and commitment toward their jobs (Clarke, 2010; Fogarty, 2004; Park et al., 2012) which in turn reduces turnover (Fogarty, 2004). In other words, if there are more job satisfaction and organizational commitment, there will be a less likelihood of employee turnover. In addition, Wright and Bonett (2007) have found that there is a strong negative relationship between job satisfaction and employee turnover

2.6.2.2 Organizational Commitment

Organizational commitment is often used to describe employee-organization linkages as individuals actually experience this relationship (Reichers, 1985). Mathieu and Zajac (1990) have found that there is a negative relationship between organization commitment and employee turnover. So when employees are dissatisfied with their jobs or not feeling that they belong to the organization, they most likely quit. However, Sjöberg and Sverke (2000) have found that turnover intention mediates the effect of organizational commitment on employee turnover.

2.6.2.3 Turnover Intention

Turnover intention refers to the probability that individuals will quit their jobs in the near future (Vandenberg & Nelson, 1999). Van Breukelen, Van der Vlist, and Steensma (2004) concluded that turnover intention is by far the best predictor of actual turnover and their result supports other results from two previous studies (George & Jones, 1996; Mor Barak, Nissly, & Levin, 2001). Turnover intention would be high if there are alternative employment opportunities. However, Vandenberg and Nelson (1999) argued that it should not be assumed that this intention cannot be lowered.

2.6.2.4 Emotional Exhaustion

Emotional exhaustion, depersonalization, and lowered personal accomplishment are generally accepted as the core meaning of burnout (Maslach & Jackson, 1981). However, emotional exhaustion constitutes the primary factor (Gaines & Jermier, 1983). Emotional exhaustion is characterized by a lack of energy and it is a chronic state of physical and emotional resources depletion (Cordes & Dougherty, 1993). Workers realize they cannot continue to give more or to be as responsible as they have been in the past. Wright and Cropanzano (1998) argued that emotional exhaustion is associated with both job performance and subsequent employee turnover, and unrelated to job satisfaction. However, Firth and Britton (1989) found no significant relationship between employee turnover and emotional exhaustion.

Other researchers have suggested that burnout can influence individual attitude, which in turn affects turnover (Jackson, Schwab, & Schuler, 1986; Wright & Cropanzano, 1998). Cordes and Dougherty (1993) summarized that burnout represents a particular type of job stress, in which a pattern of its three core components that described as strains results from a variety of work demands that describe as stressors, especially those of an interpersonal nature. Burnout and job satisfaction have a significant positive correlation (Wolpin, Burke, & Greenglass, 1991). In their study about job burnout among airline employees, Tourigny and his colleagues (Tourigny, Baba, & Lituchy, 2005) found that the relationship between emotional exhaustion and diminished personal accomplishment is moderated by absence.

Organizational characteristics such as contingency of rewards and punishments are considered as antecedents of burnout (Cordes & Dougherty, 1993). Emotional exhaustion and perceived safety climate can affect individual work performance independently and jointly in aviation industry (Baba et al., 2009). Managers need to be aware of the climate of the supervision, such as supervision meetings that reinforce the worker's value in the organization. Supervisors support can reduce the feeling toward burnout (Collings & Murray, 1996; Hombrados-Mendieta & Cosano-Rivas, 2013).

2.6.3 Safety Motivation

Safety motivation refers to "an individual's willingness to exert effort to enact safety behaviors and the valence associated with those behaviors" (Neal & Griffin, 2006). Safety climate is an antecedent of safety motivation (Barbaranelli, Petitta, & Probst, 2015; Griffin and Neal, 2000). Griffin and Neal (2000) argued that safety performance must be determined by the individuals' motivation to perform the behaviors. Studies have shown that perceived organizational concern for employee safety can influence safety climate and thus, motivates employees to perform safely (Christian et al., 2009; Clarke, 2006; Griffin & Neal, 2000).

2.6.4 Determining of Safety Performance Dimensions

“ Safety performance is viewed as reflecting behaviors, rather than outcomes” (Sackett, 2002). For example, violation of safety procedures is a behavior which might put individual, others, and organization at risk. Safety performance may be used to refer to “a metric for safety-related behavior of individuals” (Christian et al., 2009).

Understanding the importance of safety performance is critical for guiding management efforts toward the enhancement of safe work behavior. Burke, Sarpy, Tesluk, and Smith-Crowe (2002) defined general safety performance as individuals’ behaviors that exhibit to encourage the health and safety of workers and environment. They developed a 4-factor model of general safety performance with performance factors labeled; using personal protective equipment, engaging in work practices to reduce risk, communicating health and safety information, and exercising employee rights and responsibilities.

Safety knowledge and safety motivation are most strongly related to safety performance behaviors while group safety climate has a strong relationship with accidents and injuries (Christian et al., 2009). Using safety performance as individual behaviors provides researchers with a measurable criterion, which is more proximally related to psychological factors than incidents, accidents, or injuries (Christian et al., 2009). Fogarty and Buikstra (2008) have used self-reported errors and violations behaviors to measure safety performance in aviation maintenance. Griffin and Neal (2000) have used safety compliance and safety participation to represent safety behavior in a way of mitigation violations and maintenance errors occurrences. Therefore, in this study, unsafe acts and reporting unsafe behaviors were used to represent safety performance in aircraft maintenance.

2.6.4.1 Unsafe Acts

In general, the unsafe acts of maintenance technicians can be classified into two categories: errors and violations (Reason, 1990). Reason acknowledged the importance of intentional violations in his unsafe acts model. Additionally, Lawton and Parker (1998) suggest that errors and violations should be considered as unsafe act routes to accidents at work.

2.6.4.1.1 Errors

Errors in the aircraft inspection and maintenance environment arise from situational and system characteristics, human erring tendencies, and interactions between them (Latorella & Prabhu, 2000). These errors take the form of unintentional deviations from operating procedures, practices, and rules (Reason, 1990). Errors also arise when "the mental processes necessary for correct performance are incompletely specified" (Reason, 2008, p. 46). Examples of these under-specifications are inattention, forgetting, and incomplete knowledge.

Fogarty (2004) used a safety climate approach to develop a model to explain the relationships between employee morale, psychological health, turnover intentions, and errors at work by using data that were collected from an Australian aircraft maintenance fleet. In addition, Fogarty (2005) tested the mediating effect of psychological strain on the relationship between safety climate and maintenance errors. Fogarty found that the effect of safety climate on errors is partially mediated by the strain factors. Park and his colleagues (Park et al., 2012) replicated the study of Fogarty (2004) by using data from Korean aircraft maintenance unit. Their results show that a high performance and fewer maintenance errors occur when technicians experience less fatigue and stress.

2.6.4.1.2 Violations

The root causes of most accidents have been traced to latent organizational factors (Reason, 1995). These latent failures create the local conditions that help in rising errors and violations. Reason (1995) defines violations as “the deliberate deviation of actions from safe operating procedures” and thus, they bring performers into areas of greater risk. Hobbs and Kanki (2008) relate aviation maintenance violations mostly to the weakness of management and less supervision within the organization. They also argue that the most reason behind a work not being performed by maintenance personnel is his violations in act of deliberate decisions. They also conclude that local workplace factors can be antecedents of violations errors and thus, they can lead to negative maintenance outcomes.

Research has demonstrated that the link between violations and errors shows that procedural violations are the best predictors of incident involvement (Hofmann & Stetzer, 1996; Mearns, Whitaker, & Flin, 2001). Fogarty and Shaw (2010) employed the Theory of Planned Behavior to understanding violation behaviors in aircraft maintenance. They highlighted the importance of management attitudes and found that the employees’ perceptions of group safety norms (e.g., other people in my workplace violate procedures) has a strong influence on violations.

2.6.4.2 Reporting Behaviors

For self-report unsafe behaviors, managers should encourage employees to report near-misses without fear of disciplinary action and blame, so they can look at potential failures or hazards which could lead to future accidents (Ball & Procter, 1994). Maintenance technicians may hesitate to report their own errors and violations for fear of reprisal from management. Therefore, any maintenance-error reporting system will likely require some level of immunity to disciplinary action to be successful (Goldman, Fiedler, & King, 2002).

Most of error reports are used for administrative purposes such as documenting error situations rather than understanding the causal factors that led to those errors (Latorella & Drury, 1992). Some punitive safety systems emphasize on reporting safety outcomes more than safety behaviors such as reporting safety concerns and thus they may discourage individuals to further report these kinds of concerns (Probst & Estrada, 2010). Finally, reporting behavior is most influenced by managers' reactions to reports (Clarke, 1998).

To overcome the barriers of filing safety reports, Reason and Hobbs (2003) emphasized on creating a reporting culture. They developed some characteristics to have a successful reporting system and they are as follow:

- De-identification: anonymity or confidentiality of the reports.
- Protection: some guarantees for reports of honest errors.
- Separation of functions: separate the department of collecting the reports from that with disciplinary authority.
- Feedback: feedback to the reporting individual or agency is very important.
- Ease of making the report: report with open and less constrained format.

2.6.5 Safety Outcomes

According to Christian et al. (2009), safety performance and safety outcomes are different. Safety outcomes are physical events such as incidents, accidents, or injuries. Unfortunately, incidents can happen and employees may be injured at the workplace. For example, not complying with the organizational safety policies can have a high potential of workplace incidents and injuries (Probst & Brubaker, 2001). Reason (2008) defines incidents as events of sufficient severity that need to be investigated.

2.7 Literature Relating to Research Hypotheses

2.7.1 Development of a Model Addressing Safety Climate and Safety Outcomes

The following sections explain the development of a model that demonstrates the possible relationships between safety climate, employee turnover, safety motivation, unsafe acts, reporting unsafe behaviors, and workplace incidents and injuries.

2.7.1.1 Safety Climate, Safety Performance, and Safety Outcomes

The relationship between perceived safety climate and safety outcomes can be mediated by individual variables. The link of this relationship has been examined through safety climate studies, such as compliance with safe working procedures, accidents or injuries. For example, employees' perceptions of the safety climate affect their behavior which in turn affects the probability of workplace incidents and injuries (Griffin & Neal, 2000; Neal & Griffin, 2006). Pousette, Larsson, and Törner (2008) have also found a significant causal relationship between safety climate and employees' behaviors toward safety. According to Hofmann and Stetzer

(1996), the effect of safety climate on both unsafe behaviors and accidents in the workplace is negative. Additionally, Wallace, Popp, and Mondore (2006) supported this result on accidents.

Theory such as reasoned action (Fishbein & Ajzen, 1975) suggests that safety outcomes are best predicted by individual behaviors or by other factors that are not controlled by that individual. Indeed, a number of studies has found that the relationship between safety climate and safety outcomes is mediated by safety behavior either by fully mediation (Christian et al., 2009; Zohar, Huang, Lee, & Robertson, 2015), or partially mediation (Clarke, 2010). Therefore, a good safety climate will lead to a better safety performance, which results in better safety outcomes. Thus, it is expected the following hypotheses to be:

Hypothesis 1: Perceived safety climate has a direct effect on self-reported incidents and injuries.

Hypothesis 2: A self-reported unsafe act has a direct effect on self-reported incidents and injuries.

Reporting system must be supported by the management. For instance, if managers are concerned about safety incidents, the employees are more likely to report these incidents (Clarke, 1998). Furthermore, reporting behaviors of safety concern, accidents and injuries were lower in working environment with poorer safety climate or where supervisor enforcement of safety policies and practices was weak (Probst & Estrada, 2010). However, unsafe acts should occur first and then can someone report them. Accordingly, it can be predicted from safety climate that employees who perceived a more positive safety climate will engage in more reporting of safety concerns. Neal et al. (2000) found a significant direct path from safety climate to safety participation such as putting effort into improving safety in the workplace. Therefore, direct effects of safety climate and unsafe acts on reporting unsafe behaviors are expected. Accordingly, the following hypotheses are proposed:

Hypothesis 3: A self-reported unsafe act has a direct effect on reporting unsafe behaviors.

Hypothesis 4: Perceived safety climate has a direct effect on reporting unsafe behaviors.

2.7.1.2 Employee Turnover as a Mediator between Safety Climate and Safety Performance

Research of employee turnover has examined workforce-related performance based on social capital theory (Dess & Shaw, 2001; Shaw, Gupta, & Delery, 2005). For example, it is expected from employees who receive a preferential treatment from the organization to increase their productivity as well as adhering to safety policies and procedures. Williams and Livingstone (1994) have suggested that when employers reward good performance, employees are more likely to stay. A number of research has cited that the support factor at workplace has a negative direct effect on employee turnover (Kim & Stoner, 2008; Mor Barak et al., 2001; Nissly, Barak, & Levin, 2005). The sources of this support are from supervisors and top managers through an emotional and informational ways.

In this study, employee turnover was measured by the employees' perceptions of their job satisfaction, organizational commitment, emotional exhaustion, and intention to quit and not by actual turnover. However, understanding the impact of the actual turnover on organizational and individual levels can provide important information. According to Shaw (2011), there is a negative relationship between employee turnover rates and safety performance. However, other study has shown that the correlation of turnover rates-performance was very weak when performance was measured as safety-related performance such as accident rates or service violations (Park & Shaw, 2013). Moreover, a direct negative relationship between employee turnover rates and safety outcomes such as accident rate was found by Hancock et al. (2013). Additionally, Shaw et al. (2005) have found that workforce performance is high when employee turnover is low but gets lower as turnover increases which in turn leads to increase accident rate.

However, since safety motivation factor has been included in the study, it was expected that employee turnover will affect this motivation according to the two-factor theory (Herzberg, Mausner, & Snyderman, 1959). This theory suggests that creating a positive culture in the workplace (i.e., good supervision and employee-employer relationship) can increase employees' pride of what they are doing and increase interest of the job too. Therefore, they will have a feeling of job achievement which will boost their motivation to improve safety at workplace. In addition job satisfaction motivates individual to perform safely again and again (Petersen, 1978).

The Swiss cheese model of human error causation that developed by Reason (1990) describes four human failures before an accident or incident could happen. The first two failures are organizational influences (e.g., training) and unsafe supervision which are similar to the safety climate construct. The third failure is precondition for unsafe acts like personnel factors and conditions of employees, which it is like the employee turnover conditions (e.g., emotional exhaustion from stress and fatigue). The last failure of Reason's model is unsafe acts construct which has been used in this study. Accordingly, on the basis of the above theories, the following hypotheses are proposed:

Hypothesis 5: Perceived safety climate has a direct effect on employee turnover.

Hypothesis 6: Employee turnover has a direct effect on safety motivation.

Hypothesis 7: Employee turnover has a direct effect on self-reported unsafe acts.

Hypothesis 8: Employee turnover will mediate the relationship between safety climate and self-reported unsafe acts.

2.7.1.3 Safety Motivation as a Mediator between Safety Climate and Safety Performance

Safety motivation is described as "attitudes and perception relating to the influences motivating safe and unsafe behaviors" (Williamson et al., 1997, p. 17). Theory of individual performance suggests that skill, knowledge, and motivation are the determinants of performance (Campbell, 1990). Campbell argued that safety performance must be determined by the motivation of individuals to perform the behaviors. In addition, Petersen (1978) developed the motivation-reward-satisfaction model that describes skill and motivation as antecedents of work performance. Research demonstrates that safety motivation to be a significant factor in predicting safety behaviors (Chen & Chen, 2014; Neal et al., 2000). For example, safety motivation mediates the link between safety climate and safety performance (Griffin & Neal, 2000).

Expectancy Theory has been responsible of linking safety climate with safety motivation (Vroom, 1964). This theory predicts that employees will be motivated to perform safely in favorable of the desirable outcomes. Chen and Chen (2014) have stated that pilots' positive perceptions of the airline's safety management system (SMS) practices have positive effects on their safety motivation. Therefore, the following hypotheses are proposed:

Hypothesis 9: Perceived safety climate has a direct effect on safety motivation.

Hypothesis 10: Safety motivation has a direct effect on self-reported unsafe acts.

Hypothesis 11: Safety motivation has a direct effect on reporting unsafe behaviors.

Hypothesis 12: Safety motivation will mediate the relationship between safety climate and self-reported unsafe acts.

CHAPTER THREE: METHODOLOGY

3.1 Introduction

The increased number of aviation maintenance errors has increased the awareness of research on human factors. Moreover, to grant the aircrews and the public the confidence of a safe and a reliable air transportation system, enhancing the factors that affect aircraft maintenance safety must be continued. Therefore, the purpose of this research was to determine the relationships between employee turnover, safety motivation, and safety outcomes in an aircraft maintenance environment.

3.2 Proposed Research Model

The proposed research model in Figure 2 was developed based on the proposed research hypotheses. This model shows that safety climate, employee turnovers, and unsafe acts are higher order factors consisted of specific first-order factors. Safety motivation and employee turnover are mediating the relationship between safety climate and safety performance. In addition, the unsafe acts construct is mediating the relationships between employee turnover, safety motivation, and safety outcomes.

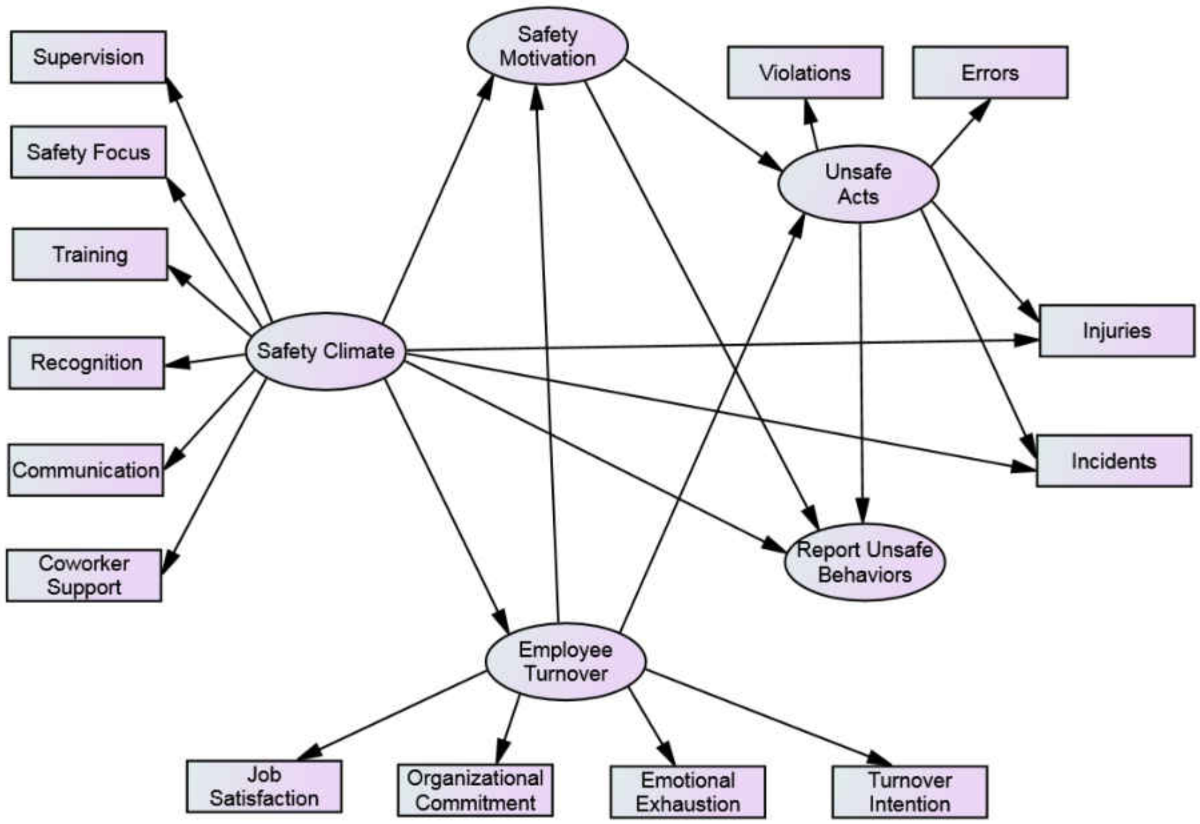

Figure 2 Proposed Research Model Linking Safety Climate, Safety Motivation, Employee Turnover, Self-Reported Unsafe Acts, Reporting Unsafe Behaviors, and Self-Reported Incidents and Injuries.

3.3 Research Survey

Quantitative methods, such as cross-sectional questionnaires, have commonly been used to assess the perceptions of safety climate in many industries (Denison, 1996). This method collects data from asking large numbers of people about certain questions in a practical way in terms of time and cost effective manner.

This study is a non-experimental research in the form of survey where many aircraft maintenance technicians (AMTs) have been surveyed to produce a large number of variables. Most of safety climate, employee turnover, and safety performance scales in this study were adapted from scales in validated surveys developed by Fogarty (2004; 2005) named as Maintenance Environment Survey (MES). Then, they were further modified and extended to reflect the purpose of this study by utilizing other important scales and items from previous published studies. Furthermore, some items were reverse-scored in order to encourage participants to read each question carefully.

Fogarty constructed some dimensions that are beneficial to research on maintenance errors and violations. He used the principle of triangulation to separate the constructs that only relevant to a maintenance environment. He used three main safety climate studies in aviation maintenance as guidance. The first one is called the Maintenance Resource Management/Technical Operations Questionnaire (MRM/TCQ) developed by Taylor & Thomas (2003), the second is Organizational Safety Culture Questionnaire developed by Patankar (2003), and third is Commercial Aviation Safety Survey (CASS) developed by Wiegmann, von Thaden, Mitchell, Sharma, and Zhang (2003). Then, he analyzed both maintenance incident database and associated incident investigation reports and found that inadequate training and poor supervision were contributed the most to those incidents. Finally, he implemented a series of focus group interviews which highlighted some factors that affected the maintenance tasks.

3.4 Survey Development

The current study survey was designed to measure safety climate, employee turnover, safety motivation, self-reported unsafe acts, reporting unsafe behaviors, and self-reported workplace incidents and injuries. The study survey was divided into two parts; part one was related to descriptive statistics and part two was related to study's variables. The survey questions were translated carefully into Arabic language. Two experienced aircraft maintenance leaders were asked to check the appropriateness of the translation. The measures of the study are discussed below and are also summarized in Table 2.

3.4.1 Supervision

Participants responded to nine survey items that measured their perceptions toward their supervisors at workplace. Seven items were adopted from the supervision scale of second version of Maintenance Environment Survey (MES) that developed by Fogarty (2005). In addition, two items were also added to this scale. The first one "My immediate supervisor helps me with my personal concerns and difficulties" was selected from the first version of MES developed by Fogarty (2004) and the second one "My supervisor always tries to enforce safe working procedure" was selected from the scale of safety rules and procedures developed by Vinodkumar & Bhasi (2010). These items were rated with a 5-point Likert Scale format ranging from 1 (*strongly disagree*) to 5 (*strongly agree*). A higher score indicates a higher level of supervision.

3.4.2 Safety Focus

Six items were used to measure the extent to which management identified safety as a core value and individual's concern toward safety. Five items were adopted from the safety concern scale of the second version of MES developed by Fogarty (2005). Another item "The safety procedures and practices in this organization are useful and effective" from safety rules and procedures scale developed by Vinodkumar and Bhasi (2010) was selected too. These items were rated with a 5-point Likert Scale format ranging from 1 (*strongly disagree*) to 5 (*strongly agree*). A higher score on this scale indicates a positive perception of safety.

3.4.3 Safety Communication and Feedback

Fogarty did not use the communication as safety climate construct in his early versions of MES and used the factor feedback instead. However, he added communication in the third version of MES with three items focusing only on communicating issues from management to tradesmen and their supervisors (Fogarty & Buikstra, 2008).

Eight items were used to measure the degree to which respondents evaluated information exchange within the unit. One item "My supervisor keeps me regularly informed of my progress" was from feedback scale (Fogarty, 2005). Three items were selected from communication scale developed by Cheyne, Cox, Oliver, and Tomás (1998). Two items "Management operates an open policy on safety issues" and "There is sufficient opportunity to discuss and deal with safety issues in meetings" from safety communication and feedback scale of Vinodkumar and Bhasi (2010) were also added. Finally, the remaining two items were taken from response and feedback scale (Gibbons, von Thaden, & Wiegmann, 2005). All items were rated with a 5-point Likert Scale format ranging from 1 (*strongly disagree*) to 5 (*strongly agree*). So, a higher score reflects greater communication and feedback processes.

3.4.4 Recognition

Five items were used to measure the extent to which the respondent thought about rewards and recognition system. Three items were from recognition scale (Fogarty, 2004; 2005) and the other two were from safety promotion policies scale (Vinodkumar & Bhasi, 2010). There were two items from Fogarty's MES that not added to this scale. The first one "There is not enough reward and recognition for doing good work" was similar to other selected item and the second one "In our promotion system, the best people generally rise to the top" was not applicable to current research workplace. These items were rated with a 5-point Likert Scale format ranging from 1 (*strongly disagree*) to 5 (*strongly agree*). A higher score on this scale indicates a higher level of rewards and recognition system.

3.4.5 Training

Seven items were used to measure the degree to which the management provides adequacy of training and encouragement to continue further training. Two items from the training scale (Fogarty, 2004) and three items from the same scale (Fogarty & Buikstra, 2008) were used. In addition, one item "Safety issues are given high priority in training programs" (Vinodkumar & Bhasi, 2010) and another item "I have been given enough training to perform my work safely" (Gibbons et al., 2005) from the safety training scale were selected too. These items were rated with a 5-point Likert Scale format ranging from 1 (*strongly disagree*) to 5 (*strongly agree*). A higher score indicates a higher level of training.

3.4.6 Coworker Support for Safety

Three items were used to measure the coworkers concern for the safety of others and for hazard. These items were adopted from the perceived coworker support for safety scale developed by Tucker et al. (2008). These items were rated with a 5-point Likert Scale format ranging from 1 (*strongly disagree*) to 5 (*strongly agree*). A higher score reflects greater coworker support.

3.4.7 Job Satisfaction

Seven items were used to measure the individuals' feeling toward their jobs. All of the items were adopted from job satisfaction scale developed by Fogarty (2004). These items were rated with a 5-point Likert Scale format ranging from 1 (*strongly disagree*) to 5 (*strongly agree*). This scale was reverse-scored so a lower score indicates a more positive job satisfaction. Because a common factor exerts a linear effect on measured variables (Fabrigar & Wegener, 2012), both job satisfaction and organizational commitment were changed to have reverse-scored questions so that all of the four measuring factors have similar influence on employee turnover.

3.4.8 Organizational Commitment

Seven items were used to measure the degree to which individuals desired to maintain organizational membership. All of the items were adopted from commitment scale developed by Fogarty (2004). Aircraft maintenance technicians (AMTs) responded using a 5-point Likert Scale format that ranged from 1 (strongly disagree) to 5 (strongly agree). This scale was reverse-scored so a lower score reflects greater organizational commitment.

3.4.9 Emotional Exhaustion

Seven items were used to measure the extent to which individuals felt of being emotionally overextended and exhausted by their work. All of the items were adopted from emotional exhaustion scale developed by Maslach and Jackson (1981). However, two items were not selected because they were unrelated to subject of the study (e.g. "Working with people directly puts too much stress on me"). Maslach and Jackson (1981) used a range of intensity from 1 (very mild, barely noticeable) to 7 (major, very strong) to measure this scale. On the other hand, in this study, these items were rated with a 5-point Likert Scale format ranging from 1 (*strongly disagree*) to 5 (*strongly agree*). A higher score indicates a higher level of emotional exhaustion.

3.4.10 Turnover Intention

This scale was measured by four items concerning plans to quit the job or remain within the unit. These four items were adopted from turnover intention scale developed by Abrams, Ando, and Hinkle (1998). These items were rated with a 5-point Likert Scale format ranging from 1 (*strongly disagree*) to 5 (*strongly agree*). So a higher score reflects greater intention to quit.

3.4.11 Safety Motivation

Participants were asked to rate their safety motivation using six items that measure the extent to which they had the willingness to perform safely. Five items were adopted from the safety motivation scale developed by Vinodkumar and Bhasi (2010). One item "I feel that it is worthwhile to put in effort to maintain or improve my personal safety" was selected from the scale developed by Neal and Griffin (2006). These items were rated with a 5-point Likert Scale format ranging from 1 (*strongly disagree*) to 5 (*strongly agree*). A higher score on this scale indicates a more positive motivation toward safety.

3.4.12 Reporting Unsafe Behaviors

Seven items were used to measure the degree to which participants were welling to report an incidents, near miss, and unsafe acts. These items were adopted from reporting system scale of the maintenance survey developed by Gibbons et al. (2005). However, some of the items might only serve as predictors of reporting unsafe behaviors. These items were rated with a 5-point Likert Scale format ranging from 1 (*strongly disagree*) to 5 (*strongly agree*). A higher score reflects greater willingness to report unsafe behaviors.

3.4.13 Errors

Ten items were used to measure the unintentional deviations from standard operating procedures that done by AMTs. These items were adopted from the error type scale developed by Fogarty and Buikstra (2008) and were rated with a 5-point Likert Scale format ranging from 1 (*never*) to 5 (*very frequently*). So a higher score indicates a higher rate of maintenance errors.

3.4.14 Violations

AMTs were asked to rate their violations on twelve items. Six items were adopted from violations and intention to violate scales developed by Fogarty and Shaw (2010) with words changed to ensure violations had been committed. One item "In this unit, supervisors have signed off a maintenance task without performing the required supervision or inspection" was used from scale developed by Fogarty and Buikstra (2008). In addition, five items were selected from violation scale of the Maintenance Behavior Questionnaire (MBQ) developed by Hobbs and Williamson (2002). These items were rated with a 5-point Likert Scale format ranging from 1 (*never*) to 5 (*very frequently*). A higher score on this scale indicates more violations.

3.4.15 Incidents and Injuries

Incidents and injuries were assessed by using two questions. Participants were asked to rate any work injuries they had sustained and any aircraft incidents that they had been involved in the last twelve months (Hobbs & Williamson, 2002). The twelve months period was also accordingly to previous studies (e.g., Probst & Estrada, 2010). Injuries were as sprains, burns, eyes injuries, and others while incidents were as damage to an aircraft or ground support equipment. These questions were rated with a 5-point Likert Scale format ranging from 1 (*never*) to 5 (*very frequently*).

3.4.16 Control Variables

The questionnaire included questions about participants' age and education level. For example, organizational characteristic such as workforce characteristics can be included as antecedents to individual safety performance (Griffin & Neal, 2000). Education level was measured by using scale format ranging from 1 (*high school degree*) to 5 (*above Master degree*).

Table 2 Study Variables

Measures	Items	Source	Scale
Supervision	9	(Fogarty, 2004; 2005)- (Vinodkumar & Bhasi, 2010)	1 (*SD*) to 5 (*SA*)
Safety Focus	6	(Fogarty, 2005)- (Vinodkumar & Bhasi, 2010)	1 (*SD*) to 5 (*SA*)
Safety Communication and Feedback	8	(Fogarty, 2005)- (Cheyne et. al., 1998)- (Gibbons at al., 2005)- (Vinodkumar & Bhasi, 2010)	1 (*SD*) to 5 (*SA*)
Recognition	5	(Fogarty, 2004; 2005)- (Vinodkumar & Bhasi, 2010)	1 (*SD*) to 5 (*SA*)
Coworker Support for Safety	3	(Tucker et al., 2008)	1 (*SD*) to 5 (*SA*)
Training	7	(Fogarty, 2004)- (Fogarty & Buikstra, 2008) - (Gibbons at al., 2005)- (Vinodkumar & Bhasi, 2010)	1 (*SD*) to 5 (*SA*)
Safety Motivation	6	(Neal & Griffin, 2006)- (Vinodkumar & Bhasi, 2010)	1 (*SD*) to 5 (*SA*)
Job Satisfaction ®	7	(Fogarty, 2004)	1 (*SD*) to 5 (*SA*)
Organizational Commitment ®	7*	(Fogarty, 2004)	1 (*SD*) to 5 (*SA*)
Emotional Exhaustion	7	(Maslach & Jackson, 1981)	1 (*SD*) to 5 (*SA*)
Turnover Intention	4	(Abrams et al., 1998)	1 (*SD*) to 5 (*SA*)
Reporting Unsafe Behaviors	7	(Gibbons at al., 2005)	1 (*SD*) to 5 (*SA*)
Errors	10*	(Fogarty & Buikstra, 2008)	1 (*never*) to 5 (*very frequently*)
Violations	12	(Fogarty & Shaw, 2010)- (Fogarty & Buikstra, 2008)- (Hobbs & Williamson, 2002)	1 (*never*) to 5 (*very frequently*)
Incidents and Injuries	2	(Hobbs & Williamson, 2002)	1 (*never*) to 5 (*very frequently*)
Education			1 (*high school degree*) to 5 (*above Master degree*)

*One item has been removed from each after the piloting; SD: Strongly Disagree & SA: Strongly Agree. ® Job Satisfaction & Organizational Commitment are reverse-scored questions.

3.5 Survey Administration

Getting the RBAF approval to conduct this research at its facilities was the first step before distributing the questionnaires. RBAF management encouraged the units' leaders to support and encourage their employees to take part in this study.

3.5.1 Human Subjects

The University of Central Florida Institutional Review Board (IRB) had approved the survey (see Appendix B). The IRB ensured that there was no physical or psychological harm on participants. Participant consent was written at the first page of the survey explaining the purpose of the questionnaire. In addition, there was no personal information collected except those related to demographical variables which were for the purpose of data analysis.

3.5.2 Pilot Study

There were between 3-12 items that were generated into each of the 14 measures of the proposed model. A panel of 15 experience aircraft maintenance technicians from different specialized area was asked to modify the items during the piloting. The panel found two ambiguous or confusing items, and therefore, they were removed. The first item was "I feel very little loyalty to my unit" from organizational commitment scale and the second one was "I have lost a component part-way through a job" from errors scale. As a result, 98 items remained and have been used in the distributed survey as it is presented in Appendix A.

3.5.3 Participants

This study has been conducted only on male Air Force maintenance personnel with an average age of 40 years. Most participants have been trained during their first two recruitment years and on-the-job (OJT) training after they had been transferred to their current positions.

3.5.4 Procedure

The study data were collected via paper-and-pen questionnaires completed by maintenance technicians from five different aircraft maintenance units. Participation was voluntary and the maintenance technicians were assured of confidentiality. They were allowed to participate in work time. They had received the questionnaires from their respective unit leader. The survey was anonymous in nature and contained a letter confirming management support for their participation. One month was the period for collecting the questionnaires back and also, there were weekly reminders via the available communication channels to encourage the participants. In addition, some questionnaires were administered by researcher on site. To maintain participant confidentiality, surveys were returned directly to the researcher in sealed envelopes.

A total of 620 questionnaires were distributed. Overall, questionnaires were received from 314 participants with a response rate of 50.6%. However, 31 questionnaires were removed due to missing data where many questions were left unanswered. As a result, a total of 283 usable samples were used in the data analysis.

3.6 Sample Size

When conducting research analysis, obtaining a large sample size that is more representative of the population can limit the influence of outliers and plays a significant role in making inferences about this population. In fact, the sample size depends more on the stability of a correlation coefficient and not on number of variables (Gorsuch, 1997). The study sample size (N = 283) was sufficient to perform the data analysis for the exploratory factor analysis. According to Fabrigar and Wegener (2012), a sample of minimum 200 or more is accepted when there are good conditions such as communalities values of 0.40 to 0.70 and 3 to 5 measured variables loading on each factor.

If the measurement is strong with 3 or 4 indicators per factor, good reliabilities, and not a complex structural path model, then samples of size 50 or 100 can be plenty to use it in structural equation modeling (Iacobucci, 2010). In addition, Bollen (1990) suggests that if the indicators are reliable and the effects are strong and the model not complex, smaller samples will be sufficient. Kline (1998) suggests sample size of greater than 200 can be considered as large and is acceptable for most models. Therefore, the current sample size (N = 283) was sufficient to perform the data analysis.

3.7 Data Analysis

The collected data were analyzed first by using an exploratory factor analysis. Then, a confirmatory factor analysis was implemented to develop the measurement model. Finally, a structure equation modeling was used to test the structural paths among the model's constructs.

3.7.1 Exploratory Factor Analysis

As the sets of items have been developed to represent the area of interest, exploratory factor analysis (EFA) has been used as an adjacent to confirmatory factor analysis (CFA) through the process of SEM. Researchers use EFA to explore for the smaller set of k latent constructs or factors to represent the larger set of j variables (Henson & Roberts, 2006). EFA can also be used to assess the impact of all the constructs on each item. EFA is appropriate for scale development and it is used before applying CFA in regard to have a solid priori theory (Hurley et al., 1997). Moreover, it is better to rely on an empirical statistical method than on theory for specification of constructs in the model (Fabrigar & Wegener, 2012). Gorsuch (1997) suggests that EFA is needed when there is no clear predictions for CFA such as number of factors existing, relationship of factors with both variables and with other factors. In additions, EFA is recommended to be used first whenever there are a large number of models that need to be compared.

Cronbach's alpha has been derived to ascertain the internal consistency of items. There are no universally established standards as to what minimally acceptable indicator reliability should be. As a result, the classic reliability standard of .70 or greater (Bagozzi & Yi, 2012) has been used in this study. To have a better homogenous scale, researchers must not only depend on the result of the internal consistency (e.g., Cronbach's alpha) but also on the outcomes of other measurements (e.g., factor analysis) to determine the set of items for a particular factor (Cortina, 1993; Gorsuch, 1997; John & Benet-Martínez, 2000).

Lastly, a matrix of association describes the relationships between the model measured variables. Correlation matrix (**R**) is most commonly used in EFA (Henson & Roberts, 2006; Thompson, 2004) and covariance matrix is the most common choice in CFA (Thompson, 2004). There are four major decisions to model specification and method of analysis when applying EFA and they are as follows;

3.7.1.1 Method of Factor Extraction

There are multiple methods that can be used to calculate factor coefficients. The most common methods used are Principle Component (PC), Principle Axes factor (PAF), and Maximum Likelihood (ML). However, it is good idea to use more than one method to confirm a replication of results (Fabrigar & Wegener, 2012). Thompson (2004) suggests using more than one set of analytical choices in EFA. Fabrigar, Wegener, MacCallum, and Strahan (1999) argued to use maximum likelihood method if the assumption of multivariate normal distribution of the variables is met and to use PC or PFA method if not met.

ML and PAF are the most used methods (Brown, 2006). However, the results of EFA model using ML can be misrepresented when data normality not attained. One of the disadvantages of ML method is that it may produce an improper solution that contains an indicator with communality above 1.0 (Brown, 2006), while PAF can overcome this issue (Fabrigar et al., 1999). Fabrigar et al. (1999) suggest that the outcomes of selecting too many factors are less severe than those of selecting too few factors.

3.7.1.2 Communality

The communality of a variable measures the percent of variance in that variable with all other remaining variables in the analysis. If there are low communalities, variables explain little variance and thus should be avoided. Low and high communalities can be considered around 0.40 and above 0.70 (Stevens, 1986). According to Fabrigar et al. (1999) , low communalities occur when there are variables with low reliability and these variables are unrelated to the domain of interest. Stevens (1986) suggests retaining factors that will account for at least 70% of the total variance and using a loading (coefficient) of about 0.40 or greater between the variable and the factor. However, Rencher and Christensen (2012) suggest factor loadings of 0.30 and greater to meet the minimal requirement; a value of 0.40 to be important; and loadings of 0.50 and above to be significant. Table 3 shows the values of the significant factor loading for each sample size.

Table 3 Guidelines for Identifying Significant Factor Loadings Based on Sample Size

Factor Loading	**Sample Size**
0.30	350
0.35	250
0.40	200
0.45	150
0.50	120
0.55	100
0.60	85
0.65	70
0.70	60
0.75	50

Source: Rencher and Christensen (2012)

3.7.1.3 Factor Retention Rule

There are numerous rules which can be used to determine the number of factors to retain (Henson & Roberts, 2006). According to Thompson and Daniel (1996), one of the most frequently used methods is the number of eigenvalues-greater-than-one rule (EV > 1; Kaiser, 1960). This method retains only those factors whose eigenvalues are greater than 1. Most statistical packages (e.g., SPSS, SAS) use this rule as the default option in EFA. However, this rule has a drawback, it will accept a factor with an EV of 1.01 and not with an EV of .99 (Fabrigar & Wegener, 2012). The second method that is mostly used to determine the number of factors is the Scree Plot (Fabrigar & Wegener, 2012). Analyst will retain the number of eigenvalues in the steep descent before they tend to level off and this number corresponds to the number of factors that will be used. The EV or Scree rules will retain an accurate number of factors when the sample size (N) > 250 and the mean communality is ≥ 0.60 (Stevens, 1986). In addition, the scree plot may give good results when the sample size is large (Brown, 2006).

3.7.1.4 Method of Factor Rotation

The idea of rotation is to simplify the data structure. The mechanism of factor rotation is to maximize factor loadings close to 1.0 and minimize those close to 0.0 to produce a solution only and without changing the fit of the data (Brown, 2006). There are two analytic rotations, orthogonal and oblique. In orthogonal, varimax rotation is probably the most common used method (Fabrigar & Wegener, 2012; Fabrigar et al., 1999). Varimax rotation looks for the best solution that has factor loadings with maximum variability across the retained factors.

Oblique rotation allows for both correlated and uncorrelated common factors, while orthogonal allows only for those that are uncorrelated. In social sciences, some factors are expected to be correlated and functioned dependently of one another. According to Fabrigar and Wegener (2012), oblique rotation has some advantages over orthogonal ones such as researchers will have additional information and actuality of data representation of how factors are interrelated. Therefore, oblique rotation solution has been used in this study for easier interpretation. Orthogonal and oblique rotation will have almost similar results whenever there are uncorrelated factors in the model. According to Fabrigar et al. (1999), promax and direct oblimin method with default values, Kappa = 4 & Delta = 0, tend to produce similar results in oblique rotation. Brown (2006) suggests using oblique solutions in CFA to free the factors to be correlated in order to have a good model fit.

Table 4 Differences between orthogonal and oblique rotated solutions in SPSS

Rotation	Orthogonal	Oblique
Interval	Bounded by -1.00 and 1.00	Not bounded by -1.00 and 1.00
Factor Loadings	Represent correlations between common factors and measured variables.	Represent the standardized partial regression coefficients.
Produce	Rotated factor loading matrix	Pattern matrix

From Table 4, both matrices represent "the influence of each common factor on the measured variables controlling for the effects of the other common factors in the model" (Fabrigar & Wegener, 2012, p. 81).

In software packages, the outputs of analytical methods for oblique rotations are a pattern matrix, a structure matrix, and a matrix of factor correlations. However, the pattern matrix is by far the most used in research (Brown, 2006; Fabrigar & Wegener, 2012). In SPSS, if the rotation is oblique, the pattern matrix is used to be the main basis of interpretation the rotated factor loading matrix. For example, any measure variable variance that is explained by more than one factor is eliminated from the loading in the pattern matrix.

3.7.2 Confirmatory Factor Analysis

Confirmatory factor analysis (CFA) is considered as an extension of factor analysis that examines the relationship of a set of indicators to a common construct (Schumacker & Lomax, 2010). CFA has been used directly when there is more theoretical basis for specifying hypothesized patterns of loadings (Hurley et al., 1997). In another way, CFA is generally used when the researcher knows the study factors of interest and the variables that characterize each factor (Henson & Roberts, 2006). Moreover, CFA allows the estimation of correlated factors and thus can be considered as a subset of structural equation modeling but without allowing factors to have structural relationships (Rencher & Christensen, 2012). One of the advantages of CFA is that it can be used to test the common method effects that result from the measurement approach (Harrington, 2009).

EFA and CFA are often conducted together, such as EFA is used to refine the factor structure and then using CFA for further scale development and construct validity. In fact, the number of latent factors is not determined at the start up of EFA while this number can be hypothesized in CFA (Rencher & Christensen, 2012).

AMOS 22 software has been used to perform CFA. AMOS 22 (Analysis of Moment Structures) is an easy-to-use program for visual SEM (Arbuckle, 2011). This software can help the users to create their models by using the graphics interference and then conducting their analysis. Furthermore, AMOS is a model-fitting program that can analyze the full range of standard SEM (Kline, 1998).

3.7.2.1 CFA Model Parameters

Observed variables can be considered as responses to questions and are represented by rectangles, while latent variables (factors) are the unobserved construct of interest and are represented by ovals in CFA models. Latent variables can be divided into exogenous and endogenous variables. Exogenous variables are like to the independent variables that are not caused by other variables, while endogenous ones (dependent variables) are affected by other variables in the model.

In CFA models, an arrow from latent variable to observed variable can represent the relationship between them and has a value (factor loading) of predicting this observed variable (item or indicator) from the latent factor. The higher the factor loading is the better relationship. Table 5 shows the suggestion of Tabachnick and Fidell (2007) about the factor loading scales. A variance accounted for the correlation between the observed variable and the corresponded factor is determined by squaring the factor loading. If the observed variable is not accounted by the factor, a unique variance (measurement error) will present.

Table 5 Factor Loading Scale

Factor Loading	Interpretation	Variance Accounted for
> 0.71	Excellent	50%
> 0.63	Very Good	40%
> 0.55	Good	30%
> 0.45	Fair	20%
> 0.32	Poor	10%
< 0.32	Not Interpreted	10%

Factor correlation is a two-headed arrow between two latent variables in CFA model. The relationship between these latent variables is a factor correlation that ranges from -1 to +1 in the standardized solution. There are also correlated errors than can exist between the indicators themselves which are related to other things other than the shared influence of the latent variables. According to Harrington (2009), correlated errors could be caused by method effects which result from the measurement approach such as self-report (e.g. the way of asking the questions).

3.7.2.2 Estimation Method

AMOS software was used to test the identification of the model when conducting CFA (degrees of freedom [*df*] > 0). Maximum Likelihood (ML) is the most commonly used estimation method and it is robust to moderate violations (Brown, 2006; Harrington, 2009). ML requires multivariate normality distribution with absolute values of skew less than 3.0 and kurtosis less than 10.0 (Kline, 1998). However, absolute values of kurtosis up to 20.0 may not be problematic with ML estimation (Harrington, 2009).

The methods of testing the CFA model goodness-of-fit were discussed in details in structural equation modeling section. These goodness-of-fit indices are used to determine how well the model fit the collected data.

3.7.3 Structural Equation Modeling

Structural equation modeling (SEM) is a statistical methodology that takes testing measurement, predictive, and causal hypotheses approaches to the analysis of a structural theory (Bagozzi & Yi, 2012; Byrne, 2006). SEM is considered as a part of the existing family of multivariate statistical techniques such as factor analysis, multiple regression, and analysis of variance (Bagozzi & Yi, 2012). SEM provides an alternative and complementary methodology to examining plausibility of hypothesized models through empirical examination (Maruyama, 1998). SEM helps researchers to articulate their thoughts about relationships of one latent variable with another in the model. The relations between these variables are defined by a series of equations that illustrates hypothesized structures of relationships. Moreover, using SEM helps in assessing in whether the model can be considered as a reasonable fit to the data.

The difference between a CFA and a SEM model is that CFA focuses on the relationships between the latent variables and their observed measures, whereas, SEM includes causal paths among the latent variables themselves (Harrington, 2009). In this study, SEM was performed using AMOS 22.

3.7.3.1 SEM Characteristics

1. SEM is a priori which means that researchers are required to think in terms of models and provide a lot of information about variables. These priori specifications make up the conceptual model to be evaluated in the analysis (Kline, 1998). SEM allows both confirmatory and exploratory modeling. The model can be accepted, rejected, or modified by the researcher.
2. SEM allows differentiating between observed and latent variables so that researchers can test a wide variety of hypotheses. SEM allows the structural relations between latent variables to be accurately estimated (Kline, 1998). Moreover, it is possible in SEM to evaluate models that contain only observed variables.
3. The basic statistic in SEM is the covariance which it helps to understand the correlations patterns among a set of variables, and to explain as much of their variance as possible with the specified model (Kline, 1998).
4. SEM can be applied to non-experimental data, experimental data, and a mix of the two data.
5. SEM is a large-sample technique but it is difficult to give a simple answer to the question of how large a sample is large enough. It varies between complex and simpler models.
6. SEM is useful in survey research, cross-sectional or longitudinal studies (Kline, 1998).

3.7.3.2 SEM Variables

1. Observed or (manifest variables): variables that are measured by the researcher and are represented by rectangles in the SEM diagram. They serve as indicators of the underlying construct that they are presume to represent.
2. Latent or (factors): they are unobserved and hypothetical constructs, and are represented by ellipses in the SEM diagram. They cannot be measured directly and thus, the researcher must define them in terms of behavior believed to represent them (Byrne, 2006). There are two types of latent variables. The first one is exogenous variables (independent variables) which are not caused by other variables and the second one is endogenous variables (dependent variables) that are caused by other variables in the model (Harrington, 2009).

3.7.3.3 Assessment of Testing the Hypothesized Model

Breckler (1990) advises practitioners to examine the goodness of fit by multiple criteria rather than to rely on a single statistic. Model fit in CFA and SEM has been assessed by using goodness-of-fit tests such as Chi-square ($\chi 2$) statistic, root mean square error of approximation (RMSEA), Tucker and Lewis index (TLI), and comparative fit index (CFI) as were recommended in the literature (Byrne, 2006; Meade, Johnson, & Braddy, 2008). Chi-square ($\chi 2$) tests whether the model fits exactly in the population while RMSEA tests the extent to which this model fits reasonably (Harrington, 2009). Both CFI and TLI are used to evaluate the fit of a model relative to a null model.

These indices are measures of the scale reduction of lack of fit when testing the hypothesized model. Hu and Bentler (1999; 1998) recommended the following standards for assessing models: RMSEA ≤ 0.06, TLI ≥ 0.95, CFI ≥ 0.95, and $\chi 2$ is nonsignificant at (p-values $\geq .05$). However, CFI and TLI values of 0.90-0.95 indicating acceptable fit, and RMSEA value of 0.05-0.08 is also acceptable (Bentler, 1990; Kline, 1998). In addition, the Akaike information criterion (AIC) and the expected cross-validation index (ECVI) were used too. Smaller AIC and ECVI suggests the model fits better when comparing two or more models on the same data set (Harrington, 2009).

RMSEA, TLI, and CFI indices have been found to perform well in detecting models with misspecified factor loadings (Hu & Bentler, 1998). Chi-square goodness-of-fit-test has limitation of increasing the probability of rejecting the hypothesized model as either the sample size gets larger or there are non-normality issues such as high kurtosis (Rencher & Christensen, 2012).

CHAPTER FOUR: RESULTS

This chapter starts with a discussion of the research descriptive statistics. It explains the process of the data screening and the results from both exploratory and confirmatory factor analysis methods. In addition, the results from structural equation modeling method are further discussed. The tests of the research hypotheses are also presented.

4.1 Descriptive Statistics

The demographical data of age, participants in each unit, and education level were collected from the survey. The average age of respondents was 40 years (SD = 10.2 years) with a range from 22-66 years (Table 6). Participants were from five maintenance units and nearly 63%, 13%, and 14% of them worked in unit 1, unit 2, and unit 3, respectively (Table 7). Figure 3 shows the participation frequencies among the five units.

Table 6 Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation
Age	283	22	66	40.31	10.173
Unit	283	1	5	1.74	1.130
Education	283	1	4	1.57	.845

Table 7 Statistics of Number of Participants in Each Unit

Unit					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1	179	63.3	63.3	63.3
	2	36	12.7	12.7	76.0
	3	39	13.8	13.8	89.8
	4	20	7.1	7.1	96.8
	5	9	3.2	3.2	100.0
	Total	283	100.0	100.0	

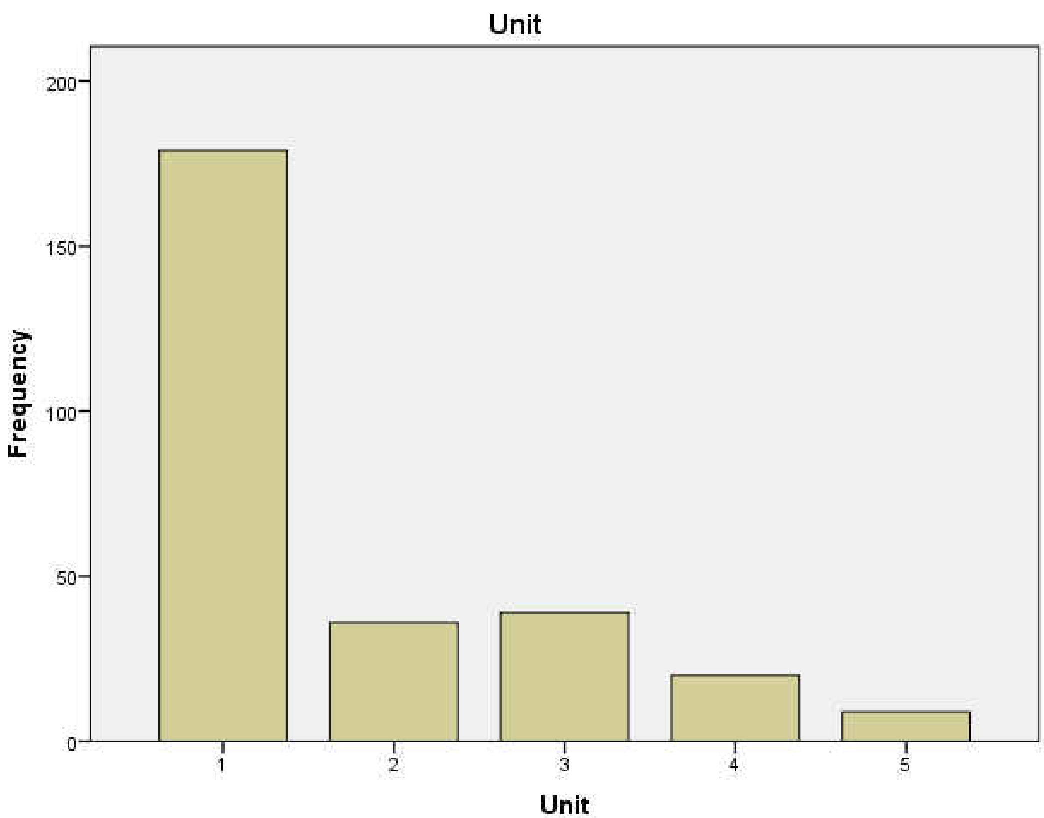

Figure 3 Participation Frequencies among RBAF Units

Table 8 and Figure 4 illustrate that about 63% of respondents hold a high school degrees, 20% with Associate degrees, 14% with Bachelor degrees, and only 3% have Master degrees.

Table 8 Statistics of Education Scale

Education					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1	178	62.9	62.9	62.9
	2	57	20.1	20.1	83.0
	3	39	13.8	13.8	96.8
	4	9	3.2	3.2	100.0
	5	0	0		
	Total	283	100.0	100.0	

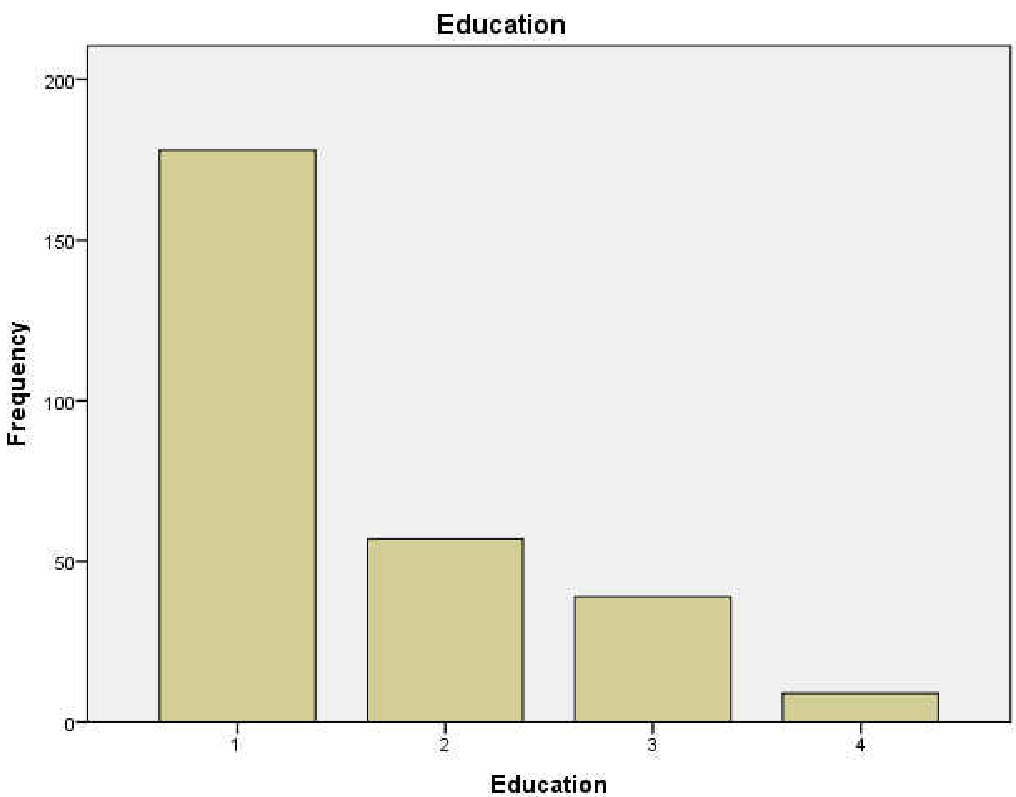

Figure 4 Education level Frequency among Participants

The statistical data of involvement in safety occurrences indicated that 186 (65.7%) respondents reported that they had not been injured at work during the last 12 months. However, 12.4% of them reported rarely, 12.4% for sometimes, 6.0% for frequently, and 3.5% for very frequently. In addition, the majority (95.4%) of the respondents reported that they had not been involved in damaging the aircraft or equipment. However, just over 2.5%, 1.8%, and 0.4% were reported for rarely, sometimes, and frequently, respectively.

4.2 Data Screening

Data screening emphasizes preparation for modeling. It ensures that the data is reliable, and valid for testing the type of the interested causal theory. Table 9 shows the factors abbreviations that have been used for the research measures (see Appendix C for more details).

Table 9 Variables Abbreviations for Research Measures

	Factor	Name
1	Supervision	Sup
2	Safety Focus	SF
3	Safety Communication and Feedback	Com
4	Recognition	Rec
5	Coworker Support for Safety	Co
6	Training	Tra
7	Job Satisfaction	JS
8	Organizational Commitment	OC
9	Emotional Exhaustion	EX
10	Turnover Intention	TI
11	Safety Motivation	SM
12	Reporting Unsafe Behavior	SRU
13	Errors	ME
14	Violations	Vio

4.2.1 Missing Data

Thirty one questionnaires were excluded due to either missing a lot of data of particular factors or inconsistency of answers (when reverse-scored questions are exists). However, 23 single missing values that were scattered through the cases were estimated by using a prior knowledge technique (e.g., demographical data) or by inserting median values (Tabachnick & Fidell, 1996).

4.2.2 Outliers

All data outliers were checked and corrected by producing a Boxplots in SPSS (e.g., Figure 5 & Figure 6). The presence of those outliers was caused by an incorrect data entry into Microsoft Excel program.

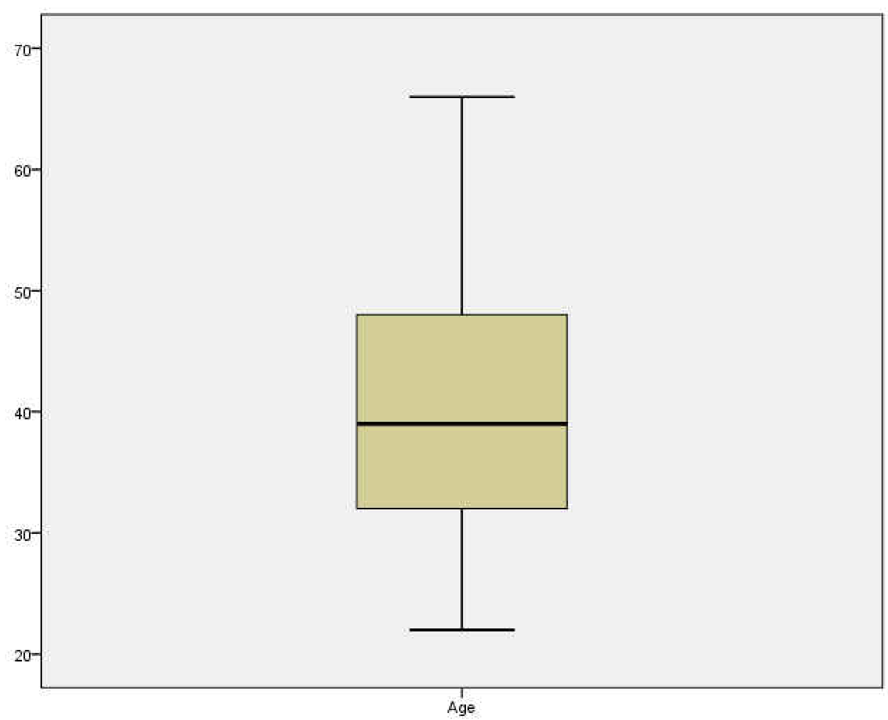

Figure 5 SPSS Boxplots for Age

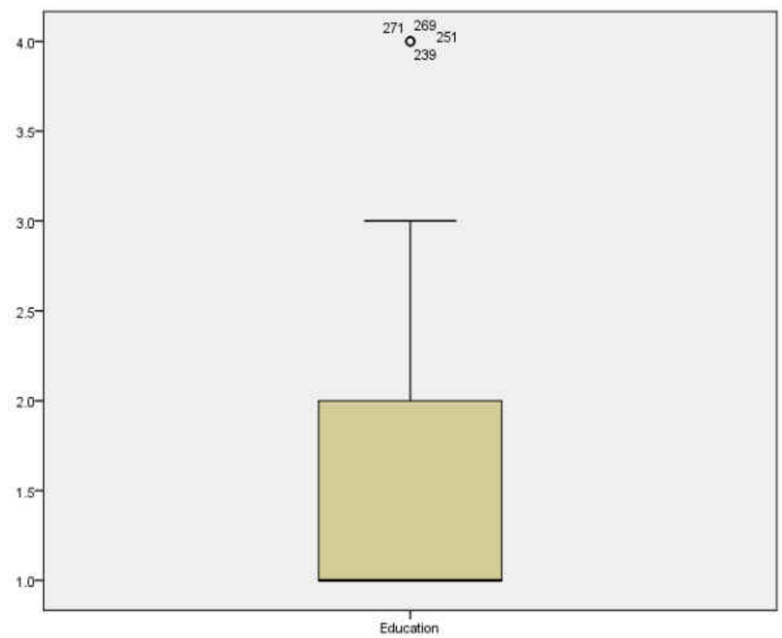

Figure 6 SPSS Boxplots for Education

4.2.3 Normality, Linearity, and Homoscedasticity Tests

Using normality, linearity, and homoscedasticity statistical tests can enhance the data analysis. These tests can be assessed through residuals scatterplots for each independent variables (IVs) using *SPSS Regression* method. If each variable and all linear combination of the variables are normally distributed, a multivariate normality can be attained. One way of checking the assumption of multivariate normality can be through examination of residuals in analyses involving prediction, which are the differences between the predicted and obtained variables values. The residuals scatterplot has predicated scores in X-axis and errors of prediction in Y-axis, and both are standardized in SPSS. If all assumptions are met, the residuals will be symmetrically distributed with a concentration of scores along a mean value of zero (Tabachnick & Fidell, 1996).

Failure of normality is indicated when the residuals do not distribute themselves evenly above and below the zero line as shown in Figure 7. Nonlinearity occurs when most of the residuals are above the zero line (Figure 8) at some predicted scores and below at other scores. The failure of homoscedasticity (heteroscedasticity) occurs when the residuals are not equal in width on the plot at all predicted scores like in Figure 9. Tabachnick and Fidell (1996) mention that failure of linearity and homoscedasticity of residuals does only weak the analysis but it will not invalidate it.

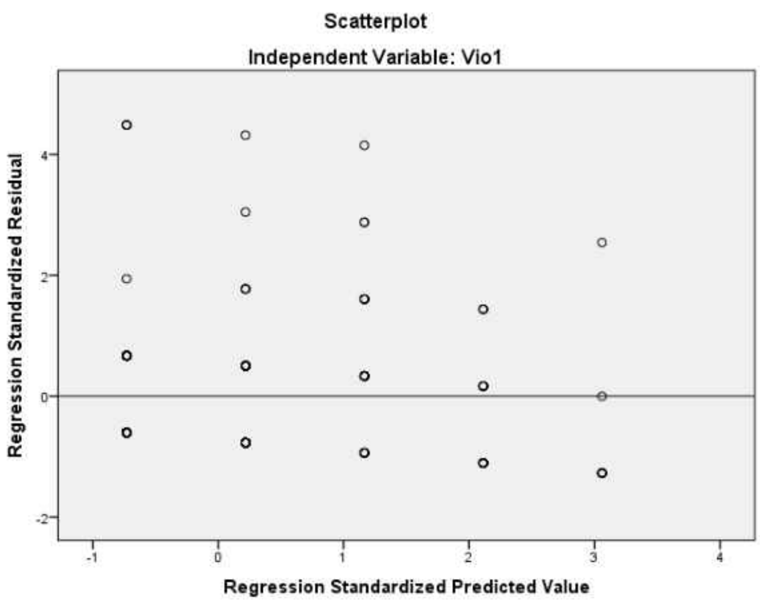

Figure 7 Plot of predicted values of the IV against residuals: showing failure of normality

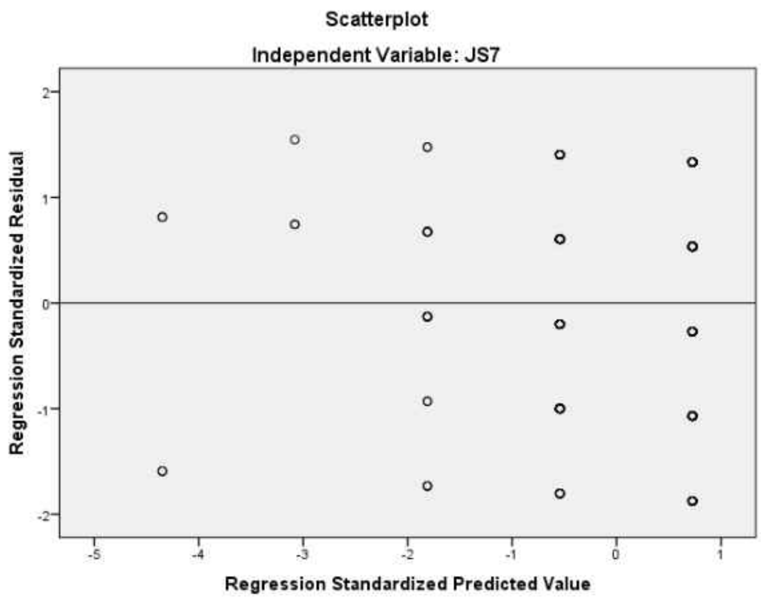

Figure 8 Plot of predicted values of the IV against residuals, showing nonlinearity

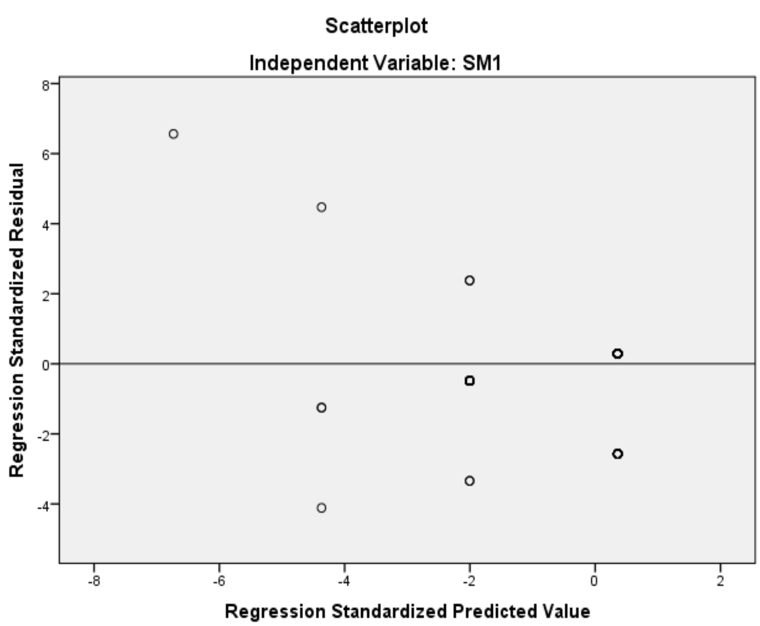

Figure 9 Plot of predicted values of the IV against residuals, showing heteroscedasticity

After applying normality, linearity, and homoscedasticity statistical tests on all of the independent variables, a total of 26 IVs (Table 10) were found to be violating the multivariate normality assumption. As a result, these IVs will be brought into consideration through the EFA process.

Table 10 Independent variables (IV) that violate multivariate normality assumption

IV	Cause	IV	Cause
Tra3	*Heteroscedasticity*	**ME4**	*Failure of normality*
Tra4	*Nonlinearity*	**ME6**	*Failure of normality*
JS1	*Failure of normality*	**ME8**	*Failure of normality*
JS2	*Failure of normality*	**ME9**	*Failure of normality*
JS7	*Nonlinearity*	**Vio1**	*Failure of normality*
OC1	*Failure of normality*	**Vio4**	*Failure of normality*
OC3	*Heteroscedasticity*	**Vio5**	*Failure of normality*
EX6	*Failure of normality*	**Vio6**	*Failure of normality*
SM1	*Heteroscedasticity*	**Vio8**	*Failure of normality*
SM2	*Failure of normality*	**Vio9**	*Failure of normality*
SM4	*Failure of normality*	**Vio10**	*Failure of normality*
SM6	*Failure of normality*	**Vio11**	*Failure of normality*
SRU1	*Failure of normality*	**Vio12**	*Failure of normality*

4.2.4 Multicollinearity

Multicollinearity is a problem with a correlation matrix. It means that at least one independent variable is too highly correlated with a combination of the other independent variables. Tabachnick and Fidell (1996) suggests when doing analysis of structure (factor analysis and structural equation modeling), a correlation above 0.90 is considered to be high. It means that at least 80% (0.90 * 0.90 = 0.81) of the variance of this independent variable is shared with some other independent variables. However, measured variables should be correlated with one another under the same factor and thus, they would be expected to have a strong internal consistency (e.g., Cronbach's alpha). The test for multicollinearity was produced in *SPSS Correlate* method as shown in Appendix C which turned that no multicollinearity was evident. The highest two correlations were in safety motivation factor with values of 0.773 & 0.785 between (SM5-SM3) and (SM6-SM5), respectively.

In addition to the multicollinearity check, Table 11 shows the independents variables (IV) that have insignificant correlation among other variables in the same construct at two-tailed test of significance. Again, these specific IVs will be brought under attention during EFA process.

Table 11 Independent variables with insignificant correlation

Factor	Correlation	Contributed IVs
Safety Focus	(SF1-SF3), (SF1-SF5), & (SF2-SF5)	SF1 & SF2 or SF5
Job Satisfaction	JS7 With (JS1, JS2, JS4, JS5,& JS6)	JS7
Emotional Exhaustion	(EX6-EX4), (EX6-EX5), & (EX7-EX6)	EX6
Self-Report Unsafe Behavior	(SRU2-SRU1) & (SRU7-SRU1)	SRU1
Maintenance Error	(ME7-ME2) & (ME6-ME2)	ME2
Violation	(Vio4-Vio1), (Vio8-Vio1), & (Vio11-Vio1)	Vio1

4.3 Exploratory Factor Analysis

Exploratory Factor Analysis (EFA) was applied by examining the factor loadings of the pattern matrix. Most studies report the outcomes of this matrix. However, it is difficult to apply EFA on the whole model at once especially, if there are many variables and factors. Therefore, EFA was divided into three parts of the model; safety climate, mediators, and safety performance. The goal from applying EFA is to minimize the significant loadings on each row of the factor pattern matrix. Because some of the independent variables violated the multivariate normality assumption, the extraction method of principle axis factor (PAF) and the rotation method of Promax with Kaiser Normalization have been used in the EFA process. However, the other methods of factor extraction that discussed earlier have been used too and it turns to be that PAF with Promax has more variables than the other methods (see Appendix D).

4.3.1 EFA of Safety Climate

Table 12 shows the initial EFA for the safety climate variables. In SPSS, the factor loading was set at an absolute value of 0.30 which based on all loadings of 0.30 having practical significant and only factors of 0.30 and above would be shown in the EFA tables. It can be seen that three independent variables (SF2, SF6, & SF1) of safety focus factor are loading only in safety communication and feedback factor. Therefore, they have been removed from analysis. In addition, variable Tra4 was also removed because it was cross loading highly with variables of coworker support for safety. After rerunning the EFA again, Com5 was removed due to cross loading with supervision variables and Tra3 was also removed because it has an unacceptable communality value of 0.289.

The revised EFA of safety climate is shown in Table 13. In addition, Table 14 shows that both coworker support for safety and safety focus factors have low correlations between them and between other factors in safety climate. To form a latent construct, all factors should be moderately correlated and thus, both of these factors will be reanalyzed in interpreting CFA.

Table 12 Initial EFA for safety climate

Pattern Matrix[a]						
	Factor					
	1	2	3	4	5	6
SF2	0.916					
Com4	0.822					
Com2	0.806					
Com3	0.797					
Com6	0.764					
Com7	0.746					
Com1	0.708					
Com5	0.638	0.31				
SF6	0.613					
Com8	0.584					
SF1	0.522					
Sup2		0.822				
Sup1		0.807				
Sup3		0.756				
Sup5		0.705				
Sup6		0.7				
Sup4		0.627				
Sup7		0.611				
Sup9		0.606				
Sup8		0.557				
Rec2			0.907			
Rec5			0.762			
Rec3			0.703			
Rec1			0.622			
Rec4			0.618			
Tra5				0.73		
Tra1				0.727		
Tra7				0.705		
Tra3				0.643		
Tra2				0.487		
Tra6	0.327			0.463		
Co1					0.856	
Co2					0.815	
Co3					0.635	
Tra4				0.339	0.348	
SF5						0.773
SF4						0.647
SF3						0.549

Extraction Method: Principal Axis Factoring.
Rotation Method: Promax with Kaiser Normalization.
a. Rotation converged in 6 iterations.

Table 13 Revised EFA for Safety Climate

Pattern Matrix[a]						
	Factor					
	1	2	3	4	5	6
Sup2	.830					
Sup1	.828					
Sup3	.760					
Sup6	.704					
Sup5	.699					
Sup4	.629					
Sup9	.615					
Sup7	.599					
Sup8	.535					
Com2		.908				
Com3		.886				
Com4		.732				
Com7		.722				
Com6		.702				
Com1		.643				
Com8		.579				
Rec2			.905			
Rec5			.758			
Rec3			.733			
Rec4			.647			
Rec1			.626			
Tra5				.783		
Tra7				.741		
Tra1				.740		
Tra6				.543		
Tra2				.437		
Co1					.863	
Co2					.822	
Co3					.649	
SF5						.780
SF4						.659
SF3						.582

Extraction Method: Principal Axis Factoring.
Rotation Method: Promax with Kaiser Normalization.
a. Rotation converged in 6 iterations.

Table 14 Correlation Matrix for Safety Climate Factors

Factor Correlation Matrix						
Factor	1	2	3	4	5	6
1. Sup	1.000					
2. Com	.603	1.000				
3. Rec	.568	.695	1.000			
4. Tra	.625	.730	.640	1.000		
5. Co	.233	.288	.148	.228	1.000	
6. SF	.230	.347	.262	.414	.031	1.000

Extraction Method: Principal Axis Factoring.
Rotation Method: Promax with Kaiser Normalization.

4.3.2 EFA of Mediators Variables

From Table 15, SM4 was deleted because it is cross loading negatively with job satisfaction variables. EX6 and EX7 were removed too because they have low communalities values of 0.162 and 0.255, respectively. In addition, EX6 has a negative loading with emotional exhaustion variables and EX7 is loading only with the variables of turnover intention. It seems the question of EX6 “I feel I am working too hard on my job” has confused the respondents. JS7 was also deleted because it has a communality value of 0.127 and is not loading on any factor as well. Generally, variables with low communalities could be either from the wording of the item that it is ambiguous or could be that the associated variable does not belong to the domain of interest as other variables in the analysis. Furthermore, OC1 is loading only on job satisfaction factor and therefore was eliminated from the model. Finally, both TI4 and OC6 were removed after running the model one more time because they both are cross loading between factors of turnover intention and organizational commitment with minimal values.

Table 15 Initial EFA for Mediators Variables

Pattern Matrix[a]						
	Factor					
	1	2	3	4	5	6
SM5	.896					
SM3	.847					
SM6	.819					
SM2	.789					
SM1	.727					
SM4	.382			-.302		
TI1		.922				
TI2		.918				
TI3		.684				
TI4		.411	.307			
EX7		.411				
OC4			.893			
OC5			.691			
OC2			.642	.349		
OC3			.498	.316		
OC6		.350	.373			
JS4				.658		
JS5				.645		
JS6				.577		
OC1				.541		
EX1					.785	
EX2					.780	
EX4					.646	
EX3					.640	
EX5					.421	
EX6					-.395	
JS7						
JS2						.896
JS3						.708
JS1						.692

Extraction Method: Principal Axis Factoring.
Rotation Method: Promax with Kaiser Normalization.
a. Rotation converged in 43 iterations.

For the revised model as seen in Table 16, JS4, JS5, and JS6 variables have moderate-size loadings on both job satisfaction and organizational commitment factors. According to Hair, Anderson, Tatham, and Black (1998), most factor solutions do not end up with a single high loading solution. Thus, this will be left as is and to be evaluated in the final EFA model. The correlations among the four factors of employee turnover in Table 17 are significant and it can be concluded that they form a common factor.

Table 16 Revised EFA for Mediators

Pattern Matrix[a]

	Factor				
	1	2	3	4	5
SM5	.854				
SM3	.842				
SM6	.819				
SM2	.812				
SM1	.714				
JS2		.929			
JS3		.894			
JS1		.786			
JS6		.543	.333		
JS5		.516	.322		
JS4		.423	.321		
OC2			.853		
OC4			.814		
OC5			.766		
OC3			.695		
EX1				.798	
EX2				.790	
EX4				.737	
EX3				.673	
EX5				.456	
TI2					.855
TI1					.810
TI3					.691

Extraction Method: Principal Axis Factoring.
Rotation Method: Promax with Kaiser Normalization.
a. Rotation converged in 6 iterations.

Table 17 Correlation Matrix for Mediators Factors

Factor Correlation Matrix					
Factor	1	2	3	4	5
1. SM	1.000				
2. JS*	-.325	1.000			
3. OC*	-.172	.659	1.000		
4. EX	-.083	.434	.510	1.000	
5. TI	-.152	.489	.601	.554	1.000

Extraction Method: Principal Axis Factoring.
Rotation Method: Promax with Kaiser Normalization.
*JS & OC are reverse-coded factors.

4.3.3 EFA for Safety Performance

From Table 18, Vio1 was removed due to unacceptable communality of 0.097 and in the same time, it was not loading on any factor. Similarly, ME9 was not loading in any factor too and was dropped out. Moreover, SRU1 was removed because it was loading by itself only in one factor. ME8 had low communality of 0.283 and was loading only with violations variables and thus was removed. SRU6 was also removed from the analysis due to a low communality value (0.252).

Finally after simplifying the model, it turned to be that both SRU2 and SRU7 were constructing a factor by themselves. As a result, both were removed since it has been recommended as discussed earlier to have at least three variables to measure a factor when the sample size is not large. Moreover, Vio11 and Vio12 were removed due to their high loading with errors variables.

Table 18 Initial EFA for Safety Performance

Pattern Matrix[a]							
	Factor						
	1	2	3	4	5	6	7
Vio3	.684						
Vio2	.679						
Vio4	.617						
Vio5	.537						
Vio6	.427					.341	
Vio10	.315						
Vio1							
SRU4		.761					
SRU3		.706					
SRU5		.702					
SRU2		.655					
SRU7		.555					
SRU6		.368					
ME6			.783				
ME5			.623				
ME7			.532				
ME3				.642			
ME4				.613		-.333	
ME2				.541			
ME1				.440			
Vio12					.629		
Vio11					.587		
Vio9	.337				.577		
Vio8					.360	.327	
Vio7						.687	
ME8						.306	
SRU1							-.552
ME9							

Extraction Method: Principal Axis Factoring.
Rotation Method: Promax with Kaiser Normalization.
a. Rotation converged in 11 iterations.

Errors factor was divided into two as it shown in Table 19. Reason (1990) identifies three kinds of errors; mistakes, lapses, and slips. It seems that these variables fall in two types of errors. The correlations between violations and errors are shown in Table 20.

Table 19 Revised EFA for Safety Performance

Pattern Matrix[a]				
	Factor			
	1	2	3	4
Vio5	.784			
Vio8	.730			
Vio7	.716			
Vio6	.690			
Vio4	.670			
Vio9	.576			
Vio3	.560			
Vio2	.546			
Vio10	.475			
ME6		.798		
ME5		.642		
ME7		.626		
SRU4			.865	
SRU5			.734	
SRU3			.659	
ME2				.644
ME3				.637
ME1				.514
ME4				.494

Extraction Method: Principal Axis Factoring.
Rotation Method: Promax with Kaiser Normalization.
a. Rotation converged in 6 iterations.

Table 20 Correlation Matrix for Safety Performance

Factor Correlation Matrix				
Factor	1	2	3	4
1. Vio	1.000			
2. ME(1)	.516	1.000		
3. SRU	-.371	-.131	1.000	
4. ME(2)	.438	.461	-.361	1.000

Extraction Method: Principal Axis Factoring.
Rotation Method: Promax with Kaiser Normalization.

Table 21 SPSS results for each EFA

EFA Model	Safety Climate		Mediators		Outcomes	
	Initial	Revised	Initial	Revised	Initial	Revised
Kaiser-Meyer-Olkin Measure of Sampling Adequacy	0.939	0.937	0.885	0.875	0.876	0.864
Total variance explained (cumulative %)	58.294	60.091	54.978	59.961	47.441	47.299
Number of Variables	38	32	30	23	28	19
Number of Factors	6	6	6	5	7	4

From Table 21, the Kaiser-Meyer-Olkin (KMO) values for the revised models are above the recommended value of 0.8 (Fabrigar & Wegener, 2012). Total variances explained by safety climate and mediators factors are reasonable except for the outcomes one which is low (47.299) and this seems to be from errors variables that are not combined. The total initial variables were 96 and became 74 after each revised EFA.

The next step was to add all the revised EFA models in one model and to test the factor loadings. It can be seen from Table 22 that Tra2 was not loading on training factor and therefore, it was removed. Com8 was found to be the connected variable that kept all safety communication and feedback variables and recognition variables together in one factor and thus, was eliminated. After re-run of the analysis, ME2 was removed because it was loading negatively on recognition factor. In addition, Sup1 was removed too as it was constructing a new factor if combined with Sup2.

Table 22 Initial EFA after adding all revised parts

Pattern Matrix[a]

	Factor														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Com2	.935														
Com3	.842														
Com7	.778														
Com1	.720														
Com6	.705														
Com4	.680														
Com8	.663														
Rec5	.551											.376			
Rec2	.533											.461			
Tra2	.522														
Rec4	.522											.453			
Rec3	.511											.360			
Rec1	.473														
Tra6	.421												.406		
Sup2		.839													.665
Sup1		.819													.602
Sup3		.763													
Sup6		.759													
Sup5		.730													
Sup9		.663													
Sup4		.649													
Sup7		.640													
Sup8		.608													
Vio5			.759												
Vio8			.708												
Vio4			.694												
Vio9			.650												
Vio6			.617												
Vio2			.578												
Vio7			.562												
Vio3			.544												
Vio10			.529												
JS3				.831											
JS2				.808											
JS1				.760											
JS5				.690											
JS6				.677											
JS4				.607											
SM3					.845										
SM5					.844										
SM6					.824										
SM2					.820										
SM1					.706										
EX2						.808									
EX1						.732									
EX4						.664									
EX3						.635									
EX5						.441									
TI2							.840								
TI1							.773								
TI3							.680								
Co1								.869							
Co2								.819							
Co3								.616							
ME5									.758						
ME6									.723						
ME7									.580						
SRU4										.842					
SRU3										.703					

Pattern Matrix[a]

SRU5										.669					
SF5											.756				
SF3											.671				
SF4											.621				
ME3									.332			-.534			
ME4									.375			-.532			
ME2												-.497			
ME1												-.366			
Tra5													.617		
Tra7													.592		
Tra1													.422		
OC4	-.328													.550	
OC5														.509	
OC2														.454	
OC3														.420	

Extraction Method: Principal Axis Factoring.
Rotation Method: Promax with Kaiser Normalization.
a. Rotation converged in 38 iterations.

The final EFA model is presented in Table 23 which shows 70 items that divided into 14 factors and this model has been used in CFA process. In this developed model, all the variables have moderate to high loadings except ME1 which has a value of 0.34. However, this value can be considered as practically significant. The EFA model's communalities are presented in Appendix D. In this appendix, the second column is the initial communalities which they are the squared multiple correlations. The third column is the extraction communalities which are the variance in variables accounted for by the extracted factors. As they have been shown, all communalities are good except for ME3, with low communality value of 0.326 but acceptable based on the sample size. The total amount of variance accounted for by the 14 factors is 59.847.

Finally, both job satisfaction and organizational commitment are not cross loading anymore as were shown earlier in Table 16. Moreover, the errors variables are loading only on one factor and not on two as they were previously shown in Table 19.

Table 23 Final EFA for the research model

Pattern Matrix[a]

	Factor													
	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Sup3	.785													
Sup6	.776													
Sup5	.762													
Sup9	.680													
Sup2	.676													
Sup8	.654													
Sup7	.650													
Sup4	.643													
Com2		.840												
Com3		.780												
Com4		.617												
Com1		.571												
Com6		.567												
Com7		.559												
JS3			.831											
JS2			.807											
JS1			.755											
JS5			.693											
JS6			.683											
JS4			.597											
Vio5				.759										
Vio8				.698										
Vio4				.697										
Vio9				.643										
Vio6				.637										
Vio7				.583										
Vio2				.563										
Vio3				.549										
Vio10				.523										
SM5					.847									
SM3					.841									
SM6					.829									
SM2					.823									
SM1					.708									
Rec2						.869								
Rec5						.686								
Rec3						.677								
Rec4						.608								
Rec1						.584								
EX2							.798							
EX1							.717							
EX4							.698							
EX3							.649							
EX5							.469							
ME5								.738						
ME6								.707						
ME7								.580						
ME4								.466						
ME3								.422						
ME1								.344						
TI2									.830					
TI1									.731					
TI3									.688					
Co1										.880				
Co2										.820				
Co3										.624				
SRU4											.875			
SRU3											.710			
SRU5											.670			

Pattern Matrix[a]

SF5											.758		
SF3											.686		
SF4											.649		
Tra5												.760	
Tra7												.656	
Tra6												.539	
Tra1												.489	
OC5													.566
OC4													.566
OC2													.520
OC3													.469

Extraction Method: Principal Axis Factoring.
Rotation Method: Promax with Kaiser Normalization.
a. Rotation converged in 14 iterations.

The factor correlation matrix of the final EFA model in Table 24 provides vital information about the factors relationship with each other. It shows that all correlations are normal.

Table 24 Correlation Matrix for final EFA model

Factor Correlation Matrix

Factor	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1. Sup	1.00													
2. Com	.569	1.00												
3. JS*	-.452	-.281	1.00											
4. Vio	-.213	-.165	.234	1.00										
5. SM	.153	.135	-.292	-.226	1.00									
6. Rec	.514	.523	-.366	-.130	-.005	1.00								
7. EX	-.315	-.306	.386	.283	-.043	-.332	1.00							
8. ME	-.100	-.103	.238	.455	-.173	-.155	.201	1.00						
9. TI	-.298	-.379	.450	.221	-.146	-.304	.473	.205	1.00					
10. Co	.261	.225	-.174	-.173	.226	.194	-.020	-.162	-.236	1.00				
11. SRU	.335	.331	-.423	-.330	.174	.408	-.305	-.265	-.266	.188	1.00			
12. SF	.265	.223	-.230	-.363	.111	.334	-.274	-.352	-.180	.168	.358	1.00		
13. Tra	.577	.624	-.360	-.269	.143	.520	-.319	-.218	-.376	.261	.348	.333	1.00	
14. OC*	-.394	-.456	.484	.136	-.129	-.340	.420	.064	.472	-.061	-.266	-.093	-.416	1.00

Extraction Method: Principal Axis Factoring.
Rotation Method: Promax with Kaiser Normalization.
*JS & OC are reverse-coded factors.

The comparison among the EFA models is presented in Table 25. There were 96 items which formed 22 factors and were reduced to 74 items within 15 factors after analyzing each part of the model separately.

Table 25 SPSS Results for the Developed EFA Model

EFA Model	Initial	Revised	Final
Kaiser-Meyer-Olkin Measure of Sampling Adequacy	0.886	0.89	0.885
Total variance explained (cumulative %)	61.964	60.417	59.847
Number of Variables	96	74	70
Number of Factors	22	15	14

Table 26 Factors Internal Consistency (Reliability) of the EFA Model

#	Factor	Initial Data		After EFA	
		Number of Items	Cronbach's Alpha	Number of Items	Cronbach's Alpha
1	Sup	9	0.915	8	0.909
2	SF	6	0.712	3	0.715
3	Com	8	0.921	6	0.903
4	Rec	5	0.892	5	0.892
5	Co	3	0.826	3	0.826
6	Tra	7	0.868	4	0.854
7	JS	7	0.762	6	0.874
8	OC	6	0.842	4	0.838
9	EX	7	0.723	5	0.829
10	TI	4	0.793	3	0.801
11	SM	6	0.87	5	0.904
12	SRU	7	0.768	3	0.791
13	ME	9	0.77	6	0.756
14	Vio	12	0.862	9	0.86
		96		70	

Finally, EFA results were checked by discriminant validity. Brown (2006) argued that poor discriminant validity exists when factor correlations are above 0.80. From Table 24, it can be seen that the all correlations were less than 0.80 and thus, discriminant validity was confirmed. In addition, all factors had a value of Cronbach's alpha greater than the recommended value of 0.7 (Table 26). Therefore, the reliability of the EFA model was confirmed.

EFA final results support the results from Tables 10 & 11 earlier. Most of the independent variables in these tables were removed from EFA except for JS1, JS2, OC3, SM1, SM2, SM6, ME4, ME6, Vio4, Vio5, Vio6, Vio8, Vio9, and Vio10. However, these remaining variables do not invalidate the EFA analysis (Tabachnick & Fidell, 1996).

4.4 Confirmatory Factor Analysis

Confirmatory Factor Analysis (CFA) can be used to confirm the EFA factor structure. In other words, CFA can be used to test structural construct validity which is the relationships among the constructs. Recall that constructs are unobserved such as latent variables or factors. In this research, the theoretical hypotheses about the relationships between each observed variable and its corresponding latent variable were tested.

There are many ways of testing the model goodness-of-fit. Hooper, Coughlan, and Mullen (2008) recommend first to assess the fit of each construct individually to find out if there are any weak items. Therefore, CFA of each construct was conducted to verify the validity and reliability of that measurement model. In addition, according to Rencher and Christensen (2012), CFA was summarized in some statistical steps:

- Hypothesizing an identifiable model
- Fitting model parameters
- Assessing the goodness of model fit
- Performing statistical inference for model parameters

CFA of safety climate, employee turnover, and unsafe acts were tested as second order factors while safety motivation and reporting unsafe behaviors were tested as first order factors. The maximum likelihood estimation method was used to measure validity and reliability of each measurement model since the absolute values of the kurtosis of the variables were below 20.0 (Harrington, 2009) as shown in Appendix F.

4.4.1 CFA of Safety Climate

Safety climate was the exogenous (independent) variable that was measured by six factors. The standardized estimates output is shown in Figure 10. Using the factor loading scale in Table 5, all factor loadings from latent to observed variables were acceptable where the highest value was 0.85 (*Recognition*-Rec2) and lowest value was 0.61 (*SafetyFocus*-SF3). Moreover, all observed variables were significantly ($p < 0.001$) loading on the expected latent variable as it shown in Table E1 in Appendix E. All the latent variables were significantly correlated as expected except for the correlation between *CoworkerSupport* and *SafetyFocus* ($r=0.04$; $p=0.582$). The covariance between them was not significantly different from zero at the 0.05 level (two-tailed). These correlations were high only between *Supervision*, *Communication*, *Recognition*, and *Training* which means that they were measuring the same construct. Moreover, these four factors did not have high correlations with *SafetyFocus*.

Using the earlier recommendations for the acceptable model fit, the initial second order safety climate CFA model did fit kindly well with RMSEA = 0.054, CFI = 0.936, and TLI = 0.929. However, there were some modifications needed to be applied to get a better fit and they were based on modification indices (MI) and examination of residuals.

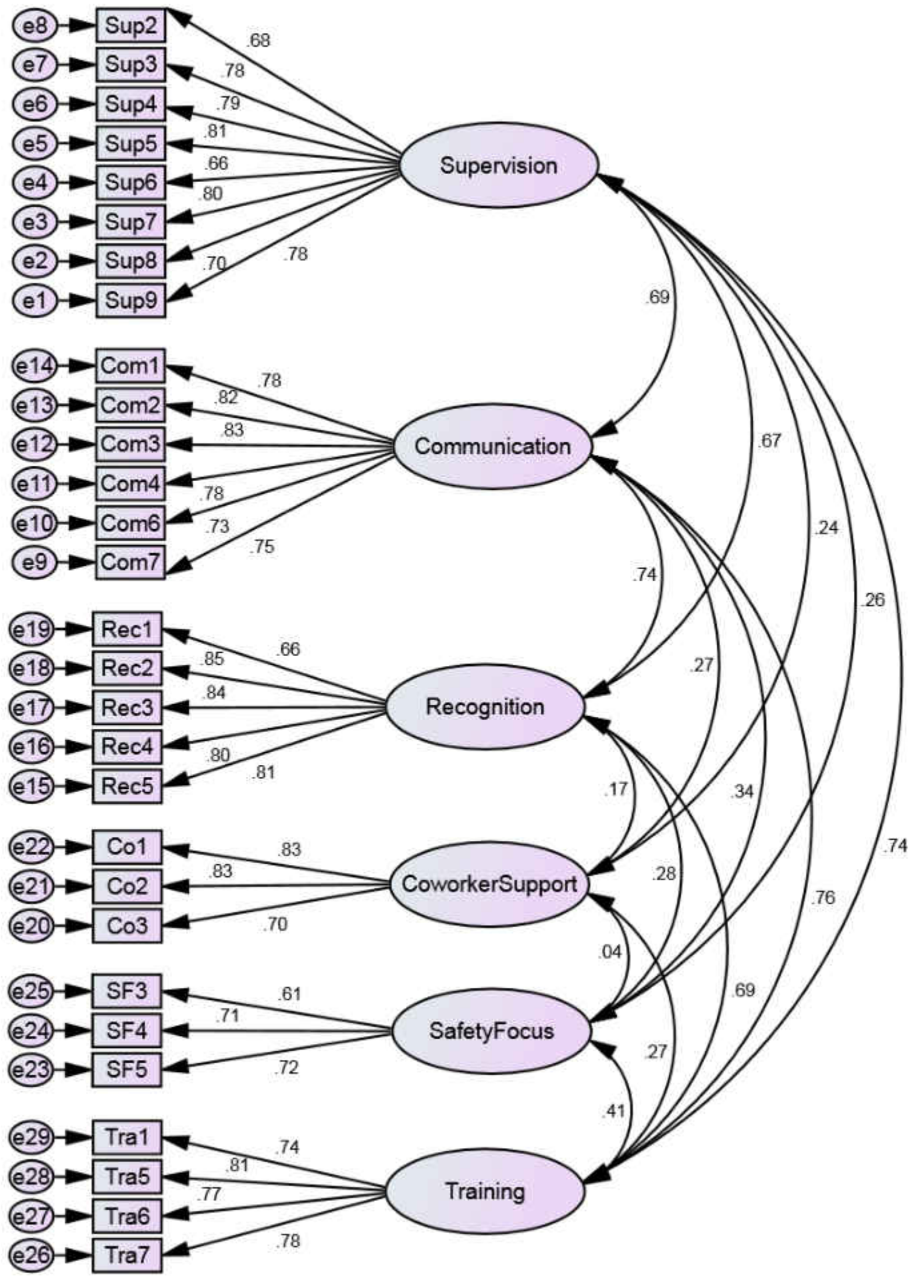

Figure 10 Standardized Output of Safety Climate CFA Model (Latent Variables Correlations)

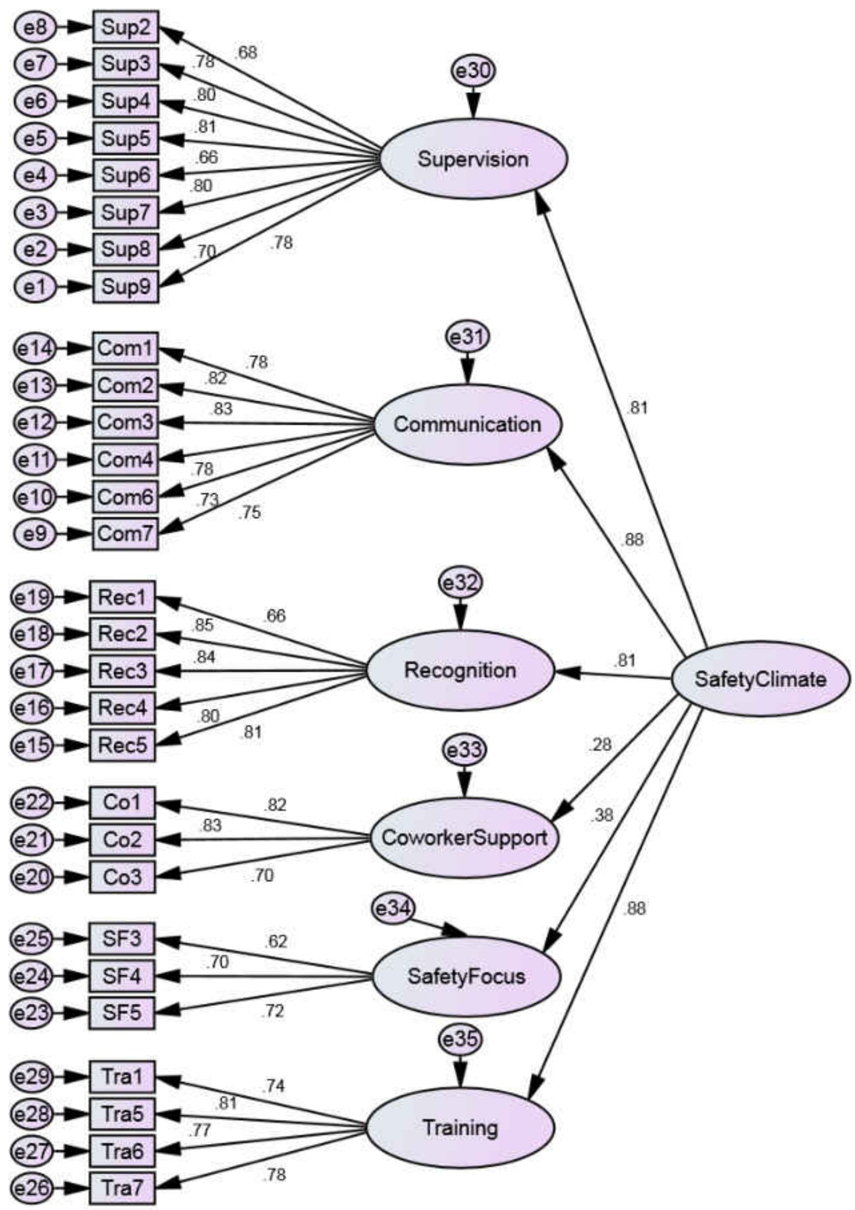

Figure 11 Standardized Output of the Initial Safety Climate CFA Model

The standardized output of the initial CFA of safety climate is presented in Figure 11. The relation between *SafetyFocus* and *SafetyClimate* was not strong since loading of *SafetyFocus* (0.38) was low. This could be from that the remaining three items of *SafetyFocus* after EFA were related more to a safety attitude (e.g. “Lack of proper equipment sometimes forces us to cut corners in our work”). The loading of *CoworkerSupport* on *SafetyClimate* was 0.28 and was not interpreted according to Table 5. Therefore, it had been eliminated from the revised model.

Table 27 Modification Indices Output for Safety Climate CFA Model

Covariances: (Group number 1 - Default model)				
			M.I.	Par Change
e20	<-->	SafetyClimate	22.748	0.178
e11	<-->	e29	10.194	0.121
e9	<-->	e17	10.088	0.132
e4	<-->	e5	12.539	0.169
e2	<-->	e8	11.635	-0.138
e1	<-->	e6	18.2	-0.139
Regression Weights: (Group number 1 - Default model)				
			M.I.	Par Change
Co1	<---	SafetyFocus	14.296	-0.155
Co1	<---	SF3	14.003	-0.092
Co3	<---	SafetyClimate	22.748	0.204
Co3	<---	Training	20.09	0.168
Co3	<---	Recognition	22.89	0.167
Co3	<---	Communication	17.8	0.186
Co3	<---	Supervision	17.382	0.191
Co3	<---	Tra6	21.405	0.158
Co3	<---	Tra7	10.064	0.087
Co3	<---	Rec2	20.106	0.121
Co3	<---	Rec3	18.287	0.116
Co3	<---	Rec4	19.474	0.115
Co3	<---	Com1	16.864	0.123
Co3	<---	Com4	13.12	0.118
Co3	<---	Com6	18.566	0.132
Co3	<---	Sup2	12.252	0.133
Co3	<---	Sup6	11.86	0.103
Co3	<---	Sup8	12.226	0.107
Co3	<---	Sup9	21.16	0.158
Com4	<---	SF3	10.575	0.107

Furthermore, to support this action, modification indices were analyzed. For simplicity of reading tables, the threshold of MI was set to be 10 instead of the default value of 4. The largest MI (22.748) suggest adding a covariance between the *SafetyClimate* and error for Co3 (e20) as it shown in Table 27. In addition, the MI suggest adding paths from *SafetyClimate*, *Training*, *Recognition*, *Communication*, and *Supervision* to Co3 (MI of 22.748, 20.09, 22.89, 17.8, and 17.382, respectively) and other paths from Co3 to other variables. There were also other paths from *SafetyFocus* and SF3 to Co1 and from SF3 to Com4 according to the MI output.

According to Harrington (2009), any standardized residuals greater than 1.96 (for $p < 0.05$) may indicate areas of strain and affect the model's fit. Generally, in sufficiently large samples, standardized residual covariances have a standard normal distribution if the model is correct and most of them should be less than 2.58 in absolute value (Schumacker & Lomax, 2010). Examining the localized area of strain in Table 28, all indicator variables were below 2.58 except for some variables of *CoworkerSupport* and *SafetyFocus.* For instance, the residual covariance between Com4 and SF3 was 2.838 which is greater than the recommended value of 2.58.

Table 28 Selected Output Standardized Residuals for Safety Climate CFA Model

Standardized Residual Covariances (Group number 1 - Default model)									
	Tra1	Tra5	Tra6	Tra7	SF3	SF4	SF5	Co1	Co3
Co1				-2.025			-2.694	0	
Co3	2.27	2.09	3.98						0
Rec2									2.305
Rec3									2.422
Rec4									2.347
Com1									2.214
Com2									2.107
Com4					2.838				2.306
Com6									3.15
Com7									2.664
Sup2									2.833
Sup6						-2.575	-2.441		
Sup7									2.156
Sup8									2.292
Sup9									3.48

Finally, in order to have a better fit, both *SafetyFocus* and *CoworkerSupport* factors were dropped from the model as they have low factor loading and some complex items. In addition, a single higher-order factor (safety climate) may relate to the interrelated factors that have nearly the same magnitude. As a result, the new indices showed some improvement in model fit (CFI = 0.946, TLI = 0.940 and RMSEA = 0.060). However, after examining the MI for this modified model (Table 29), there were still some modifications that need to be made.

Table 29 Modification Indices Output for Safety Climate CFA Model: after modifications

Covariances: (Group number 1 - Default model)				
			M.I.	Par Change
e11	<-->	e29	10.694	0.124
e4	<-->	e5	12.159	0.166
e2	<-->	e8	11.558	-0.138
e1	<-->	e6	18.047	-0.139
Regression Weights: (Group number 1 - Default model)				
			M.I.	Par Change

The new MIs suggest adding error covariances between e1 and e6 (MI = 18.047), e4 and e5 (MI = 12.159), e2 and e8 (MI = 11.558), and e11 and e29 (MI = 10.694). It was reasonable to add the error covariance only between e4 and e5 since these related items are very similar. The estimated correlations between (e1 and e6) and (e2 and e8) were significant at $p < 0.001$ with values of -0.37 and -0.21, respectively. However, the correlations (see Appendix C) between their items were positive, 0.536 for (Sup4-Sup9) and 0.374 for (Sup2-Sup8). As recalled earlier, items Sup8 and Sup9 were added to those items of supervision scale from different survey. Therefore, these two items had been omitted from the model. All of the standardized residual covariances were checked and they were within the required ranged. This final modification in Figure 12 shows an improvement in the model's fit (CFI = 0.956, TLI = 0.961 and RMSEA = 0.053) which reached the recommended guidelines. Table 30 shows that the final value of chi-square ($\chi2$) was dropped to almost half of the initial value of $\chi2$.

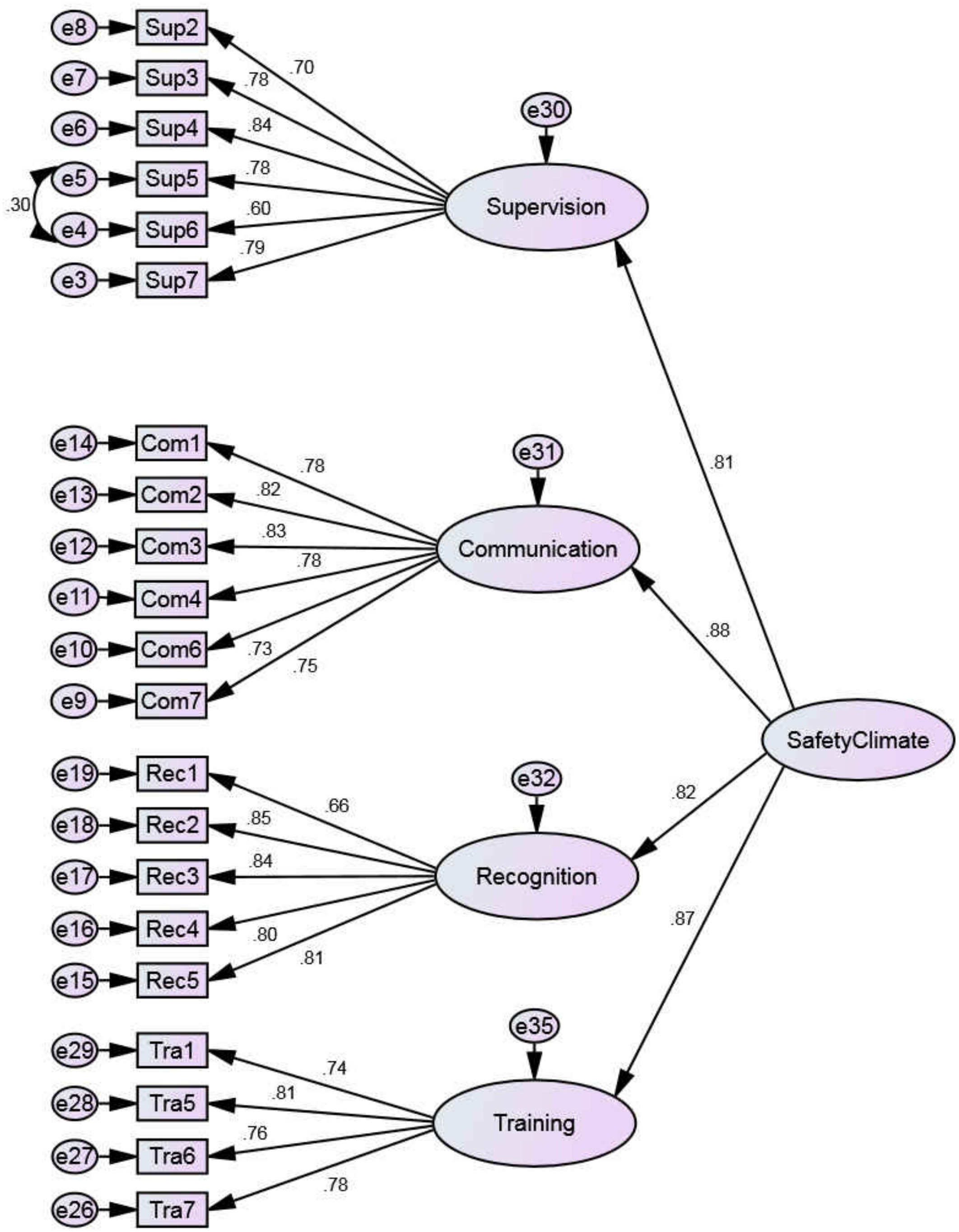

Figure 12 Standardized Output of the Final Safety Climate CFA Model

Table 30 Comparison among Fit Indices of Safety Climate CFA Models

Model	χ2	DF	P	χ2/DF	CFI	TLI	RMSEA	PCLOSE	AIC	ECVI
Initial	681.126	371	0.000	1.836	0.936	0.929	0.054	0.127	809.126	2.869
Modified	452.188	226	0.000	2.001	0.946	0.940	0.060	0.025	552.188	1.958
Final	328.767	184	0.000	1.787	0.956	0.961	0.053	0.299	422.767	1.499

4.4.2 CFA of Employee Turnover

Employee turnover was an endogenous variable that was measured by four factors as shown in Figure 13. The standardized estimates output is also shown in Figure 13. Recall earlier, the curved lines represent the correlations among the latent variables. All the latent variables were significantly ($p < 0.001$) correlated as hypothesized previously where the highest correlation was between *JobSat* and *OrgComt* (0.73) and the lowest one was between *JobSat* and *TurnInt* (0.52). Thus, it can be concluded that these latent variables were all measuring employee turnover.

Table E2 in Appendix E shows the significant of all loadings and correlations. All observed variables significantly ($p < 0.001$) loaded on the expected factor and had values of 0.54 and above that were considered good to excellent. The loadings of the six indicators on *JobSat* ranged from 0.67 (JS4) to 0.78 (JS5 and JS6). The loadings of the four indicators on *OrgComt* ranged from 0.61 (OC4) to 0.81 (OC2). The loadings of the three indicators on *TurnInt* ranged from 0.72 (TI2) to 0.82 (TI1), and the loadings of the five indicators on *EmoEx* ranged from 0.54 (EX1) to 0.81 (EX4).

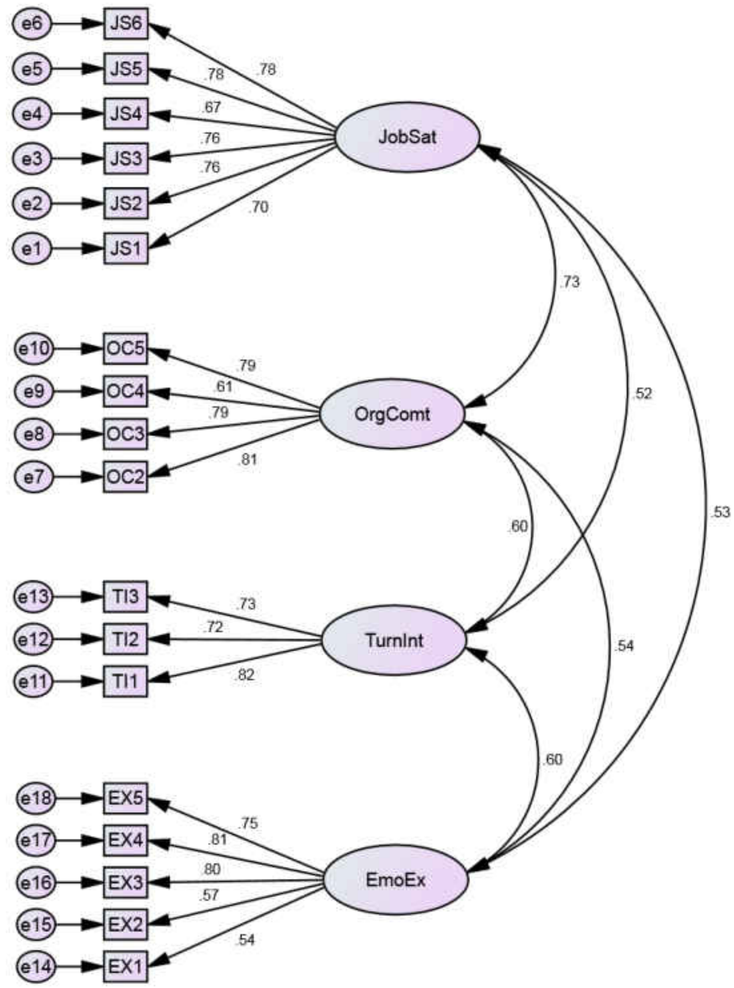

Figure 13 Latent Variables Correlations Output of Employee Turnover CFA Model

From Figure 14, the loadings of *JobSat*, *OrgComt*, *TurnInt*, and *EmoEx* on *Employee Turnover* were 0.80, 0.86, 0.71, and 0.68, respectively. These loadings were significant ($p < 0.001$) and considered to be very good to excellent. However, the initial Employee Turnover CFA model did not fit well, with RMSEA = 0.094, CFI = 0.875, and TLI = 0.855. These fit indices suggest that the model required some modifications.

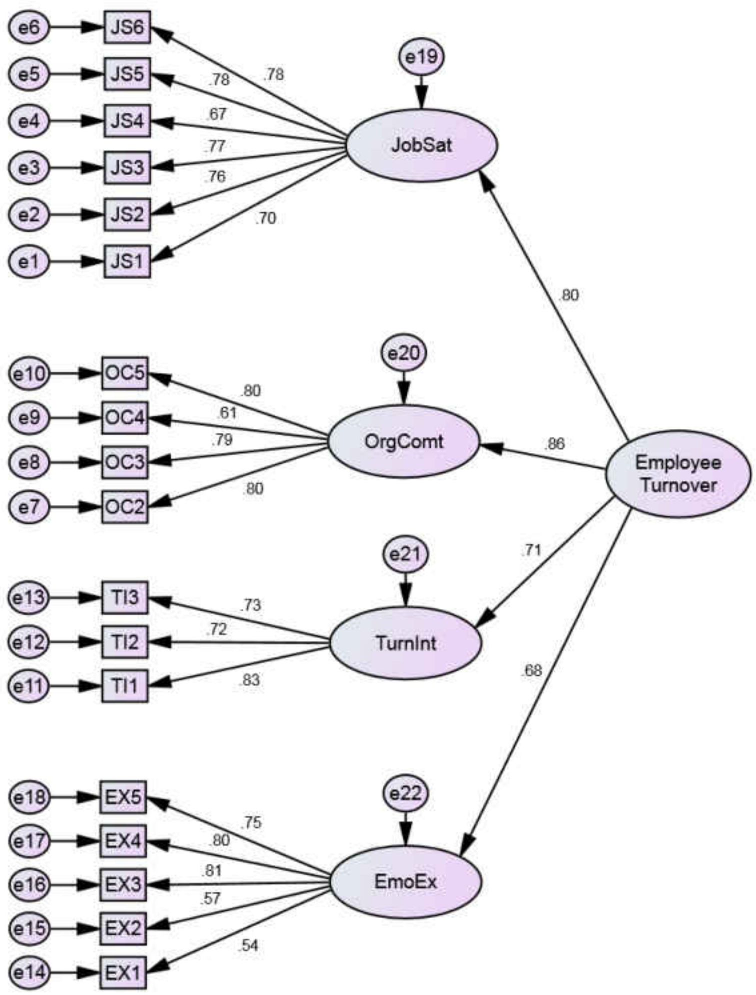

Figure 14 Standardized Output of Initial Employee Turnover CFA Model

Examining the MI in Table 31, it can be seen that the three largest MIs suggest adding a covariance between the errors for JS1 and JS2, JS2 and JS3, and EX1 and EX2. Job Satisfaction item 1 is the job's significant to a person and JS2 is the sense of achieving this work. It makes sense that a meaningful job to someone would lead him to feel his success and adding that covariance would be reasonable. It was the same for JS2 and JS3 where are both considered to have a sense of a job well done. Moreover, it was logically adding the last covariance where the participants thought that both items 1 and 2 of Emotional Exhaustion are somewhat related in the feeling of emotionally drained at work would affect the performance at the end of the day.

Another thing that needed to be looked on are several of MIs involve EX5 item. This item seems to be related directly to the common factor (*Employee Turnover*) either by adding a covariance or a path. MIs also suggest adding paths between *TurnInt* and *OrgComt* to EX5 (MI of 12.603 and 17.035, respectively). Finally, MIs suggest adding covariances between the error for EX5 and the errors of *EmoEx*, *OrgComt*, and OC5 and adding paths between EX5 and three other variables (OC2, OC4, and OC5). EX5 is being frustrated at the workplace and it was reasonable to be related with other latent variables and other items and thus, removing it from the model.

After adding the recommended covariances above and removing EX5, the impact of the new modification showed improvement in the model's fit (RMSEA = 0.059, CFI = 0.954, and TLI = 0.944). However, the model was still in need of some improvements according to the MIs in Table 32. The largest MIs suggest adding a covariance between the errors for JS1 and JS3 (e1 and e3) in which it is reasonable when a job is important to someone, he/she would be most likely to be proud of his/her well done tasks.

Table 31 Modification Indices Output for Employee Turnover CFA Model

Covariances: (Group number 1 - Default model)

			M.I.	Par Change
e18	<-->	Employee_Turnover	12.244	0.085
e18	<-->	e22	12.232	-0.099
e18	<-->	e20	12.407	0.132
e14	<-->	e15	47.443	0.405
e10	<-->	e18	12.719	0.143
e7	<-->	e17	12.19	-0.123
e5	<-->	e6	24.04	0.153
e4	<-->	e5	14.221	0.137
e3	<-->	e5	11.734	-0.081
e2	<-->	e6	19.021	-0.101
e2	<-->	e5	16.428	-0.099
e2	<-->	e3	47.262	0.121
e1	<-->	e5	11.11	-0.087
e1	<-->	e2	49.707	0.137

Regression Weights: (Group number 1 - Default model)

			M.I.	Par Change
EX5	<---	Employee_Turnover	12.244	0.489
EX5	<---	TurnInt	12.603	0.2
EX5	<---	OrgComt	17.035	0.261
EX5	<---	OC5	24.788	0.236
EX5	<---	OC4	22.582	0.226
EX5	<---	OC2	10.11	0.15
EX4	<---	OC2	10.637	-0.136
EX2	<---	EX1	32.035	0.294
EX2	<---	JS2	10.471	-0.243
EX1	<---	EX2	30.188	0.277
OC2	<---	EX4	10.583	-0.129
JS3	<---	JS2	17.674	0.17
JS2	<---	JS3	17.007	0.176
JS2	<---	JS1	23.088	0.202
JS1	<---	JS2	18.403	0.19

In addition, MIs suggest adding a covariance between the errors for OC2 and EX4 (MI = 10.965 with negative correlation). Logically, to relate these two errors, the Organizational

Commitment item 2 is speaking positively about the workplace and the Emotional Exhaustion item 4 is being burnout. People with job burnout are more often to speak negatively to their friends about workplace. Moreover, from SPSS results, CO2 and EX4 had a significant negative correlation at ($r = -0.220$; $p < 0.01$).

Table 32 Modification Indices Output for Employee Turnover CFA Model: after modifications

Covariances: (Group number 1 - Default model)				
			M.I.	Par Change
e7	<-->	e17	10.965	-0.121
e1	<-->	e3	15.415	0.066
Regression Weights: (Group number 1 - Default model)				
			M.I.	Par Change
OC2	<---	EX4	10.33	-0.127
JS3	<---	JS1	11.912	0.134
JS1	<---	JS3	10.058	0.137

After adding the covariance from e1 to e3 and e7 to e17, the new model fit became better than the earlier two models with RMSEA = 0.048, CFI = 0.970, and TLI = 0.963. However, after examining the residual covariances, all came out within the required range except for that between CO4 and EX2 with a value of -2.763 (> 2.58). Finally, it was determined that if CO4 was removed, CFI would become better with a value of 0.975 instead of 0.974 when removing EX2. TLI and RMSEA had the same results for both cases. The final model is shown in Figure 15 and fit indices are shown in Table 33.

Table 33 Comparison among Fit Indices of Employee Turnover CFA Models

Model	χ2	DF	P	χ2/DF	CFI	TLI	RMSEA	PCLOSE	AIC	ECVI
Initial	455.84	131	0.000	3.480	0.875	0.855	0.094	0.000	535.84	1.900
Modified1	222.09	112	0.000	1.983	0.954	0.944	0.059	0.094	304.09	1.078
Modified2	181.23	110	0.000	1.648	0.970	0.963	0.048	0.595	267.23	0.948
Final	151.91	95	0.000	1.599	0.975	0.968	0.046	0.670	233.91	0.829

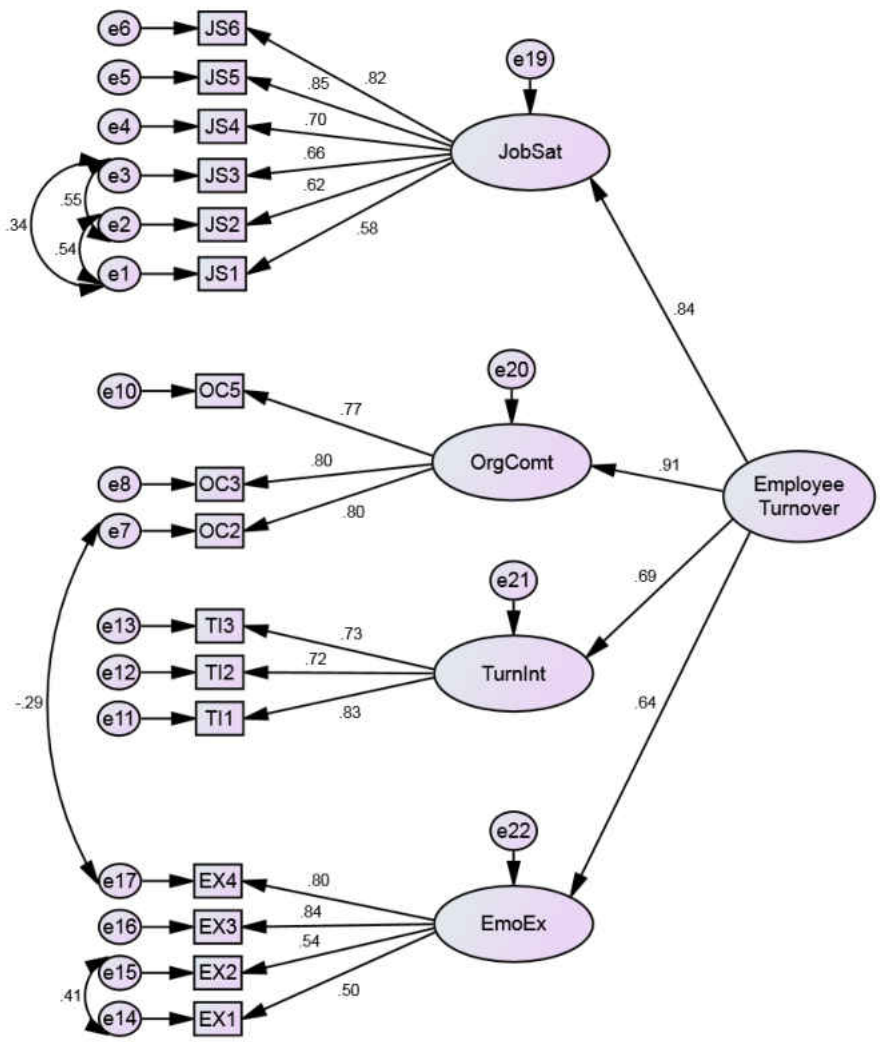

Figure 15 Standardized Output of the Final Employee Turnover CFA Model

4.4.3 CFA of Safety Motivation

The standardized estimates output is shown in Figure 16. All factor loadings from *SafetyMotivation* to observed variables were acceptable where the highest value was 0.89 (SM5) and lowest one was 0.71 (SM1) and they were all significant at ($p < 0.001$). The initial model did not fit well; with RMSEA = 0.230, CFI = 0.922, and TLI = 0.843. Therefore, the model required to be modified using the MI suggestion in Table 34.

Table 34 Modification Indices Output for Safety Motivation CFA Model

Covariances: (Group number 1 - Default model)				
			M.I.	Par Change
e4	<-->	e5	10.093	0.01
e3	<-->	e5	13.383	-0.014
e2	<-->	e4	30.574	-0.021
e1	<-->	e2	24.215	0.029
Regression Weights: (Group number 1 - Default model)				
			M.I.	Par Change
SM5	<---	SM2	11.817	-0.11
SM2	<---	SM1	11.19	0.124

It can be seen from Table 34 that there were two largest MI, the first one was between e2 and e4 and the second one was between e1 and e2. However, adding a covariance between the errors for SM2 and SM5 was not reasonable with estimated correlation of -1.121. These two variables should have positive correlation since believing of the importance of safety at workplace will help employee to encourage others to follow safety procedures. In addition, AMOS provided a solution that was not admissible (Table 35). If the solution is inadmissible, it indicates that some exogenous variables have an estimated covariance matrix that is not positive definite due to either that the model is wrong or that the sample is too small (Arbuckle, 2011). As result, a solution to admissible parameter values required to be made.

Table 35 AMOS Notes adding Covariance between SM1 and SM5

The following covariance matrix is not positive definite (Group number 1 - Default model)		
	e4	e2
e4	0.019	
e2	-0.034	0.049
Correlations: (Group number 1 - Default model)		
		Estimate
e2 <--> e4		-1.121

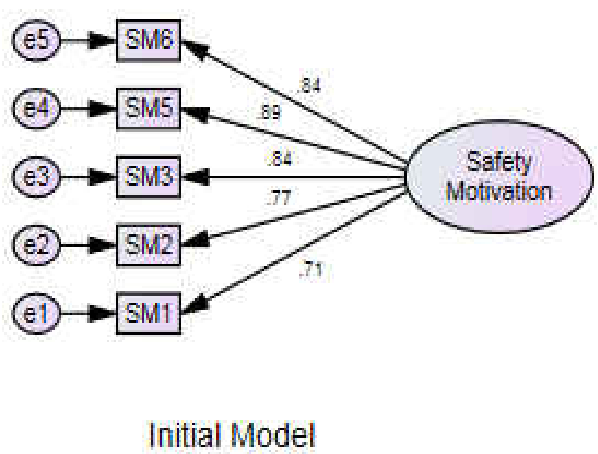

Figure 16 Standardized Output of the Initial Safety Motivation CFA Model

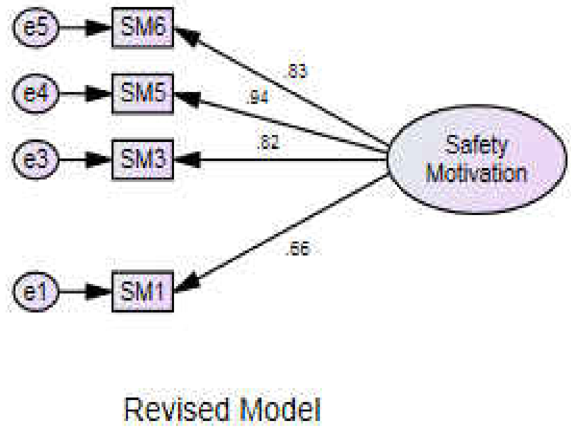

Figure 17 Revised Safety Motivation CFA Model Standardized Output

Since that several of the suggested modifications involve SM2 as shown in Table 34 earlier, this particular item was omitted from the model. This modification (Figure 17) resulted in the following fit indices: RMSEA = 0.079, CFI = 0.995 and TLI = 0.984. Although RMSEA did not reach the recommended value of 0.05, it was still less than 0.08. This model fits better than the initial one as it shown in Table 36.

Table 36 Comparison among Fit Indices for Models of Safety Motivation

Model	χ2	DF	P	χ2/DF	CFI	TLI	RMSEA	PCLOSE	AIC	ECVI
Initial	79.298	5	0	15.86	0.922	0.843	0.23	0	99.298	0.352
Revised	5.528	2	0.063*	2.764	0.995	0.984	0.079	0.198	21.528	0.076

* The probability of getting a discrepancy as large as 5.528 is .063

4.4.4 CFA of Safety Performance

Unsafe acts construct was measured by errors and violation. Reporting unsafe behaviors was added also to unsafe acts CFA model. The standardized estimates output is shown in Figure 18. All factor loadings from latent to observed variables were between excellent and fair, and were significant (p < 0.001), where the highest was 0.83 (RepUnsafe-SRU4) and lowest was 0.46 (Errors-ME3).

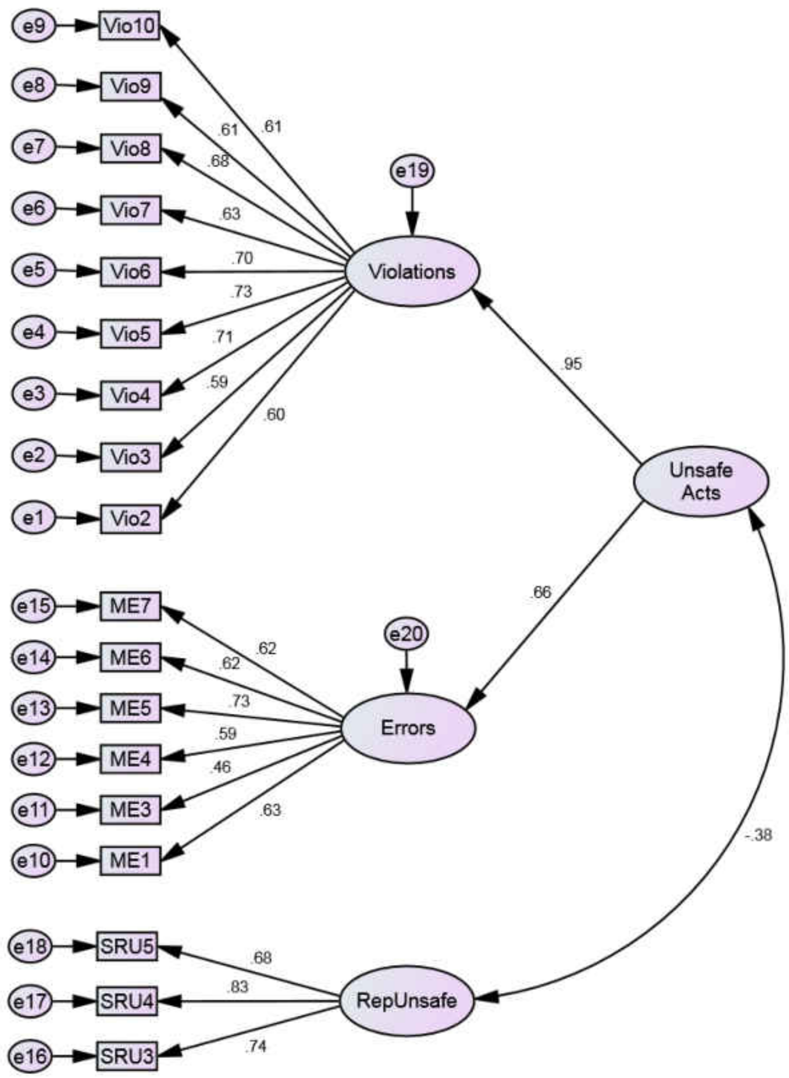

Figure 18 Standardized Output of Initial Safety Performance CFA Model

The estimated correlation between *Violations* and *Errors* was 0.62, thus both were measuring the same construct of *UnsafeActs*. Moreover, both *UnsafeActs* and *RepUnsafe* were significantly correlated (-0.38). Table E3 in Appendix E shows the significant of all loadings and correlations. The loadings of *Violations* and *Errors* on *UnsafeActs* were 0.95 and 0.66, respectively. This model did not fit well; with RMSEA = 0.077, CFI = 0.878, and TLI = 0.859. These fit indices suggest that the model was required some modifications according to Table 37.

Table 37 Modification Indices Output Safety Performance CFA Model

Covariances: (Group number 1 - Default model)				
			M.I.	Par Change
e14	<-->	e15	13.847	0.036
e12	<-->	e15	11.979	-0.057
e11	<-->	e12	23.317	0.162
e7	<-->	e11	11.13	0.1
e7	<-->	e8	12.868	0.072
e6	<-->	e12	11.635	-0.117
e6	<-->	e7	11.956	0.106
e5	<-->	e13	15.601	0.069
e1	<-->	e2	16.908	0.197
Regression Weights: (Group number 1 - Default model)				
			M.I.	Par Change
ME4	<---	ME3	17.469	0.189
ME3	<---	ME4	13.668	0.223
ME1	<---	Vio7	11.258	0.16
ME1	<---	Vio3	12.082	0.154
Vio3	<---	Vio2	10.073	0.166
Vio2	<---	Vio3	10.412	0.151

Accordingly, the largest MIs suggest adding a covariance between the errors for ME3 and ME4. In addition, paths between ME3 and ME4 (MI = 17.469) or between ME4 and ME3 (MI = 13.668) were suggested to be added. In addition, MIs suggest adding another covariance between e1-e2 and between e5-e13 (MI of 16.908 and 15.601, respectively). It was reasonable to relate e1 and e2 since both items were about not following the correct procedures. On the other hand, it was not reasonable to relate e5 and e13 because the first one is about forgetting to sign off a task and the second is signing a task that was performed by other person. All other error covariances in Table 37 were not added because there was no logic behind that. It was also apparent from the MIs (threshold = 4) that Vio7 and Vio8 had relations with several items. Furthermore, MIs suggest adding a path from Vio7 to ME1 (MI = 11.258). As a result, Vio7 had been omitted. By doing so, this resulted in a better model with RMSEA = 0.064, CFI = 0.920, and TLI = 0.905; however, the model was still in need of an improvement as it shown in Table 38.

Table 38 Modification Indices Output of the Safety Performance CFA Model: after Modifications (Threshold = 8)

Covariances: (Group number 1 - Default model)

			M.I.	Par Change
e14	<-->	e15	9.717	.029
e12	<-->	e15	9.404	-.048
e9	<-->	e20	8.051	.056
e7	<-->	e11	12.745	.106
e7	<-->	e8	14.193	.077
e5	<-->	e13	13.607	.065
e2	<-->	e10	8.126	.129

Variances: (Group number 1 - Default model)

	M.I.	Par Change

Regression Weights: (Group number 1 - Default model)

			M.I.	Par Change
ME1	<---	Vio3	13.655	.167
ME1	<---	Vio2	10.946	.158
Vio8	<---	Vio9	8.189	.161

The largest Par Change (0.129) suggests adding error covariance between e2 and e10. It was reasonable to do that since Vio3 is not following procedures in order to complete a task and ME1 is missing out steps in performing the tasks. In addition, another new error covariance between e1 and e10 was suggested to be added (Par Change = 0.131). It was also reasonable to add this covariance. Finally, Vio10 was removed from the model because it was loading on *Errors* which means it had a relationship with both *Violations* and *Errors*. The residual covariances were checked and they were within the required range. This final model resulted in the following fit indices: RMSEA = 0.058, CFI = 0.939, and TLI = 0.925 as they are shown in Table 39. The standardized output for the final modified model is shown in Figure 19.

Table 39 Comparison among Fit Indices for Models of Unsafe Acts and Reporting Behavior

Model	χ2	DF	P	χ2/DF	CFI	TLI	RMSEA	PCLOSE	AIC	ECVI
Initial	349.909	132	0.000	2.651	0.878	0.859	0.077	0.000	427.909	1.517
Modified1	244.048	114	0.000	2.141	0.920	0.905	0.064	0.022	322.048	1.142
Final	187.894	97	0.000	1.937	0.939	0.925	0.058	0.149	265.894	0.943

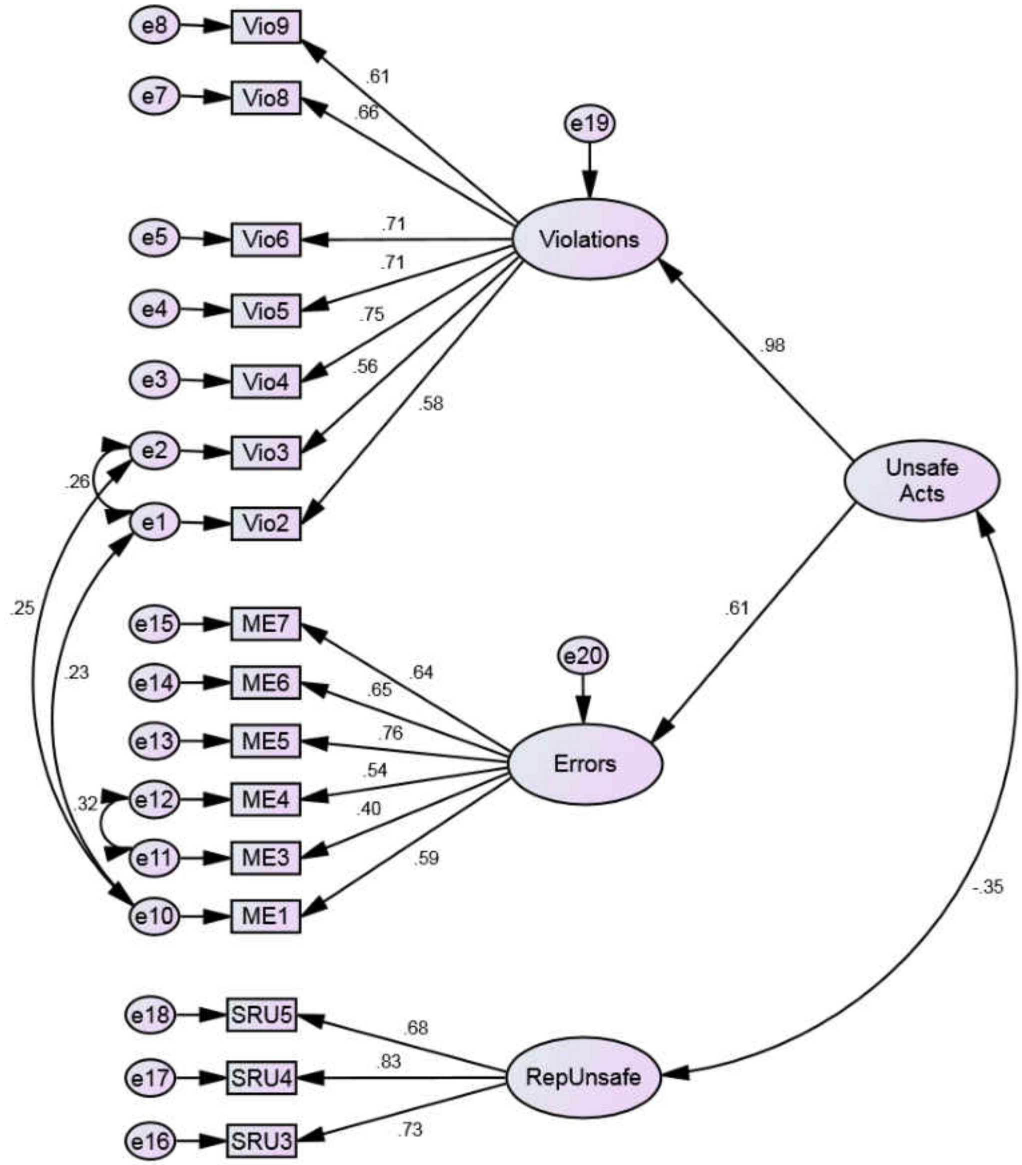

Figure 19 Standardized Output of the Final Safety Performance CFA Model

4.5 General Model Validation

All previous revised CFA models were brought together to form the general structural equation model. These CFA models were reliable in which the measurements were regressed on their latent variables (significant regression weights). Thus, these steps would reduce any complication on the hypothesized structure model.

Therefore, two steps have been applied to the analysis of the model. First, analyzing the model as CFA model and second analyzing the full structure model. In CFA, the significant of hypothesized factor model is being statistically examined to determine whether the sample date confirm that model (Schumacker & Lomax, 2010).

4.5.1 Hypothesized CFA Model

The hypothesized model included all variables in the study except for incidents and injuries variables because they were observed variables (with rectangular shape) that measured by a single item. However, they would be included in the final CFA model for testing its validation.

A confirmatory factor analysis was conducted to validate the hypothesized research model. The correlations among the latent variables are shown in Table 40. All correlations were significant with critical ratios greater than 1.96 at $p < 0.05$, where the highest correlation was -0.73 between *SafetyClimate* and *EmployeeTurnover*. The lowest one was between *SafetyClimate* and *SafetyMotivation* with a value of 0.16 and this weak relationship suggests that safety motivation is affected more by individual attitude rather than organizational factors especially in a high risk industry like aviation.

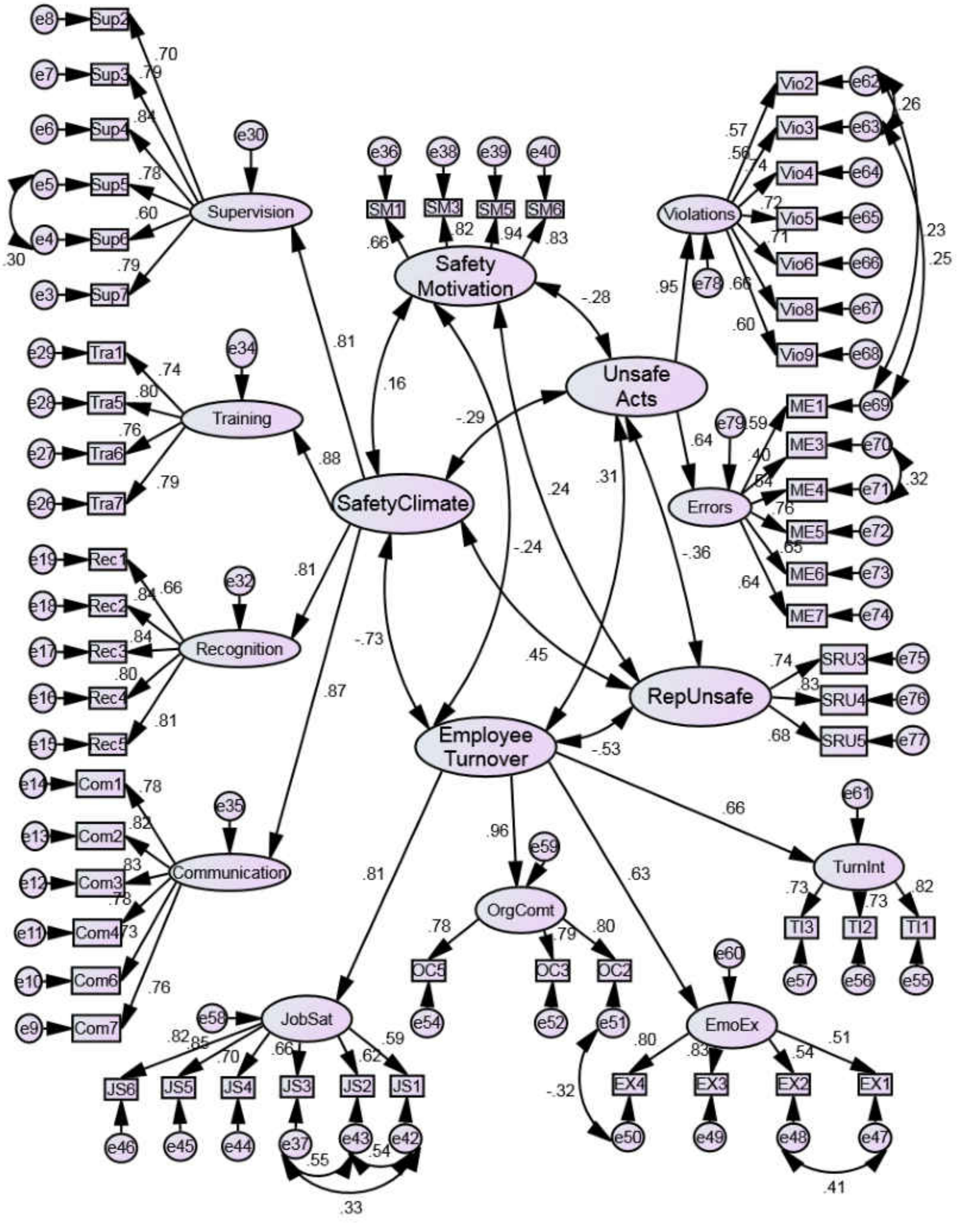

Figure 20 Hypothesized CFA Model for the First Run (Standardized Estimates)

Table 40 Selected Standardized Output for Hypothesized CFA Model: Latent Variable Correlations

Correlations: (Group number 1 - Default model)

			Estimate
SafetyClimate	<-->	Employee_Turnover	-.727
Employee_Turnover	<-->	RepUnsafe	-.526
Safety_Motivation	<-->	Unsafe_Acts	-.283
Safety_Motivation	<-->	Employee_Turnover	-.236
SafetyClimate	<-->	Unsafe_Acts	-.291
SafetyClimate	<-->	RepUnsafe	.455
RepUnsafe	<-->	Unsafe_Acts	-.364
Employee_Turnover	<-->	Unsafe_Acts	.309
Safety_Motivation	<-->	SafetyClimate	.158
Safety_Motivation	<-->	RepUnsafe	.238

It can be seen from Figure 20 that all factor loadings were significant at $p < 0.001$ where the highest value was 0.96 between *EmployeeTurnover* and *OrgComt* and the lowest value was 0.40 between *Errors* to ME3. The fit indices for this initial model did not fit well; RMSEA = 0.048, CFI = 0.893, and TLI = 0.887.

The first modification for the hypothesized CFA model was removing ME3 because it had a low factor loading with value of 0.40. Therefore, the new fit indices became better with values of RMSEA = 0.047, CFI = 0.898, and TLI = 0.893. Then, a second modification was performed to improve the model's fit through examining MIs as shown in Table 41. For the interest of space, the threshold for MIs was set at 15.

Table 41 Modification Indices of Hypothesized CFA Model

Modification Indices (Group number 1 - Default model)

Covariances: (Group number 1 - Default model)

			M.I.	Par Change
e67	<-->	SafetyClimate	20.978	-.096
e67	<-->	e68	15.661	.082
e5	<-->	e58	19.603	-.078

Variances: (Group number 1 - Default model)

	M.I.	Par Change

Regression Weights: (Group number 1 - Default model)

			M.I.	Par Change
ME6	<---	Tra7	16.111	.069
Vio8	<---	SafetyClimate	15.725	-.232
Vio8	<---	Training	18.148	-.158
Vio8	<---	Recognition	17.441	-.146
Vio8	<---	Rec2	15.620	-.107
Vio8	<---	Com7	15.509	-.126
Vio5	<---	SM3	21.010	-.359
JS1	<---	Unsafe_Acts	16.096	.393
JS1	<---	Violations	16.503	.235
JS1	<---	Vio5	18.070	.171
SM1	<---	Com3	17.416	.072

The largest MIs represent that there were factor cross-loadings (regression weights) and error covarainces, respectively. As a result, Vio8 was removed because it had strong error covariances with *SafetyClimate* and with error for Vio9 and beside it had several relations with other latent variables as well. In addition, Sup5 was also removed because MIs suggest to add an error covariance between e5 and e58 (MI = 19.603) and a path between Sup5 and *JobSat* (Par

Change = -0.280). The model fit of this second modification was better than those of previous models; CFI=0.909, TLI=0.903, and RMSEA=0.045 (see Table 42).

The final modification of the hypothesized CFA model was investigating new MIs. After setting the threshold for MIs at 10, new MIs (not shown in the interest of space) had been utilized and this led to removing Com7. MIs suggest to add an error covariance between e9 and e54 (MI = 14.283) and a path between OC5 and Com7 (MI = 14.867). Moreover, covariances were added between error for ME1 and error for ME4 and between error for *TurnInt* and error for *EmoEx*. As a result from Figure 21, the final model's fit became much better with CFI = 0.912, TLI = 0.907, and RMSEA = 0.044. It is noteworthy to mention that JS1 involved with other items and removing it did not change the model fit indices. Although, many new suggestions would come up by lowering the threshold For MIs, there seems to be no reason to do that which might eventually result in over-fitting model.

Table 42 shows the fit indices for the initial and final research measurement model. The difference between $\chi 2$ was 466.88 which led to an improvement in the model fit. All other indices were within the acceptable fit criteria.

Table 42 Comparison between Hypothesized CFA models

Model	χ2	DF	P	χ2/DF	CFI	TLI	RMSEA	PCLOSE	AIC	ECVI
Initial	2482.34	1509	0.000	1.645	0.893	0.887	0.048	0.856	2770.34	9.82
Modified1	2364.39	1455	0.000	1.625	0.898	0.893	0.047	0.919	2646.39	9.38
Modified2	2120.00	1349	0.000	1.572	0.909	0.903	0.045	0.989	2392.00	8.48
Final	2015.46	1295	0.000	1.556	0.912	0.907	0.044	0.994	2287.46	8.12

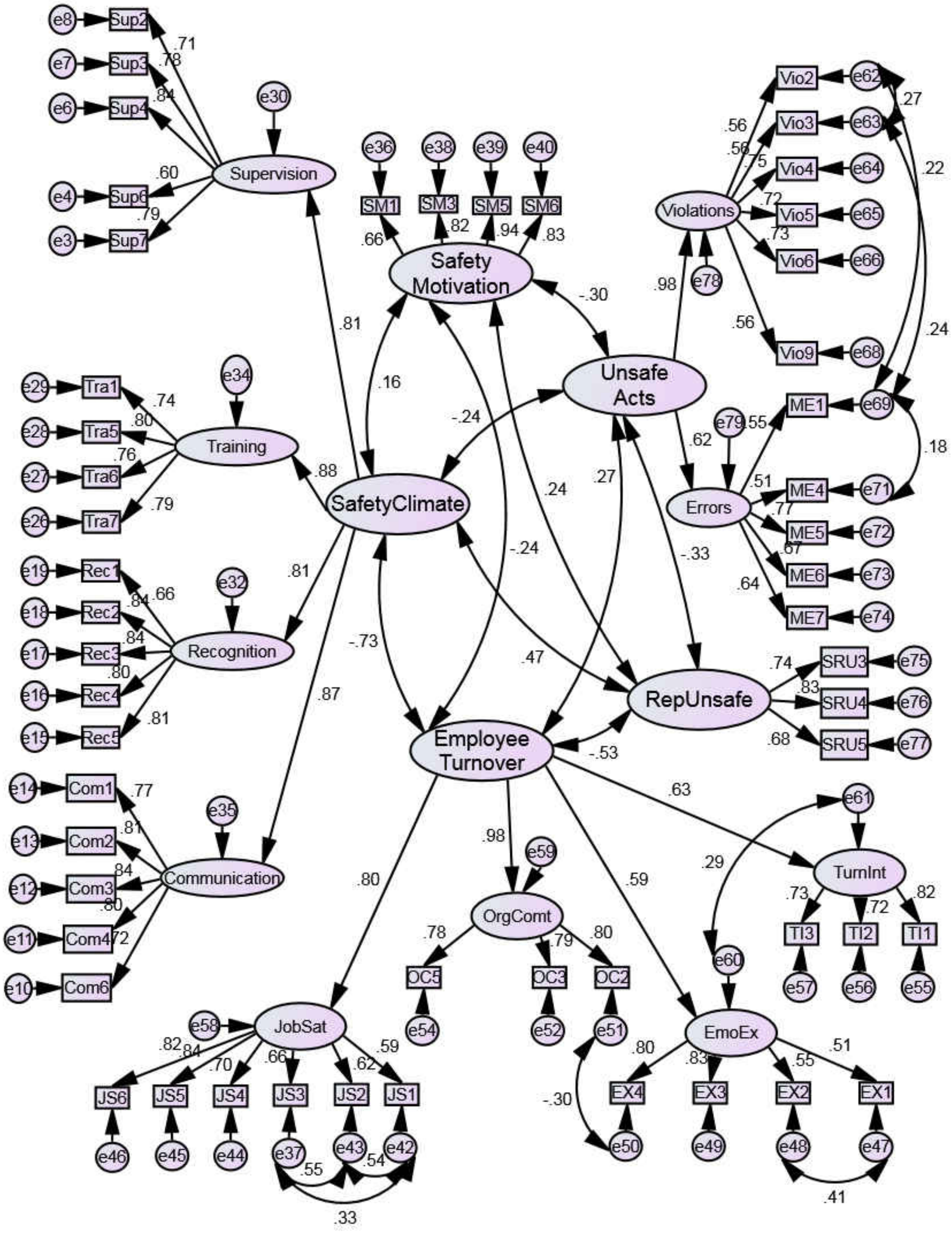

Figure 21 Final Hypothesized CFA Model (Standardized Estimates)

4.5.2. Model Reliability and Validity

Incidents and injuries variables were added in the final CFA model for model reliability and validity among all constructs. After adding these two variables, the model fit was still acceptable with CFI = 0.908, TLI = 0.901, and RMSEA = 0.044, and there was no need for further modification.

Table 43 Selected AMOS Output for Correlations among Final CFA Model's Constructs

Covariances: (Group number 1 - Default model)

			Estimate	S.E.	C.R.	P	Label
SafetyClimate	<-->	Employee_Turnover	-.185	.031	-6.057	***	par_53
Employee_Turnover	<-->	RepUnsafe	-.163	.031	-5.311	***	par_54
Safety_Motivation	<-->	Unsafe_Acts	-.039	.011	-3.425	***	par_55
Safety_Motivation	<-->	Employee_Turnover	-.028	.009	-3.203	.001	par_56
SafetyClimate	<-->	Unsafe_Acts	-.069	.024	-2.878	.004	par_57
SafetyClimate	<-->	RepUnsafe	.261	.049	5.370	***	par_58
Safety_Motivation	<-->	SafetyClimate	.033	.014	2.283	.022	par_59
Safety_Motivation	<-->	RepUnsafe	.061	.019	3.243	.001	par_60
RepUnsafe	<-->	Unsafe_Acts	-.113	.033	-3.476	***	par_67
Employee_Turnover	<-->	Unsafe_Acts	.044	.014	3.077	.002	par_68
RepUnsafe	<-->	II2	-.009	.019	-.479	.632	par_69
Unsafe_Acts	<-->	II1	.147	.040	3.709	***	par_70
II2	<-->	II1	.008	.023	.327	.744	par_71
Safety_Motivation	<-->	II1	-.031	.022	-1.449	.147	par_72
SafetyClimate	<-->	II1	-.279	.055	-5.114	***	par_73
Employee_Turnover	<-->	II1	.185	.035	5.353	***	par_74
RepUnsafe	<-->	II1	-.212	.063	-3.334	***	par_75
Employee_Turnover	<-->	II2	.006	.008	.728	.467	par_76
SafetyClimate	<-->	II2	-.012	.015	-.821	.412	par_77
Safety_Motivation	<-->	II2	.003	.007	.408	.683	par_78
Unsafe_Acts	<-->	II2	.018	.010	1.755	.079	par_79

Where II1: Injuries and II2: Incidents

Table 43 shows that all constructs' correlation were statistically significant at 0.05 level except for those related with *Incidents* (II2) and correlation between *Injuries* (II1) and *SafetyMotivation* ($r = -0.090$, $p > 0.05$). Descriptive statistics, Cronbach's alpha and correlations among the model's constructs are also presented in Table 44. All significant correlations were ranged between 0.157 and -0.729. All scales demonstrated good reliability through Cronbach's alpha values that were above the criterion value of 0.70 (Bagozzi & Yi, 2012). There were no Cronbach's alpha values for incidents and injuries because each was measured by one item only.

The probable cause for the incidents variable to not have any correlations with others is due to the high percentage (95.4%) of respondents selected the *Never* point on the scale. The reason would either be no reported damages to the aircrafts/equipment during the twelve months period or they were afraid to report that they had a role in these actions (Weddle, 1996). As a result, incidents variable was removed from the model due to non-relation and an extreme kurtosis value of 32.05 would violate the assumption of normality when using the maximum likelihood method (Kline, 1998).

Table 44 Descriptive Statistics, Cronbach's α Values, and Correlations among Latent Constructs

	M	SD	α	SC	SM	ET	UA	RU	II1	II2
SC	3.345	1.240	0.941	-						
SM	4.826	0.434	0.882	0.157*	-					
ET	2.184	1.126	0.893	-0.729***	-0.239***	-				
UA	1.478	0.820	0.840	-0.258**	-0.325***	0.299**	-			
RU	3.929	1.036	0.791	0.465***	0.238***	-0.529***	-0.331***	-		
II1	1.69	1.118	-	-0.367***	-0.090	0.444***	0.339***	-0.23***	-	
II2	1.07	0.350	-	-0.052	0.025	0.047	0.131	-0.032	0.02	-

SC = Safety Climate, SM = Safety Motivation, ET = Employee Turnover, UA = Unsafe Acts, and RUB = Reporting Unsafe Behavior, II1 = Incidents, II2 = Injuries, and α = Cronbach's alpha.
*p < 0.05, **p < 0.01, and ***p < 0.001.

4.5.2.1 Convergent Validity

To have a convergent validity of CFA results, all of item reliability, construct reliability (CR), and average variance extracted (AVE) must support these results (Hair et al., 1998). AVE reflects the amount of variance in the indicators accounted for by the construct. Items reliability was verified earlier and they were all statistically significant with critical ratios (c.r.) above 1.96 as they are presented in Table 45. In order to assess, whether the specified indicators were sufficient in their representation of the constructs, CR and AVR measures for each construct were calculated from the equations (1) and (2) below:

$$CR = (\sum \lambda)^2/[(\sum \lambda)^2 + \sum(\theta)] \quad (1)$$

$$AVE = (\sum \lambda^2)/[\sum \lambda^2 + \sum(\theta)] \quad (2)$$

Where ∑= summation of the indicators of the latent constructs, λ = indicator standardized loadings that were obtained directly from AMOS output, θ = indicator error variances or measurement error (Fornell & Larcker, 1981a; Fornell & Larcker, 1981b). Both Fornell and Larcker (1981a) and Hair et al. (1998) suggest that 0.60 and 0.50 or larger as critical values for CR and AVR, respectively.

CR and AVE values for the model are displayed in Table 45. CR estimates range from 0.796 to 0.906 which are greater than the suggested value of 0.60. AVE estimates range from 0.567 to 0.707 which are above the suggested value of 0.50. These results show that the final hypothesized CFA model meet the requirements for both reliability and validity.

Table 45 Convergent Validity

Constructs	**Indicators**	**Item Reliability**	**Cronbach's alpha**	**CR**	**AVE**
		Factor Loadings			
Safety Climate				0.906	0.707
	Supervision	0.810*	0.857		
	Communication	0.866*	0.890		
	Training	0.879*	0.854		
	Recognition	0.806*	0.892		
Employee Turnover				0.846	0.587
	JobSat	0.809*	0.874		
	OrgComt	0.960*	0.833		
	EmoEX	0.619*	0.801		
	TurnInt	0.637*	0.801		
Safety Motivation				0.890	0.671
	SM1	0.665*	-		
	SM2	0.817*	-		
	SM3	0.941*	-		
	SM4	0.830*	-		
Unsafe Acts				0.798	0.675
	Violations	0.885*	0.814		
	Errors	0.692*	0.736		
Reporting Unsafe Behaviors				0.796	0.567
	SRU3	0.742*	-		
	SRU4	0.828*	-		
	SRU5	0.682*	-		

*Standardizes values at $p < 0.001$

4.5.2.2 Discriminant Validity

Discriminant validity of the model was tested by comparing the construct correlations with the square root of AVE. Discriminant validity was confirmed since the value of the square root of AVE (Table 46) for each construct was larger than values of correlations involving the construct).

Table 46 Discriminant Validity

Constructs	**1**	**2**	**3**	**4**	**5**
1.Safety Motivation	0.819				
2.Safety Climate	0.156	0.841			
3.Employee Turnover	-0.237	-0.727	0.766		
4.Reporting Unsafe Behaviors	0.238	0.465	-0.528	0.753	
5.Unsfe Acts	-0.304	-0.239	0.271	-0.335	0.821

Factor correlation matrix with square root of the AVE on the diagonal

4.6 Structural Equation Modeling

Structural Equation Modeling (SEM) was used to examine the structural model of the relationships among latent variables. The generic structural model was built based on the theoretical framework that was discussed earlier in Chapter Two. The research hypotheses were tested by the SEM path analysis by using AMOS 22. Blunch (2013) argues that any modifications to the new structural model should not significantly change the regression weights from the previous measurement model (CFA model). The whole hypothesized structure model is shown in Figure 22.

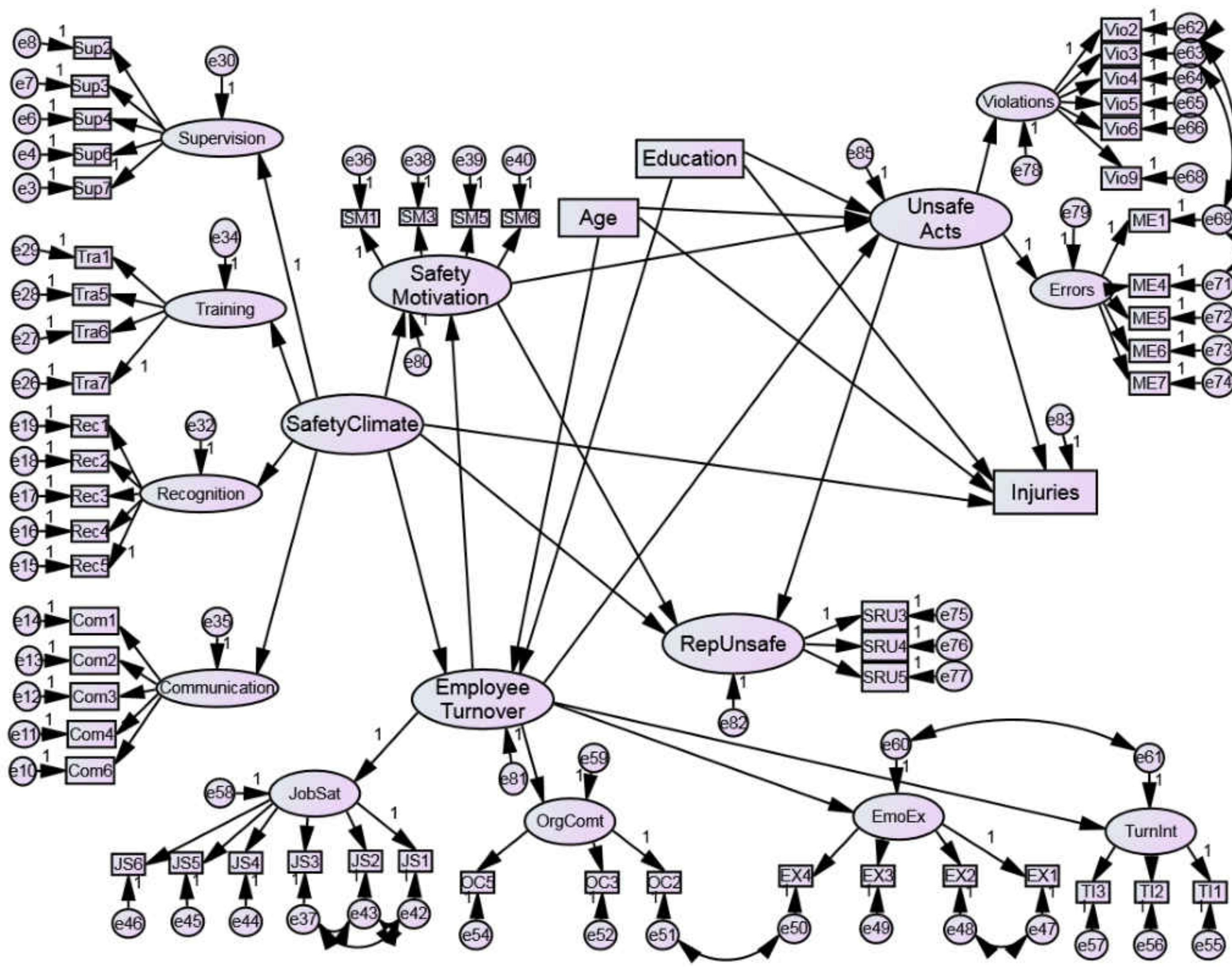

Figure 22 Hypothesized Structural Model (Hyper Model)

Table 47 Selected Output for Hypothesized Model: Variable Summary

Variable Summary
Observed, endogenous variables
Injuries
Incidents
Observed, exogenous variables
Age
Education
Unobserved, endogenous variables
Safety Motivation
Employee Turnover
Rep Unsafe
Unsafe Acts
Unobserved, exogenous variables
Safety Climate

4.6.1 Testing for the Validity of the Causal Structure

After validating the measurement model, the hypothesized research model was tested to determine the validity of causal linkages among all constructs. Additionally, age and education level were included in the hypothesized structural model to provide more insight to the study. Using AMOS 22, a composite model was built by imputing all observed variables to develop a scale score for each construct. Composite model in SEM is simpler to use than hyper model (whole model) and provides better model fit (Landis, Beal, & Tesluk, 2000). This model included all endogenous and exogenous variables as they are displayed in Table 47. The standardized path coefficients for the generic structural model for the effect of safety climate on safety outcomes are shown in Figure 23.

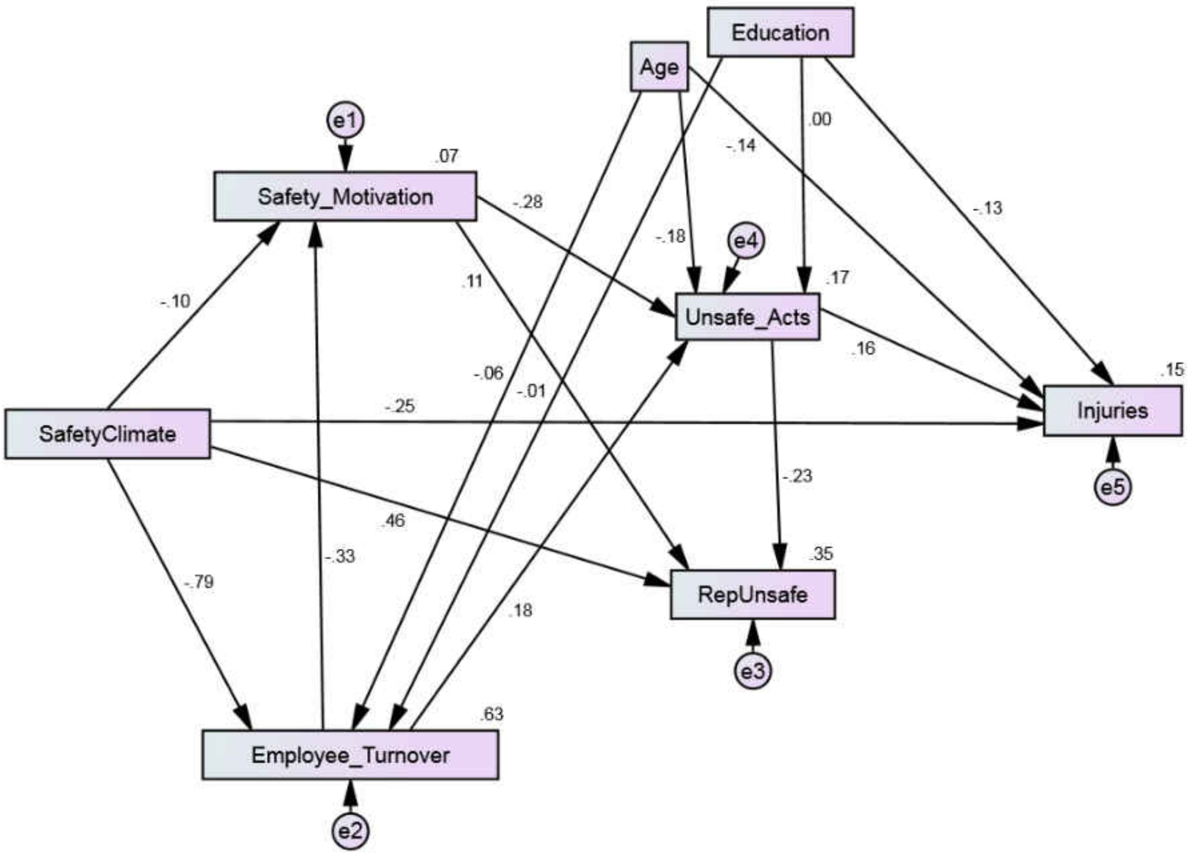

Figure 23 Generic Structural Model

<u>4.6.1.1 Assessment of the Hypothesized SEM Model</u>

After testing the generic structural model, the fit indices were summarized as follow: CFI = 0.796, TLI = 0.523, RMSEA = 0.206. The model was not well fitting. Therefore, modification indices (MIs) were reviewed and suggestion were made by adding covariances between *Age* and *Education* (MI = 55.236), *Age* and *SafetyClimate* (MI = 47.514), and *Education* and *SafetyClimate* (MI = 11.859). It is reasonable to relate them since previous study has found significant positive relationships between safety climate and both education level older employees (Fang, Chen, & Wong, 2006). In addition, as it illustrated in Figure 24, a path was added from *employee turnover* to *RepUnsafe* (MI = 24.70 for error covariance and MI = 9.196 for regression weight). Theoretically, causes of employee turnover can reduce willingness of reporting unsafe behaviors. The standardized residual covariances were checked and they all were below the level of 1.96.

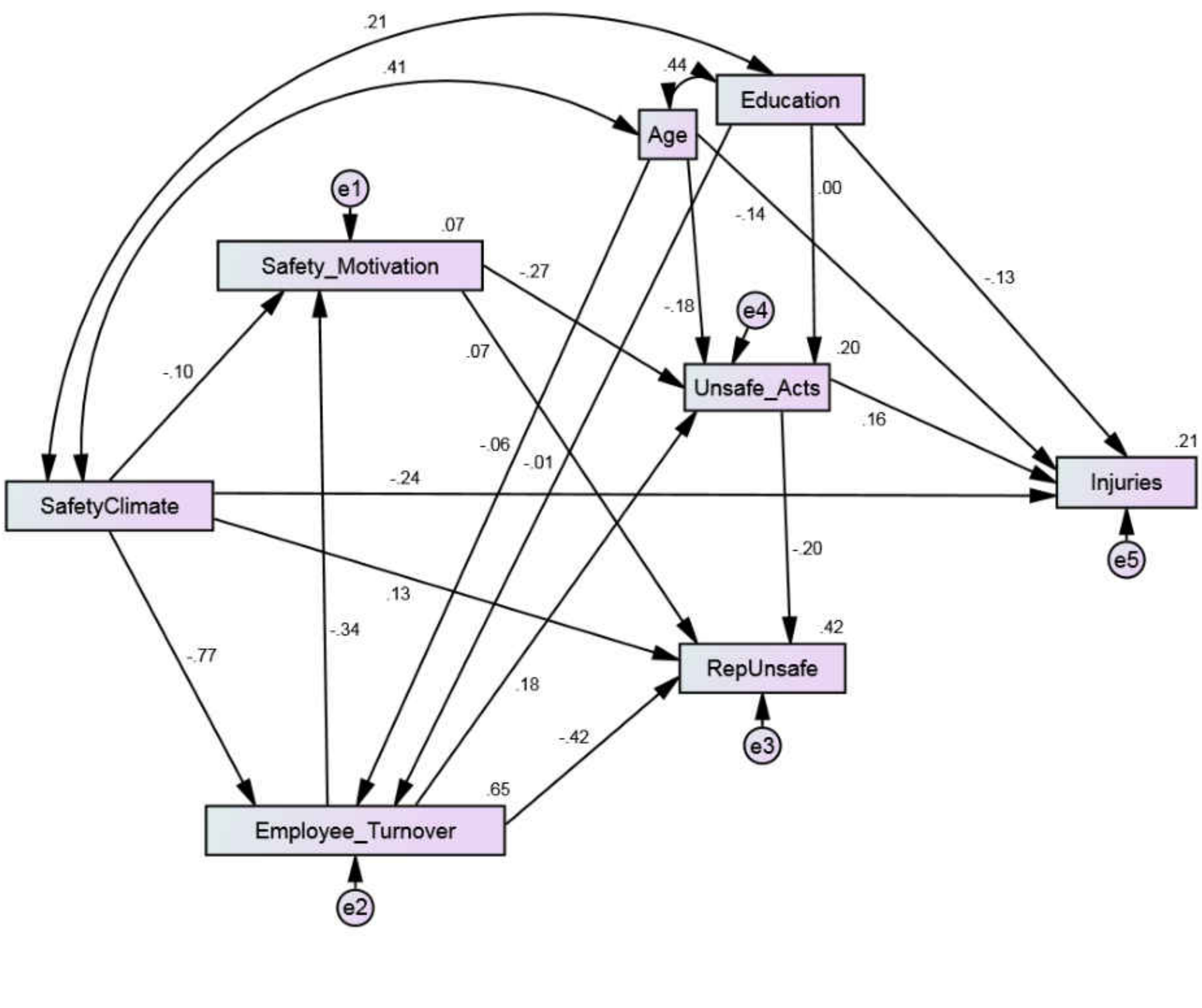

Figure 24 Revised Structural Model

The new fit indices has improved with CFI = 0.991, TLI = 0.968, RMSEA = 0.053. The new chi-square ($\chi2$) value had dropped to 14.338 and there was a 90% confidence that RMSEA would fall between 0.00 and 0.097. Additionally, the Goodness-of-Fit Index (GFI) was added to the fitting criteria. Table 48 shows the fit criteria for the generic and revised structural model. The fit indices of the revised structural model are within the suggested criteria except for that of the probability of closeness of fit (PCLOSE). PCLOSE is a probability for testing the null hypothesis that population RMSEA is no greater than .05. The PCLOSE value of 0.401 was closed to the recommended level of 0.5; thus marginal acceptance can be given on this measure. According to Byrne (2010), PCLOSE should exceed the value of 0.5. However, other research has used less fit criteria of 0.5 (Hair et al., 1998), thus the revised structural model (Figure 24) can be considered fitting the empirical data. In summary, measures of the model goodness-of-fit support the results as an acceptable representation of the hypothesized constructs.

Table 48 Goodness-of-fit summary for the models

Index	**Threshold**	**Generic Model**	**Revised Model**
Chi-Square Statistic ($\chi2$)	Low	155.427	14.338
Degrees of Freedom (df)	>= 0	12	8
Probability Value (p)*	> 0.05	0.000	0.073
$\chi2$/df*	<= 5	12.952	1.792
Comparative Fit Index (CFI)	> 0.90	0.796	0.991
Tucker & Lewis Index (TLI)	> 0.90	0.523	0.968
Goodness-of-Fit Index (GFI)*	> 0.90	0.881	0.988
Root Mean Square Error of approximation (RMSEA)	< 0.05-0.08	0.206	0.053
90% Confidence Interval (LO90-HI90)*	< 0.05-0.08	0.178-0.235	0.000-0.097
Probability of Closeness of Fit (PCLOSE)*	> 0.5	0.000	0.401

*see Byrne (2010)

The modified model regression weights are presented in Table 49. The significance (p > 0.05) of standardized path coefficients (β) in the revised structural model was used to test the research hypotheses.

Table 49 Unstandardized Estimates Regression Weights for Modified Model: Structural Path

			Estimate	S.E.	C.R.	P	Label
Employee_Turnover	<---	SafetyClimate	-.418	.021	-19.945	***	
Employee_Turnover	<---	Age	-.002	.001	-1.459	.145	
Employee_Turnover	<---	Education	-.003	.016	-.163	.871	
Safety_Motivation	<---	SafetyClimate	-.047	.045	-1.051	.293	
Safety_Motivation	<---	Employee_Turnover	-.294	.083	-3.553	***	
Unsafe_Acts	<---	Safety_Motivation	-.284	.057	-4.956	***	
Unsafe_Acts	<---	Employee_Turnover	.160	.053	2.996	.003	
Unsafe_Acts	<---	Education	-.001	.022	-.068	.946	
Unsafe_Acts	<---	Age	-.005	.002	-2.830	.005	
II1*	<---	Unsafe_Acts	.570	.201	2.837	.005	
RepUnsafe	<---	Unsafe_Acts	-.494	.121	-4.098	***	
RepUnsafe	<---	SafetyClimate	.157	.089	1.767	.077	
II1	<---	SafetyClimate	-.423	.102	-4.140	***	
II1	<---	Education	-.166	.078	-2.137	.033	
II1	<---	Age	-.015	.007	-2.167	.030	
RepUnsafe	<---	Safety_Motivation	.171	.123	1.387	.165	
RepUnsafe	<---	Employee_Turnover	-.904	.169	-5.343	***	

*II1: Injuries

4.7 Hypotheses Testing

The revised structural model in Figure 24 shows that the effect of unsafe acts on workplace injuries is significantly positive ($\beta = 0.16$, $p < 0.01$), indicating that the less employees' unsafe acts are, the less likely they will injured themselves. **H1** is thus confirmed. In addition, safety climate has a significant negative effect on workplace injuries ($\beta = -0.24$, $p < 0.001$), indicating that the more positive perceived safety climate is, the less workplace injuries among the employees. Therefore, **H2** is confirmed. **H3** is also supported since the effect of unsafe acts on reporting unsafe behaviors is significantly negative ($\beta = -0.20$, $p < 0.001$), indicating that the more employees' unsafe acts are, the poorer they are of reporting these acts.

However, the direct effect of safety climate on reporting unsafe behaviors ($\beta = 0.13$) is not significant ($p = 0.077$) which is just slightly above the recommended level; thus **H4** is not confirmed. This means that safety climate has a significant indirect effect on reporting unsafe behaviors through employee turnover ($\beta = 0.36$, $p < 0.001$; see Table 51). In addition, the total effect of safety climate on reporting unsafe behaviors is 0.505 which includes the direct effect of safety climate and indirect effects of employee turnover, safety motivation, and unsafe acts (Table 50). Moreover, safety climate has a significant negative effect on employee turnover ($\beta = -0.77$, $p < 0.001$), indicating that the more positive perceived safety climate is, the less likely that employee will leave the organization. Therefore, **H5** is supported.

The effect of the structural path which was added from employee turnover to reporting unsafe behavior in the revised structural model is significantly negative ($\beta = -0.42$, $p < 0.001$). This finding implies that the more high perception of employee turnover, the less willingness to report any safety concerns. Regarding the direct effects of perception of employee turnover on safety motivation and on unsafe acts, all paths show a significant direct influence (e.g., $\beta = -0.34$, $p < 0.001$ and $\beta = 0.18$, $p < 0.01$, respectively), thus indicating **H5** and **H6** are supported. These findings imply that the higher the perception of employee turnover, the decreased safety motivation and the increased unsafe acts. In addition, the statistical data reveals that the relationship between safety climate and unsafe acts is fully mediated by employee turnover.

According to Table 51, this indirect effect is significant ($\beta = -0.14$, $p < 0.05$) and thus **H8** is confirmed. Safety climate has also an indirect effect ($\beta = -0.183$) on unsafe acts through combination of employee turnover and safety motivation as it shown in Table 50.

Table 50 Standardized Direct, Indirect, and Total Effects

Model	Direct Effect	Indirect Effect	Total Effect
Unsafe Acts			
Safety Climate	-	-0.183	-0.183
Employee Turnover	0.178	0.093	0.272
Safety Motivation	-0.274	-	-0.274
Age	-0.179	-0.017	-0.196
Education	-0.004	-0.002	-0.006
Reporting Unsafe Behaviors			
Safety Climate	0.134	0.371	0.505
Employee Turnover	-0.417	-0.078	-0.495
Safety Motivation	0.068	0.056	0.124
Unsafe Acts	-0.204	-	-0.204
Age	-	0.067	0.067
Education	-	0.004	0.004
Injuries			
Safety Climate	-0.244	-0.029	-0.273
Employee Turnover	-	0.043	0.043
Safety Motivation	-	-0.043	-0.043
Unsafe Acts	0.158	-	0.158
Age	-0.139	-0.031	-0.170
Education	-0.126	-0.001	-0.127
Safety Motivation			
Safety Climate	-0.101	0.264	0.163
Employee Turnover	-0.341	-	-0.0341
Age	-	0.021	0.021
Education	-	0.002	0.002
Employee Turnover			
Safety Climate	-0.775	-	-0.775
Age	0.062	-	-0.062
Education	-0.006	-	-0.006

The effect of safety climate on safety motivation is not significant ($\beta = -0.10$, $p > 0.05$). Therefore, there is no direct effect and thus, **H9** is not supported.

Even though it is insignificant, the negative coefficient (-0.10) does not make sense which indicates as climate improves, motivation decreases. However, the correlation between safety climate and safety motivation is positive ($r = 0.16$, see Table 46). According to Fogarty (2004), "reversals of sign in path coefficients can occur when predictors of a dependent variable are themselves correlated". In the current case, both employee turnover and safety climate are used to predict safety motivation and they are highly correlated. Accordingly, **H12** is rejected because there is no mediating effect of safety motivation on the relationship between safety climate and unsafe acts. As result, it can be concluded that the relationship between safety climate and safety motivation is fully mediated by employee turnover and this indirect effect is significant ($\beta = 0.26$, $p < 0.00$; see Table 51).

Table 51 Mediated Effect: Standardized Path Coefficients (β) using AMOS Bootstrapping

Path	Direct without Mediator	Direct with Mediator	Indirect (Mediated)
SC →ET→ RUB	0.46 ($p < 0.001$)	0.14 ($p > 0.05$)	0.36 ($p < 0.001$)
SC → ET → UA	-0.19 ($p < 0.01$)	-0.05 ($p > 0.05$)	-0.14 ($p < 0.05$)
SC → ET → SM	0.17 ($p < 0.01$)	-0.10 ($p > 0.05$)	0.26 ($p < 0.001$)

SC: Safety Climate, ET: Employee Turnover, RUB: Reporting Unsafe Behaviors, UA: Unsafe Acts, & SM: Safety Motivation

The result also reveals a significant direct effect of safety motivation on unsafe acts ($\beta = -0.27$, $p < 0.001$), which supports **H10**. In addition, safety motivation does not have direct effect on reporting unsafe behaviors ($\beta = 0.07$, $p > 0.05$). Therefore, **H11** is rejected. Furthermore, the estimated results of all the hypothesized paths are summarized in Table 52.

Table 52 Tests of Hypotheses

Hypothesis	β	t	Supported?
H1: Unsafe Acts → Injuries	0.16	2.827**	Yes
H2: Safety Climate → Injuries	-0.24	-4.140*	Yes
H3: Unsafe Acts → Reporting Unsafe Behaviors	-0.20	-4.098**	Yes
H4: Safety Climate → Reporting Unsafe Behaviors	0.13	1.767	No
H5: Safety Climate → Employee Turnover	-0.77	-19.945**	Yes
H6: Employee Turnover → Safety Motivation	-0.34	-3.553**	Yes
H7: Employee Turnover → Unsafe Acts	0.18	2.996*	Yes
H8: Safety Climate → Employee Turnover → Unsafe Acts		Partially Mediated	
H9: Safety Climate → Safety Motivation	-0.10	-1.051	No
H10: Safety Motivation → Unsafe Acts	-0.27	-4.956**	Yes
H11: Safety Motivation → Reporting Unsafe Behaviors	0.07	1.387	No
H12: Safety Climate → Safety Motivation → Unsafe Acts		No Mediation	
New line: Employee Turnover → Reporting Unsafe Behaviors	-0.42	-5.343**	Yes

β = standardized path coefficient, t = critical ratio, *$p < 0.001$, **$p < 0.01$

Turning to the control variables effects, the insignificant coefficients found between age and employee turnover (β = -0.06, $p > 0.05$), and between education and employee turnover (β = -0.01, $p > 0.05$) identified that both have no effects on employee turnover. In addition, only age has a significant effect on unsafe acts (β = -0.18, $p < 0.01$), indicating that younger maintenance technicians are more like to commit these unsafe acts. Both of age and education have a significant effect on workplace injuries (e.g., β = -0.14 & β = -0.13, $p < 0.05$). These statistical data reveal that younger technicians are more likely to injured themselves as well as technicians with a low level of education. A summary of the estimated results of the control variables paths in the revised model is also presented in Table 53.

Table 53 Age and Education Effects

Effect	β	t	Significant
Age → Employee Turnover	-0.06	-1.459	No
Education → Employee Turnover	-0.01	-0.163	No
Age → Unsafe Acts	-0.18	-2.830*	Yes
Education → Unsafe Acts	0.00	-0.068	No
Age → Injuries	-0.14	-2.137**	Yes
Education → Injuries	-0.13	-2.167**	Yes

β = standardized path coefficient, t = critical ratio, *p < 0.01, **p < 0.05

4.8 Final Research Model

After removing the insignificant structural paths from the revised structural model, the final research model was developed and tested. Figure 25 shows the estimated model with standardized path coefficients and square multiple correlations. The fit indices are summarized in Table 54. The value of $\chi 2$ is changed because some of the model parameters were changed. However, $\chi 2/df$ is lower with a value of 1.663. RMSEA is 0.047 and PCLOSE value is above the recommended level of 0.5. Accordingly, the final model fits the research data well.

Table 54 Goodness-of-Fit Indices for Final Model

Index	Threshold	Revised Model	Final Model
Chi-Square Statistic ($\chi 2$)	Low	14.338	22.858
Degrees of Freedom (df)	>= 0	8	14
Probability Value (p)	> 0.05	0.073	0.063
$\chi 2/df$	<= 5	1.792	1.663
Comparative Fit Index (CFI)	> 0.90	0.991	0.987
Tucker & Lewis Index (TLI)	> 0.90	0.968	0.975
Goodness-of-Fit Index (GFI)	> 0.90	0.988	0.980
Root Mean Square Error of approximation (RMSEA)	< 0.05-0.08	0.053	0.047
90% Confidence Interval (LO90-HI90)	< 0.05-0.08	0.000-0.097	0.000-0.081
Probability of Closeness of Fit (PCLOSE)	> 0.5	0.401	0.507

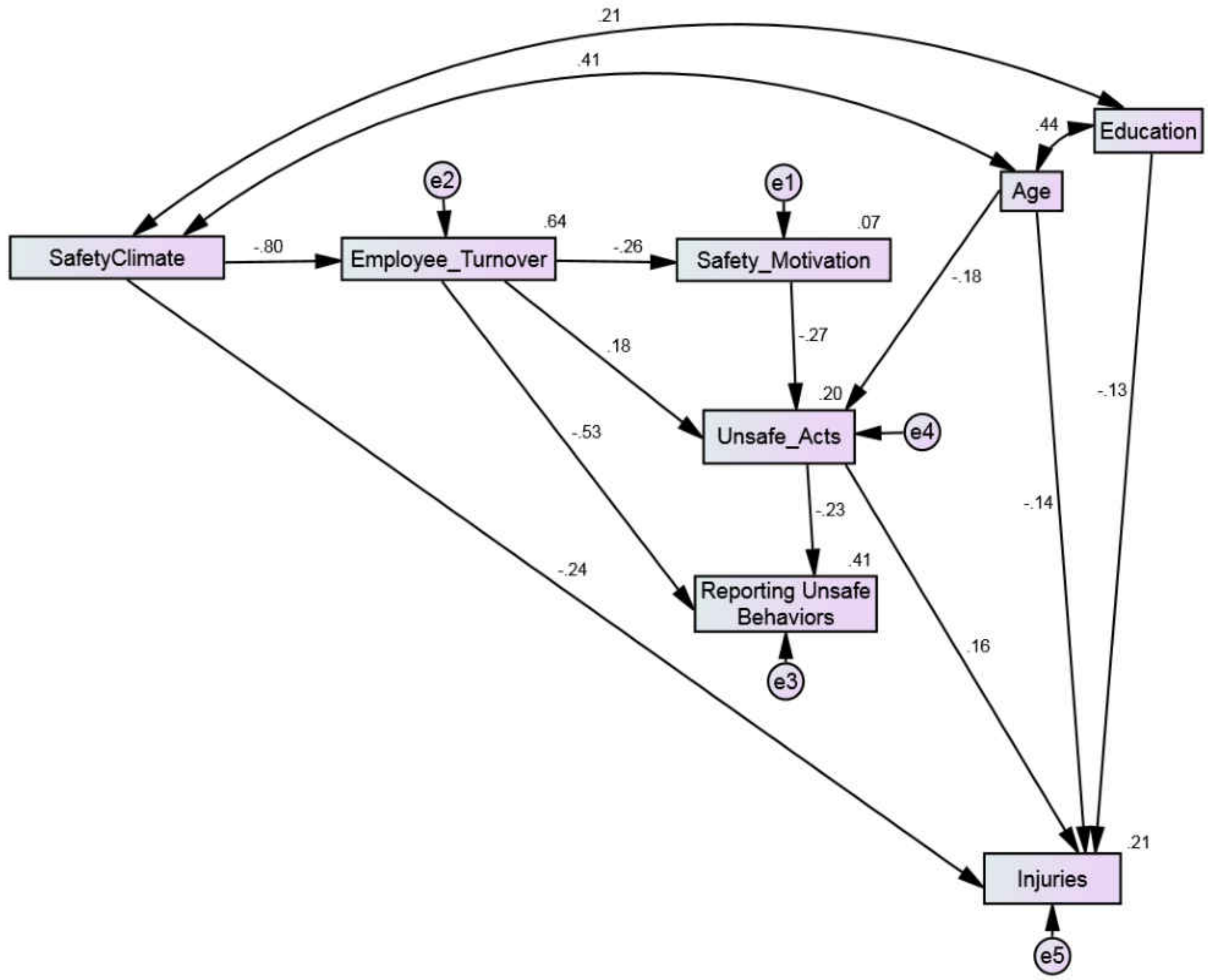

Figure 25 Final Structure Model

All pathways illustrated in the model are significant. The model accounted for 64% of the variance in Employee Turnover, 7% of the variance in Safety Motivation, 20% of the variance in Unsafe Acts, 41% of the variance in Reporting Unsafe Behaviors, and 21% of the variance in self-reported workplace Injuries. The final structure model was redesigned as a human factor model and is shown in Figure 26.

It can be seen first from Figure 26 that safety climate has direct negative effects on both employee turnover and workplace injuries. Second, employee turnover has a positive direct effect on unsafe acts and negative direct effects on both safety motivation and reporting unsafe behavior. Third, there is a negative relationship between safety motivation and unsafe acts. Finally, unsafe acts affect the workplace injuries positively and reporting unsafe behavior negatively.

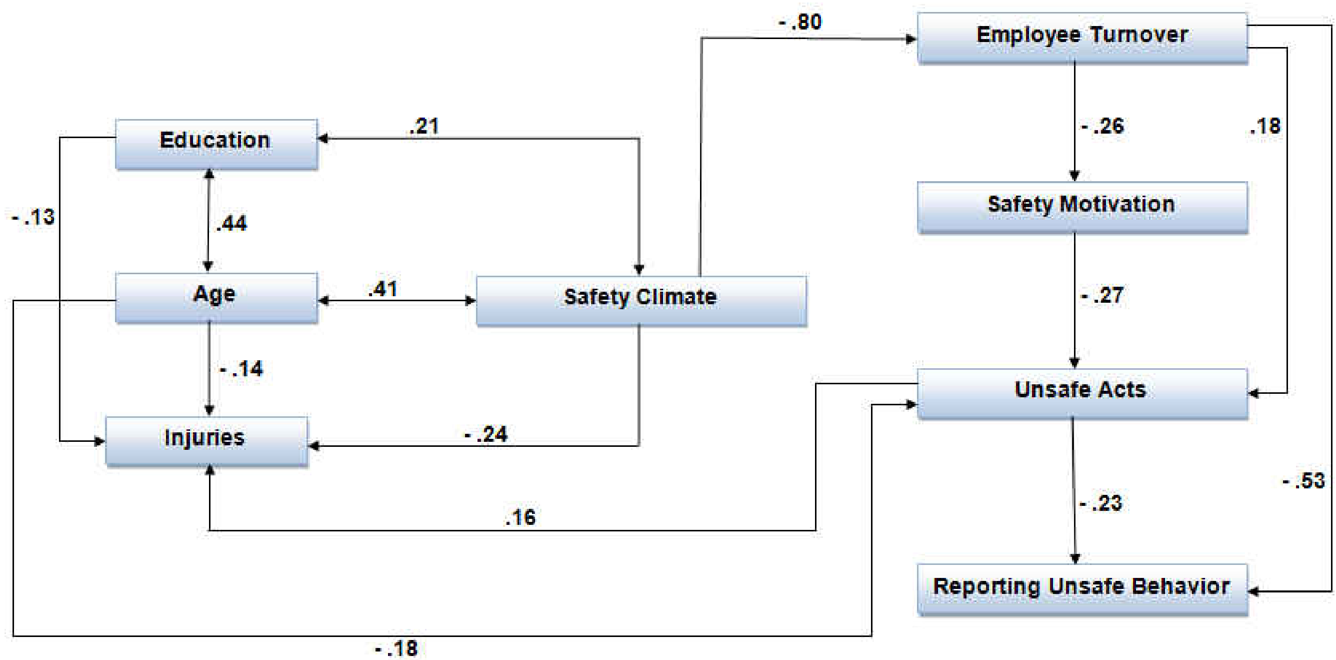

Figure 26 Final Structure Model as Human Factor Model

CHAPTER FIVE: DISCUSSION, CONCLUSION, STUDY SIGNIFICANCE, IMPLICATIONS, LIMITATIONS, AND SUGGESTIONS FOR FUTURE RESEARCH

The main purpose of this study is to develop a model that explains the relationships between safety climate, employee turnover, safety motivation, self-reported unsafe acts, reporting unsafe behavior, incidents, and injuries in the aviation maintenance environment. Another aim is to investigate the mediating effects, if any, of employee turnover and safety motivation on the relationship between safety climate and safety outcomes. This chapter discusses the research results, followed by conclusion, study significance, implications, limitations, and suggestions for future research.

5.1 Discussion

The study survey provided descriptive data and data relevant to relations among variables that important to aircraft maintenance. The study considered six factors (i.e., supervision, safety focus, safety communication and feedback, recognition, coworker support for safety, and training) to measure safety climate. The results demonstrated that safety climate had poor factor loadings on safety focus and coworker support for safety. This could be due to the questions that were used to measure each factor. Most probably, the three questions of safety focus were related to individual safety attitudes, while the other three questions of the factor of coworker support for safety were related to group safety attitudes.

The influence of aircraft maintenance technicians' unsafe acts on workplace injuries was analyzed in the first hypothesis. The results showed that the unsafe acts had a significant effect on injuries indicating that the more deviation from following safety rules, the more likely a technician will get injured. This result is consistent with Probst and Brubaker (2001) who found that safety compliance is negatively related to workplace injuries. The second hypothesis links safety climate to workplace injuries. Perceived safety climate has a significant direct effect on injuries, indicating that the stronger climate is, the fewer workplace injuries. The study of Clarke (2010) supports this result. The effect of unsafe acts on reporting unsafe behaviors (hypothesis 3) is significant and consistent with the result of Fogarty (2003). In the fourth hypothesis, the p-value of the path coefficient (0.077) from safety climate to reporting unsafe behaviors is just slightly above the 0.05 significant level. It was expected that safety climate (e.g., reporting channels and opened communication) will help maintenance technicians to report their safety concerns better according to Fogarty (2003). Research also revealed that safety climate and safety performance are positively related to one another (Wallace & Chen, 2006). However, a significant indirect effect of safety climate on reporting behaviors exists through the mediating effect of employee turnover since safety climate has a significant effect on employee turnover (hypothesis 5) and employee turnover has a significant effect on reporting behaviors.

Fogarty (2004) has found that the role of turnover intention has a positive relationship with safety climate which does not make sense from theoretical viewpoint. However, in his study, the correlations between the individual climate measures and turnover were negative which indicate higher job turnover when the climate is poor. It is noteworthy to mention, that Fogarty used only one question to measure turnover intention scale in his model. Research suggests that the effects of safety climate on individual safety behaviors are mediated by job attitudes. For example, Clarke (2010) has found that work-related attitudes such as job satisfaction and organizational commitment is partially mediated the relationship between safety climate and safety behaviors. Additionally, Park et al., (2012) argued that individual emotional response to one's job and organization mediates the relationship between safety climate and organization performance level and not with individual level such as errors. However, the finding from the seventh hypothesis shows that there is a direct significant effect of perceived individual turnover on unsafe acts such as violations and errors. This finding does not support the result of Fogarty (2004) since he argued that turnover intention has no influence on maintenance errors.

The sixth hypothesis of the research examined the effect of perceived employee turnover on safety motivation. Findings show that perceived turnover has a significant direct effect on safety motivation, indicating as maintenance technicians have high perception of turnover, their motivation toward safety decreases. Because employee turnover affects safety motivation, variables such jobs satisfaction, organizational commitment, or burnout are more distally related to safety motivation (Zohar et al., 2015). The ninth and tenth hypotheses examined the effect of safety climate on unsafe acts through safety motivation. Findings show that safety climate has insignificant effect on safety motivation and this motivation has significant influence on unsafe acts. Accordingly, these results do not support (hypothesis 12), indicating that safety motivation does not mediate the relationship between safety climate and unsafe acts. These results do not support other results in which safety motivation was found to be positively related to safety climate (Griffin & Neal, 2000; Neal et al., 2000; Neal & Griffin, 2006). This is, as mentioned earlier, due to the existence of employee turnover influence on the relationship between safety climate and safety motivation. In addition, this influence mediates the relationship between safety climate and unsafe acts (Hypothesis 8). It is also concluded from Figure 25 that the relationship between perceived individual turnover and unsafe acts is partially mediated by safety motivation. Finally, the eleventh hypothesis which examined the direct effect of safety motivation on reporting behaviors was not confirmed because there was only a significant indirect effect through unsafe acts.

The statistical data from the control variables reveals that both age and education have insignificant effect on the perceived individual turnover. The path coefficient from age to employee turnover is negative with a p-value of 0.145 which is above the 0.05 significant level, while the effect of education on employee turnover has a p-value of 0.871. However, when all insignificant paths were removed one at a time in Figure 25, the p-value of the path coefficient of age dropped from 0.145 to 0.07 which is just above 0.05. AMOS output from Figure 22 showed that age has a high negative direct effect on emotional exhaustion factor only and this might cause the affect of age on employee turnover to be less significant. Research has shown that age is negatively related to turnover such as younger employees are the most likely to quit (Cotton & Tuttle, 1986). In addition, age as being young is statistically significant predictor for turnover (Mor Barak et al., 2001). This might relate to the notion that younger employees have more job opportunities and older employees are less attractive to new jobs (Mor Barak et al., 2001). Cotton and Tuttle (1986) also found that education has a positive correlation with turnover. However, one study has found that education is relatively a weak predictor of turnover (Allen et al., 2010).

Turning to the effect of control variables on unsafe acts, the significant coefficient was found only between age and unsafe acts, but not between education and unsafe acts. The finding of the effect of age is consistent with result of the study of Hobbs and Williamson (2002). According to Hobbs and Williamson (2002), unsafe behaviors are related significantly with age such as younger employees report a higher level of aircraft maintenance violations. However, the insignificant effect of education on unsafe acts was not expected. Education can enhance employee knowledge and can help in reducing violations and errors at workplace. This insignificant relationship could be due to the on-job-training works in reducing the unsafe behaviors regardless of the employee educational level.

Finally, the results indicate that the effects of both age and education on workplace injuries are negatively significant where around 34.3% of respondents reported that they had been injured at work during the previous 12 months. As a whole, these findings are consistent with previous studies that have found that age-related injury ratios were lower for older workers than those for younger workers (Breslin & Smith, 2005; Knapik, Ang, Reynolds, & Jones, 1993; Laflamme, 1997). The reason behind that could be from that older employees work as supervisors and have less level of physical activities that required in the job. It could also be from the lack of relevant experience of younger employees since it plays an important role in raising the risk of injuries. In addition, Siu, Phillips, and Leung (2003) have found that positive attitudes toward safety were correlated with older workers and they have argued that older workers are more experienced and therefore, they have decreased the injury risk at work. Moreover, Weddle (1996) has found that older workers with an average age of 41 years did not report injuries compare to those that were younger.

These findings are also supportive of earlier studies that shown higher-educated workers (e.g., university degrees) have lowest accident involvement rate or risk exposure (e.g., less injuries) than those having a basic education (Gyekye & Salminen, 2009). Education level can enhance the workers' cognitive abilities which lead them to perform their job in a right way and to have also an accurate work hazard perception. Generally, these cognitive abilities can affect employees' knowledge, strategies, and decisions making when performing certain tasks (Hunter, 1986; Layer, Karwowski, & Furr, 2009).

5.2 Conclusion

Aircraft maintenance is a complex organization in which individuals perform varied tasks in an environment with time pressures, minimal feedback, and sometimes difficult ambient conditions. Organizational factors have been identified as contributor factors that lead to unsafe acts like maintenance errors. Safety climate can reflect the correctness of safety-related behaviors as it is considered a predictor of unsafe work behavior. Safety climate also provides a framework for the analysis of organizational events. Therefore, it is crucial to identify the factors that may enhance the safety performance of aircraft maintenance technicians.

This study utilized the safety climate approach to develop a model that examines the relationships between perceived individual turnover, safety motivation, self-reported unsafe acts, reporting unsafe behaviors, and self-reported workplace injuries. The two measures of unsafe acts were violations and maintenance errors. The results show that perceptions of organizational safety climate play an essential role in enhancing the causes of employee turnover which in turn increase the safety motivation and decrease the technicians' unsafe acts that eventually will lead to fewer injuries at workplace. The results also show there was no direct effect of safety climate on safety motivation. However, safety motivation was found to partially mediate the relationship between perceived individual turnover and technicians' unsafe acts. Furthermore, the developed model predicted 64% of the variance in employee turnover, 7% of the variance in safety motivation, 20% of the variance in unsafe acts, 41% of the variance in reporting unsafe behavior, and 21% of the variance in workplace injuries.

Finally, the significant direct effects that perceived individual turnover and safety motivation have on the unsafe acts of the maintenance technicians have not been reported in previous studies. In addition, the study results emphasize the role of organizational factors on employees' attitudes. Therefore, the management must enforce positive safety climate to minimize turnover and maximize safety motivation, which in turn leads to safe performance and fewer injuries.

5.3 Study Significance

The developed model can provide a basis for predicting unsafe acts and implementing ways to improve safety and productivity in the aviation maintenance operations. The results of this study can be used to improve the ability of executives and safety managers to take preventive measures to enhance the organizational safety processes and individual safety behaviors. In addition, these results have potential of making a significant contribution to safe practices in high-risk industries, especially in handling complex systems like aviation maintenance. Organizations may also benefit from the presented results by enhancing knowledge of the working environment by creating a strong safety climate and a good safety reporting system. The present study also adds an important contribution to the employee turnover research. Finally, this study may help in bridging the gap in the literature by providing a validated model that captures some of the factors influencing the aircraft maintenance tasks.

5.4 Limitations

While the current hypotheses are generally supported, there are a number of limitations that must be acknowledged. One limitation is the issue of a problem of common method variance by implementing a cross-sectional self-report measurement which is using a single-source self-reported data. However, according to Christian et al. (2009), it is possible not to find common method variance issue for correlations between self-reported climate and self-reported safety performance in relation to those correlations between self-reported climate and archival data that based on incidents, injuries, and safety violations. Therefore, Christian et al. (2009) concluded that common bias may not be a major concern in the field of safety. Another study limitation is the issue from the nature of military work. Maintenance technicians have the military duties aside from their works on the aircrafts and this issue may affect their responses.

5.5 Implications

Despite these limitations, the present study adds an important contribution to turnover research in general, and aircraft maintenance in specifically. Utilizing this information could help in investigating the reasons of why employees leave the organization. Managers should deal with the source of individual disaffection in order to reduce the intention to leave (Vandenberg & Nelson, 1999).

In addition, management can enhance the organizational safety climate for the sake of improving safety performance and reducing safety outcomes and employees turnover. While the study results are related to Air Force bases, they have some implications on enhancing performance and reducing workplace injuries in other organizations. Furthermore, organizations should benefit from creating positive safety climate and an accurate reporting environment for the safety of their employees and equipment. Managers should also examine employees' reasons for not reporting safety concerns issues. Finally, this study provides empirical evidence supporting safety climate as a predictor of safety outcomes.

5.6 Suggestions for Future Research

Future research should continue to investigate the impact of employee turnover on safety performance in aircraft maintenance environment using longitudinal studies. Additionally, using supervisor reports of employee safety performance, incidents and injuries data, or observations can aid in avoiding problems of the shared-method variance (Koeske, 1994).

Future research could also investigate errors and violations deeply. The maintenance errors can be classified into basic errors type such as lapses, slips, and mistakes. They also can be classified into skilled based errors, decision errors, and perceptual errors. In addition, violations can be classified into routine and exceptional violations (Hobbs & Williamson, 2002).

The insignificant relationships that found between self-reported incidents and other constructs require further investigation. Finally, other demographical variables (e.g. marital status and family with children) could be included in the survey in order to provide more insight about employee characteristics.

APPENDIX A:
SURVEY QUESTIONNAIRES

SURVEY QUESTIONNAIRES

This research is conducted as part of my Ph.D. degree requirement. The main purpose is to develop a model of the relationships between safety climate, employee turnover, safety motivation, and safety performance in aircraft maintenance. You are invited to participate in a 98 questions survey. The survey is designed on a 5-point Likert Scale. All data and measurements obtained from this study will be completely anonymous, only researcher will have access to view any data collected. You are expected to complete the survey in 20-30 minutes. Your participation is voluntary and if there are any questions you feel you cannot answer please let me know. You must be 18 years of age or older to take part in this research study.

Your opinion is very important.

Background Information:

DATE : ______________________________

JOB TITLE : ______________________________

WING : ______________________________

RANK : ______________________________

AGE : ______________________________

EDUCATIONAL DEGREE : ______________________________

WHERE DO YOU WORK? (CIRCLE ONE) : **1ST LINE** **2ND LINE** **QUALITY** **SHOP** **OTHERS** _____

YEARS OF SERVICE AT MAINTENANCE : ______________________________

Please Take some time and answer the following questions

A. Safety Climate

1	Strongly Disagree	2	Disagree	3	Neutral	4	Agree	5	Strongly Agree

Using the above scale, please circle the number that best describes your opinion.

1. Supervision

1 2 3 4 5	**1.**	My immediate supervisor has had many years experience in aviation maintenance.
1 2 3 4 5	**2.**	My supervisor really understands the maintenance task.
1 2 3 4 5	**3.**	I trust my supervisor.
1 2 3 4 5	**4.**	My supervisor sets clear goals and objectives for the team.
1 2 3 4 5	**5.**	My supervisor actively encourages team members to lift their level of performance.
1 2 3 4 5	**6.**	When I make an error, my supervisor will support me.
1 2 3 4 5	**7.**	My immediate supervisor checks my work very carefully.
1 2 3 4 5	**8.**	My immediate supervisor helps me with my personal concerns and difficulties.
1 2 3 4 5	**9.**	My supervisor always tries to enforce safe working procedure.

2. Safety Focus

1 2 3 4 5	**10.**	Personnel are well trained in the consequences of unsafe acts.
1 2 3 4 5	**11.**	This unit regards safety as a major factor in achieving its goals.
1 2 3 4 5	**12.**	Lack of proper equipment sometimes forces us to cut corners in our work ®.
1 2 3 4 5	**13.**	There is not always time to follow safe procedures ®.
1 2 3 4 5	**14.**	In high workload conditions, I am prepared to take a few shortcuts to get jobs done on time ®.
1 2 3 4 5	**15.**	The safety procedures and practices in this unit are useful and effective.

3. Safety Communication and Feedback

1 2 3 4 5	**16.**	Management operates an open door policy on safety issues.
1 2 3 4 5	**17.**	There is sufficient opportunity to discuss and deal with safety issues in meetings.
1 2 3 4 5	**18.**	There are good communications about safety issues in this workplace.
1 2 3 4 5	**19.**	Relevant safety issues are always communicated.
1 2 3 4 5	**20.**	My supervisor keeps me regularly informed of my safety progress.
1 2 3 4 5	**21.**	I am informed of the outcome of safety meetings.
1 2 3 4 5	**22.**	When technicians report a safety problem, supervisors act quickly to correct them.
1 2 3 4 5	**23.**	Safety issues raised by technicians are communicated regularly to all other technicians in this unit.

1	Strongly Disagree	2	Disagree	3	Neutral	4	Agree	5	Strongly Agree

Using the above scale, please circle the number that best describes your opinion.

4. Recognition

1 2 3 4 5	**24.**	In this unit the rewards and encouragement usually outweigh the threats and the criticism.
1 2 3 4 5	**25.**	In this unit technicians are rewarded according to performance.
1 2 3 4 5	**26.**	I am satisfied with the recognition I get for doing good work.
1 2 3 4 5	**27.**	In my unit safe conduct is considered as a positive factor for job promotions.
1 2 3 4 5	**28.**	In my unit technicians are rewarded for reporting safety hazards (thanked, cash or other rewards, recognition in news letter, etc).

5. Coworker Support for Safety

1 2 3 4 5	**29.**	My coworkers are ready to talk to fellow employees who fail to use safety equipment/procedures.
1 2 3 4 5	**30.**	My coworkers are prepared to stop others from working dangerous
1 2 3 4 5	**31.**	My coworkers encourage each other to work safely.

6. Training

1 2 3 4 5	**32.**	My training has prepared me well for duties in my current job.
1 2 3 4 5	**33.**	On-the-job training is a high priority in my unit.
1 2 3 4 5	**34.**	I have a good "system knowledge" of the equipment that I work on.
1 2 3 4 5	**35.**	My coworkers have a good "system knowledge" of the equipment that they work o
1 2 3 4 5	**36.**	I have been given enough training to perform my work safely.
1 2 3 4 5	**37.**	Safety issues are given high priority in training programs.
1 2 3 4 5	**38.**	I have been encouraged to improve myself through continued training.

B. Employee Turnover

1	Strongly Disagree	2	Disagree	3	Neutral	4	Agree	5	Strongly Agree

<u>Using the above scale, please circle the number that best describes your opinion</u>.

1. Job Satisfaction

1 2 3 4 5	**39.**	The work I do is very meaningful to me ®.
1 2 3 4 5	**40.**	My work gives me a sense of achievement ®.
1 2 3 4 5	**41.**	I like to look back on a day's work with a sense of a job well done ®.

1 2 3 4 5	**42.** I enjoy my work more than my leisure time ®.
1 2 3 4 5	**43.** I feel that I am happier in my work than most people ®.
1 2 3 4 5	**44.** Most days I am enthusiastic about my work ®.
1 2 3 4 5	**45.** There is not enough variety in my job.

2. Organizational Commitment

1 2 3 4 5	**46.** I am willing to put in a great deal of effort beyond that normally expected in order to help my unit ®.
1 2 3 4 5	**47.** I speak highly of this unit to my friends as a great place to work ®.
1 2 3 4 5	**48.** I would accept almost any type of job assignment in order to keep working for this unit ®.
1 2 3 4 5	**49.** I find that my values and the unit's values are very similar ®.
1 2 3 4 5	**50.** I am proud to tell others that I am part of this unit ®.
1 2 3 4 5	**51.** Deciding to work for this unit was a definite mistake on my part.

3. Emotional Exhaustion

1 2 3 4 5	**52.** I feel emotionally drained from my work.
1 2 3 4 5	**53.** I feel used up at the end of the workday.
1 2 3 4 5	**54.** I feel fatigued when I get up in the morning and have to face another day on the job.
1 2 3 4 5	**55.** I feel burned out from my work.
1 2 3 4 5	**56.** I feel frustrated by my job.
1 2 3 4 5	**57.** I feel I am working too hard on my job ®.
1 2 3 4 5	**58.** I feel like I am at the end of my rope.

1	Strongly Disagree	2	Disagree	3	Neutral	4	Agree	5	Strongly Agree

Using the above scale, please circle the number that best describes your opinion.

4.Turnover Intention

1 2 3 4 5	**59.**	In the next few months I intend to leave this organization.
1 2 3 4 5	**60.**	In the next few years I intend to leave this organization.
1 2 3 4 5	**61.**	I occasionally think about leaving this organization.
1 2 3 4 5	**62.**	I'd like to work in this organization until I reach retirement age ®.

C. Safety Motivation

1 2 3 4 5	**63.**	I feel that it is important to maintain safety at all times.
1 2 3 4 5	**64.**	I believe that safety at workplace is a very important issue.
1 2 3 4 5	**65.**	I feel that it is necessary to put efforts to reduce accidents and incidents at workplace.
1 2 3 4 5	**66.**	I feel that it is worthwhile to put in effort to maintain or improve my personal safety.
1 2 3 4 5	**67.**	I feel that it is important to encourage others to use safe practices.
1 2 3 4 5	**68.**	I feel that it is important to promote safety programs.

D. Safety Performance

1. Reporting Unsafe Behaviors

1 2 3 4 5	**69.**	I don't bother reporting mishaps or close calls since these events don't cause any real damage ®.
1 2 3 4 5	**70.**	The safety reporting system is convenient and easy to use.

1 2 3 4 5 | **71.** I can report safety discrepancies without the fear of negative repercussions.

1 2 3 4 5 | **72.** I'm willing to report information regarding the marginal performance or unsafe actions of other technicians.

1 2 3 4 5 | **73.** I'm willing to file reports about unsafe situations, even if the situation was caused by my own actions.

1 2 3 4 5 | **74.** Technicians who raise safety concerns are seen as troublemakers ®.

1 2 3 4 5 | **75.** I'm satisfied with the way this unit deals with safety reports.

<u>For the remaining three variables, please use the below scale and circle the number that best describes your opinion.</u>

1 Never	2 Rarely	3 Sometimes	4 Frequently	5 Very Frequently

2. Errors

1 2 3 4 5 | **76.** I have missed out steps in maintenance tasks.

1 2 3 4 5 | **77.** I have resumed at the wrong place when returning to a task after an interruption.

1 2 3 4 5 | **78.** I have failed to detect a fault when completing a visual inspection.

1 2 3 4 5 | **79.** I have forgotten to check that all steps in a procedure were completed.

1 2 3 4 5 | **80.** I have forgotten to sign off a task.

1 2 3 4 5 | **81.** I have left a tool or some other item in an aircraft.

1 2 3 4 5 | **82.** I have installed a part the wrong way.

1 2 3 4 5 | **83.** I have found a part left over after a job was completed.

1 2 3 4 5 | **84.** I have had difficulty with a task because I misunderstood how a particular aircraft system worked.

3. Violations

1 2 3 4 5 | **85.** When given a task, I ensure that approved procedures are followed ®.

1 2 3 4 5 | **86.** I have performed a familiar task without referring to the maintenance manual or other approved documentation.

1 2 3 4 5 | **87.** I have deliberately ‘bent” formal procedures in order to complete a task on time.

1 2 3 4 5 | **88.** I have temporarily disconnected or removed a part to make a job easier, but not documented the disconnection/removal.

1 2 3 4 5 | **89.** I have taken risks, other than those inherited in my job, to get a task done.

1 2 3 4 5 | **90.** I have signed off a task that I either did not perform or only partially performed.

1 2 3 4 5 | **91.** In this unit, supervisors have signed off a maintenance task without performing the required supervision or inspection.

1 2 3 4 5 | **92.** Done a job without the proper tool or equipment.

1 2 3 4 5 | **93.** Turned a blind eye to minor defect when correcting it would have delayed an aircraft.

1 2 3 4 5 | **94.** Not made a system safe before working on it, or in its vicinity.

1 2 3 4 5 | **95.** Decided not to do functional check or engine run because of a lack of time.

1 2 3 4 5 | **96.** Intentionally over-torqued a bolt to make it fit

4. Incidents and Injuries

1 2 3 4 5 | **97.** Have you had any injuries (sprains, burns, fractures, bruising, head and eye injuries or others) at work over the past 12 months?

1 2 3 4 5 | **98.** Have you had any role that caused damages to the aircraft or ground support equipment in the past 12 months?

® *Reverse-scored questions*

THANK YOU

استبانة بحث

المقدمه :

لقد تم إعداد هذه الاستبانه كجزء من متطلبات الدراسة البحثية للحصول علي درجة الدكتوراه في الهندسة الصناعية و الهدف الرئيسي من هذه الدراسة البحثية هو دراسة و تحليل "بيئة السلامة في أجنحة صيانة الطائرات التابعة لسلاح الجو الملكي البحريني".

جميع البيانات و القياسات المأخوذة من هذه الاستبانه سوف تكون سرية و مجهولة المصدر الا على الباحث الذي سوف يتمتع بكامل الصلاحية للاطلاع عليها.

إن الوقت المفترض لإنهاء هذه الاستبانه هو من 20 الى 30 دقيقة حيث إن مشاركتكم تطوعية و عليه إذا كان لديكم أية أسئلة أو استفسارات أرجو منكم الرجوع للباحث. يجب ان يكون عمر المشارك فوق 18 سنة.

رأيكم ذو أهمية كبيرة و داعم للباحث لاستكمال إجراءات الدراسة البحثية للحصول على درجة الدكتوراة.

هذا مالزم و لكم جزيل الشكر.

استبانة بحث التخرج

التاريخ: ____

المسمي الوظيفي: ____

الجناح: ____

الرتبة: ____

العمر: ____

المؤهل العلمي: ____

مكان العمل : 1) الخط الاول 2) الخط الثاني 3) الرقابة 4)الورشة 5) اخرى ______________

سنوات الخدمة: ____

بيئة السلامة:

5 موافق بشدة	4 موافق	3 محايد	2 غير موافق	1 غير موافق بشده

الرجاء استخدام المعيار الموضح فى الجدول أعلاه و ذلك لتحديد الرقم الملائم لرأيك:

الاشراف

1. المسؤول أوالضابط المباشر لديه خبرة لعدد من السنوات في مجال صيانة الطائرات.	1 2 3 4 5
2. المسؤول المباشر يفهم تماما مهام الصيانة.	1 2 3 4 5
3. أنا أثق بالمسؤول المباشر.	1 2 3 4 5
4. المسؤول المباشر يضع أهداف واضحة لفريق العمل.	1 2 3 4 5
5. المسؤول المباشر يقدم الدعم و التشجيع لأعضاء فريق العمل لرفع مستوى الأداء.	1 2 3 4 5
6. عندما اتسبب في حدوث أي خطأ في العمل ؛ المسؤول المباشر يقدم لي الدعم.	1 2 3 4 5
7. المسؤول المباشر يدقق علي أداء عملي و المهام الوظيفية بعناية.	1 2 3 4 5
8. المسؤول المباشر يقدم لي الدعم في شؤوني و اهتماماتي الشخصية.	1 2 3 4 5
9. المسؤول المباشر يحاول دائما و باستمرار دعم و تحفيز إجراءات السلامة في العمل.	1 2 3 4 5

5 موافق بشدة	4 موافق	3 محايد	2 غير موافق	1 غير موافق بشده

<u>الرجاء استخدام المعيار الموضح في الجدول أعلاه و ذلك لتحديد الرقم الملائم لرأيك:</u>

<u>محور السلامة</u>

10. الفنيون مدربون على التعامل مع عواقب الأعمال غير الآمنة.	1 2 3 4 5
11. هذا الجناح يولي اهتمام لشؤون السلامة و يضعها كمعيار رئيسي في تحقيق اهدافه.	1 2 3 4 5
12. قلة و نقص المعدات يجبرنا في بعض الاحيان علي اختصار إجراءات العمل.	1 2 3 4 5
13. ليس هناك وقت كافي لإتباع إجراءات السلامة.	1 2 3 4 5
14. أثناء ضغط ظروف العمل العالية ,أنا على استعداد لاختصار بعض إجراءات العمل لإنجاز المهام الوظيفية في الوقت المحدد.	1 2 3 4 5
15. إجراءات و تطبيقات السلامة في هذا الجناح مفيدة و فعالة.	1 2 3 4 5

<u>التواصل في شؤون السلامة</u>

16. الادارة العليا تتبنى سياسة الباب المفتوح للتواصل في شؤون و إجراءات السلامة.	1 2 3 4 5
17. هناك وقت كافي في الاجتماعات للمناقشة و التعامل مع شؤون و إجراءات السلامة.	1 2 3 4 5
18. هناك وسائل و قنوات تواصل جيدة بخصوص إجراءات و شؤون السلامه في مكان العمل هذا.	1 2 3 4 5
19. دائما ما تطرح مواضيع السلامة المهمة و ذات العلاقة للنقاش.	1 2 3 4 5
20. الضابط المباشردائما ما يبقيني علي إطلاع بما يتعلق بتطور مستوى أدائي في اتباع إجراءات السلامة.	1 2 3 4 5
21. أنا على اطلاع بمجريات و نتائج اجتماعات السلامة.	1 2 3 4 5
22. عندما يتم التبليغ عن مشاكل السلامة بواسطة الفنيين ، يقوم المشرفون باتخاذ الاجراءات اللازمة لتصحيح الوضع.	1 2 3 4 5
23. شؤون السلامة التي ترفع من قبل الفنيين يتم تبليغها عادة لجميع الفنيين في هذا الجناح.	1 2 3 4 5

<u>التميز و التقدير</u>

24. في هذا الجناح الحوافز و التشجيع عادة ما تكون أكثر ترجيح من التهديدات و الانتقادات.	1 2 3 4 5
25. في هذا الجناح, يتم تكريم الفنيين بما يتناسب مع أدائهم الوظيفي.	1 2 3 4 5
26. أنا راض جدا بالتقدير و التميز الذي أحصل علية نتيجة عملي المتقن.	1 2 3 4 5
27. في هذا الجناح اتباع إجراءات السلامة يعد معيار إيجابي يؤخذ به في الترقيات.	1 2 3 4 5
28. في هذا الجناح يتم تكريم الفنيين الذين يقومون بالتبليغ عن مخاطر السلامة. (شكر، حوافز نقدية ، تكريم في المجلة الداخلية .... الخ)	1 2 3 4 5

5 موافق بشدة	4 موافق	3 محايد	2 غير موافق	1 غير موافق بشده

الرجاء استخدام المعيار الموضح فى الجدول أعلاه و ذلك لتحديد الرقم الملائم لرأيك:

دعم زملاء العمل للسلامه

29. زملائي في العمل على استعداد لتنبيه و توجيه زملائهم الذين اخطؤا في اتباع إجراءات او استخدام معدات السلامة.	1 2 3 4 5
30. زملائي في العمل على استعداد لإيقاف زملائهم عند ملاحظة انهم يعملون بخطوره.	1 2 3 4 5
31. زملائي في العمل يشجعون بعضهم البعض للعمل بسلامة.	1 2 3 4 5

التدريب

32. التدريب المهني أعدني بصوره ممتازة لأداء مهامي الوظيفية.	1 2 3 4 5
33. التدريب علي العمل (OJT) يحتل أولوية عالية في هذا الجناح.	1 2 3 4 5
34. لدي معرفة و إلمام بالانظمه والأدوات التي أعمل بها.	1 2 3 4 5
35. زملائي لديهم معرفة و المام باالانظمه و الأدوات التي يعملون بها.	1 2 3 4 5
36. لقد حصلت علي فرص تدريبية كافية لأداء عملي بسلامه.	1 2 3 4 5
37. شؤون السلامة تحتل أولوية عليا في البرامج التدريبية.	1 2 3 4 5
38. حصلت علي الدعم و التشجيع لتطوير نفسي من خلال الدورات التدريبيه المتواصلة.	12 3 4 5

الرضى الوظيفي

39. العمل الذي أقوم به ذو هدف و قيمة لي.	1 2 3 4 5
40. عملي الذي أقوم به يعطيني الشعور بالإنجاز.	1 2 3 4 5
41. أحب النظر الي أيام العمل الماضية مع الشعور بالإتقان في العمل.	1 2 3 4 5
42. وقت العمل أحب إلي من وقت الراحة و الفراغ.	1 2 3 4 5
43. أشعر إنني سعيد في عملي أكثر من الاخرين.	1 2 3 4 5
44. أشعر بالحماس اتجاه عملي في معظم الايام.	1 2 3 4 5
45. لا يوجد الكثير من التنويع في عملي.	1 2 3 4 5

الالتزام تجاه المؤسسة

46. أنا على أتم الاستعداد لبذل مجهود أكبر من المتوقع من أجل المساعدة في العمل.	1 2 3 4 5
47. اتحدث عن هذا الجناح أمام أصدقائي كمكان رائع للعمل.	1 2 3 4 5
48. أنا مستعد لتقبل أي نوع من الأعمال من أجل البقاء و العمل في هذا الجناح.	1 2 3 4 5
49. أجد إن قيمي المهنية (العطاء, التفاني, الالتزام, احترام الاخرين .....) و قيم هذا الجناح متشابهة.	1 2 3 4 5
50. أشعر بفخر عند إخبار الاخرين إنني انتسب لهذا الجناح.	1 2 3 4 5
51. قراري للعمل في هذا الجناح كان قرار خاطئا.	1 2 3 4 5

5 موافق بشدة	4 موافق	3 محايد	2 غير موافق	1 غير موافق بشده

الرجاء استخدام المعيار الموضح في الجدول أعلاه و ذلك لتحديد الرقم الملائم لرأيك:

الاجهاد العاطفي

52. أشعر بالاستنزاف العاطفي و الانفعالي قي عملي.	1 2 3 4 5
53. أشعر بالاستنزاف التام بعد نهاية يوم العمل.	1 2 3 4 5
54. أشعر بالتعب و الاجهاد عند الاستيقاظ صباحا و مواجهة يوم آخر في العمل.	1 2 3 4 5
55. أشعر بالاستنزاف الكامل و عدم الرغبة ببذل المزيد في عملي.	1 2 3 4 5
56. أشعر بالإحباط في عملي.	1 2 3 4 5
57. أشعر إنني اعمل بجهد في الجناح.	1 2 3 4 5
58. أشعر انني في نهاية عطائي الوظيفي.	1 2 3 4 5

الرغبة بترك العمل

59. لدي الرغبة بترك العمل خلال الأشهر القليلة القادمة.	1 2 3 4 5
60. لدي الرغبة بترك العمل خلال السنوات القليلة القادمة.	1 2 3 4 5
61. أحيانا أفكر بترك العمل.	1 2 3 4 5
62. لدي الرغبة للعمل في هذه المؤسسة حتى أصل إلى سن التقاعد.	1 2 3 4 5

تحفيز و تشجيع السلامة

63. أشعر بأنه من الضروري المحافظة علي إتباع إجراءات السلامه في كافة الأوقات.	1 2 3 4 5
64. أؤمن ان السلامة في مكان العمل شيء ضروري.	1 2 3 4 5
65. اشعر إنه من الضروري تكثيف الجهود للتقليل من الحوادث و الإصابات في مكان العمل.	1 2 3 4 5
66. اشعر بأن تطوير مستوى السلامة علي الصعيد الشخصي أمر ذو قيمة و اهمية.	1 2 3 4 5
67. أشعر بأنه من الضروري تشجيع الآخرين علي إتباع إجراءات السلامة.	1 2 3 4 5
68. أشعر إنه من الضروري دعم و تشجيع برامج التوعية بأمور السلامة.	1 2 3 4 5

اداء السلامه.

5 موافق بشدة	4 موافق	3 محايد	2 غير موافق	1 غير موافق بشده

الرجاء استخدام المعيار الموضح فى الجدول أعلاه و ذلك لتحديد الرقم الملائم لرأيك:

الإبلاغ الفردى (الشخصى) بالسلوكيات المخالفة للسلامة

69. أنا لا اهتم بالتبليغ عن الحوادث الوشيكة و ذلك على اعتبار إنها لم تتسبب في أي ضرر حقيقي يذكر.	1 2 3 4 5
70. نظام التبليغ عن شؤون السلامة سهل و ملائم للاستخدام	1 2 3 4 5
71. أنا استطيع الإبلاغ عن مخالفات السلامة بدون قلق أو خوف من ردود الفعل السلبية.	1 2 3 4 5
72. أنا على وجه الاستعداد للتبليغ عن التجاوزات المخالفة للسلامة من قبل الفنيين.	1 2 3 4 5
73. أنا علي استعداد لرفع تقارير عن تجاوزات إجراءات السلامة حتى و إن كنت أنا المتسبب بها.	1 2 3 4 5
74. الفنييون الذين يبلغون عن أي من شؤون السلامة ينظر لهم على إنهم مثيرون للمشاكل.	1 2 3 4 5
75. انا راضي عن اسلوب و طريقه التعامل مع تقارير السلامه في هذا الجناح.	1 2 3 4 5

للأسئلة المتبقية ارجو استخدام المعيار الموضح ادناه لاختيار الرقم الانسب لإيضاح رأيك

5 متكرر كثيرا	4 متكرر	3 احيانا	2 نادرا	1 ابدا

اخطاء الصيانة

76. لقد تعديت من دون قصد بعض الخطوات أثناء أداء مهام الصيانة.	1 2 3 4 5
77. عدت لمواصله العمل بدء من خطوة خاطئة بعد تعرضي لتشتيت الانتباه.	1 2 3 4 5
78. لقد فشلت في تحديد مكان الخلل بعد إتمام عملية التفتيش النظري.	1 2 3 4 5
79. لقد نسيت بأن أقوم بعملية التاكد لجميع خطوات إجراءات الصيانه بعد الانتهاء من العمل.	1 2 3 4 5
80. لقد نسيت أن أوقع بعد اتمام عملية الصيانه.	1 2 3 4 5
81. لقد قمت بترك أداة من أدوات الصيانة او قطع اخرى بداخل الطائرة.	1 2 3 4 5
82. لقد قمت بتركيب قطعة بطريقة خاطئة.	1 2 3 4 5
83. لقد وجدت قطعة غيار أو أداة من أدوات الصيانة نسيت متروكة بعد الانتهاء من العمل.	1 2 3 4 5
84. لقد وجدت صعوبة في اداء العمل نتيجة عدم فهمي و إلمامي بجزئية معينة في نظام الطائره.	1 2 3 4 5

التجاوزات و الانتهاكات

85. عندما يتم إسناد مهمة وظيفية لي أحرص علي إتباع إجراءات السلامة الموصي بها.	1 2 3 4 5
86. لقد قمت بأداء وظائفي المعتادة دون الرجوع إلى إجراءات أو دليل العمل المتبعة في النشرات الفنيه.	1 2 3 4 5
87. لقد تعمدت بإختصار اجراءات العمل لإتمام المهمة الوظيفية في الوقت المحدد.	1 2 3 4 5
88. لقد قمت بفك أو إزالة قطعه لتسهيل العمل دون توثيق او كتابة هذه الخطوة .	1 2 3 4 5
89. لقد قمت بمخاطر و تجاوزات غير معهودة في محيط العمل و ذلك لإتمام العمل.	1 2 3 4 5
90. لقد قمت بالتوقيع علي مهمة وظيفية لم أقم بها أو كنت مسؤول جزئيا عنها.	1 2 3 4 5
91. في هذه الجناح، المشرفون وقعوا علي إتمام عدد من عمليات الصيانه دون تطبيق أي من إجراءات التدقيق و التأكد منها فعليا.	1 2 3 4 5
92. قمت بانجاز العمل باستخدام معدات أو أدوات غير ملائمه.	1 2 3 4 5
93. قمت بالتقاضي أو صرف النظر عن خلل بسيط حيث إن تصليحه قد يؤخر جاهزية الطائرة.	1 2 3 4 5
94. لم أقم بتجهيز مسبق لسلامة المعدة أو محيط العمل قبل البدأ بالصيانة.	1 2 3 4 5
95. قررت عدم القيام بالتاكد من عمل الجهاز بعد تصليحه نتيجة ضيق الوقت.	1 2 3 4 5
96. تعمدت لاستخدام قوة مفرطه لتركيب قطعة دون الرجوع الى دليل النشرات الفنية.	1 2 3 4 5

الحوداث و الإصابات

97. هل تعرضت أثناء العمل لأي نوع من الإصابات التالية (إلتواءات, كسور, جروح, حروق, إصابات في العين أو الرأس أو اخرى ......) خلال الأشهر 12 الماضية.	1 2 3 4 5
98. هل كان لك دور في التسبب بأية أضرار لجسم الطائره أو المعدات الآلية المساندة خلال الأشهر 12 الماضية.	1 2 3 4 5

وشكرا

APPENDIX B:
LETTER OF IRB APPROVAL

University of Central Florida Institutional Review Board
Office of Research & Commercialization
12201 Research Parkway, Suite 501
Orlando, Florida 32826-3246
Telephone: 407-823-2901 or 407-882-2276
www.research.ucf.edu/compliance/irb.html

Approval of Exempt Human Research

From: **UCF Institutional Review Board #1**
FWA00000351, IRB00001138

To: **Muhana Alnoaimi**

Date: **February 27, 2014**

Dear Researcher:

On 2/27/2014, the IRB approved the following activity as human participant research that is exempt from regulation:

Type of Review:	Exempt Determination
Project Title:	SAFETY CLIMATE, EMPLOYEE TURNOVER, AND SAFETY PERFORMANCE IN AIRCRAFT MAINTENANCE: A STRUCTURAL EQUATION MODEL
Investigator:	Muhana Alnoaimi
IRB Number:	SBE-13-09822
Funding Agency:	
Grant Title:	
Research ID:	N/A

This determination applies only to the activities described in the IRB submission and does not apply should any changes be made. If changes are made and there are questions about whether these changes affect the exempt status of the human research, please contact the IRB. When you have completed your research, please submit a Study Closure request in iRIS so that IRB records will be accurate.

In the conduct of this research, you are responsible to follow the requirements of the Investigator Manual.

On behalf of Sophia Dziegielewski, Ph.D., L.C.S.W., UCF IRB Chair, this letter is signed by:

Signature applied by Joanne Muratori on 02/27/2014 02:13:34 PM EST

Joanne Muratori

IRB Coordinator

APPENDIX C:
CORRELATIONS AMONG ALL INDICATORS

Supervision Correlations

		Sup1	Sup2	Sup3	Sup4	Sup5	Sup6	Sup7	Sup8	Sup9
Sup1	Pearson Correlation	1								
	Sig. (2-tailed)									
Sup2	Pearson Correlation	.723**	1							
	Sig. (2-tailed)	.000								
Sup3	Pearson Correlation	.561**	.587**	1						
	Sig. (2-tailed)	.000	.000							
Sup4	Pearson Correlation	.520**	.607**	.660**	1					
	Sig. (2-tailed)	.000	.000	.000						
Sup5	Pearson Correlation	.482**	.508**	.637**	.645**	1				
	Sig. (2-tailed)	.000	.000	.000	.000					
Sup6	Pearson Correlation	.435**	.444**	.509**	.479**	.615**	1			
	Sig. (2-tailed)	.000	.000	.000	.000	.000				
Sup7	Pearson Correlation	.495**	.555**	.593**	.644**	.612**	.483**	1		
	Sig. (2-tailed)	.000	.000	.000	.000	.000	.000			
Sup8	Pearson Correlation	.340**	.374**	.570**	.512**	.604**	.503**	.549**	1	
	Sig. (2-tailed)	.000	.000	.000	.000	.000	.000	.000		
Sup9	Pearson Correlation	.504**	.544**	.580**	.536**	.625**	.557**	.660**	.567**	1
	Sig. (2-tailed)	.000	.000	.000	.000	.000	.000	.000	.000	

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

Safety Focus Correlations

		SF1	SF2	SF3	SF4	SF5	SF6
SF1	Pearson Correlation	1					
	Sig. (2-tailed)						
SF2	Pearson Correlation	.586**	1				
	Sig. (2-tailed)	.000					
SF3	Pearson Correlation	.111	.190**	1			
	Sig. (2-tailed)	.063	.001				
SF4	Pearson Correlation	.135*	.157**	.415**	1		
	Sig. (2-tailed)	.023	.008	.000			
SF5	Pearson Correlation	.087	.102	.438**	.516**	1	
	Sig. (2-tailed)	.142	.085	.000	.000		
SF6	Pearson Correlation	.490**	.731**	.232**	.149*	.131*	1
	Sig. (2-tailed)	.000	.000	.000	.012	.027	

**. Correlation is significant at the 0.01 level (2-tailed) &* at the 0.05

Safety Communication Correlations

		Com1	Com2	Com3	Com4	Com5	Com6	Com7	Com8
Com1	Pearson Correlation	1							
	Sig. (2-tailed)								
Com2	Pearson Correlation	.644**	1						
	Sig. (2-tailed)	.000							
Com3	Pearson Correlation	.645**	.705**	1					
	Sig. (2-tailed)	.000	.000						
Com4	Pearson Correlation	.571**	.627**	.702**	1				
	Sig. (2-tailed)	.000	.000	.000					
Com5	Pearson Correlation	.532**	.553**	.604**	.644**	1			
	Sig. (2-tailed)	.000	.000	.000	.000				
Com6	Pearson Correlation	.559**	.592**	.571**	.577**	.647**	1		
	Sig. (2-tailed)	.000	.000	.000	.000	.000			
Com7	Pearson Correlation	.594**	.631**	.602**	.531**	.569**	.588**	1	
	Sig. (2-tailed)	.000	.000	.000	.000	.000	.000		
Com8	Pearson Correlation	.510**	.594**	.537**	.492**	.545**	.585**	.673**	1
	Sig. (2-tailed)	.000	.000	.000	.000	.000	.000	.000	

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

Coworker Support Correlations

		Co1	Co2	Co3
Co1	Pearson Correlation	1		
	Sig. (2-tailed)			
Co2	Pearson Correlation	.697**	1	
	Sig. (2-tailed)	.000		
Co3	Pearson Correlation	.572**	.572**	1
	Sig. (2-tailed)	.000	.000	

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

Recognition Correlations

		Rec1	Rec2	Rec3	Rec4	Rec5
Rec1	Pearson Correlation	1				
	Sig. (2-tailed)					
Rec2	Pearson Correlation	.611**	1			
	Sig. (2-tailed)	.000				
Rec3	Pearson Correlation	.509**	.731**	1		
	Sig. (2-tailed)	.000	.000			
Rec4	Pearson Correlation	.548**	.639**	.652**	1	
	Sig. (2-tailed)	.000	.000	.000		
Rec5	Pearson Correlation	.503**	.698**	.668**	.667**	1
	Sig. (2-tailed)	.000	.000	.000	.000	

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

Training Correlations

		Tra1	Tra2	Tra3	Tra4	Tra5	Tra6	Tra7
Tra1	Pearson Correlation	1						
	Sig. (2-tailed)							
Tra2	Pearson Correlation	.619**	1					
	Sig. (2-tailed)	.000						
Tra3	Pearson Correlation	.457**	.360**	1				
	Sig. (2-tailed)	.000	.000					
Tra4	Pearson Correlation	.281**	.510**	.417**	1			
	Sig. (2-tailed)	.000	.000	.000				
Tra5	Pearson Correlation	.596**	.538**	.381**	.413**	1		
	Sig. (2-tailed)	.000	.000	.000	.000			
Tra6	Pearson Correlation	.568**	.544**	.362**	.372**	.628**	1	
	Sig. (2-tailed)	.000	.000	.000	.000	.000		
Tra7	Pearson Correlation	.578**	.582**	.382**	.345**	.666**	.546**	1
	Sig. (2-tailed)	.000	.000	.000	.000	.000	.000	

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

Job Satisfaction Correlations

		JS1	JS2	JS3	JS4	JS5	JS6	JS7
JS1	Pearson Correlation	1						
	Sig. (2-tailed)							
JS2	Pearson Correlation	.706**	1					
	Sig. (2-tailed)	.000						
JS3	Pearson Correlation	.589**	.731**	1				
	Sig. (2-tailed)	.000	.000					
JS4	Pearson Correlation	.455**	.446**	.444**	1			
	Sig. (2-tailed)	.000	.000	.000				
JS5	Pearson Correlation	.471**	.509**	.530**	.616**	1		
	Sig. (2-tailed)	.000	.000	.000	.000			
JS6	Pearson Correlation	.474**	.501**	.595**	.516**	.706**	1	
	Sig. (2-tailed)	.000	.000	.000	.000	.000		
JS7	Pearson Correlation	-.055	-.090	-.153*	-.083	-.067	-.109	1
	Sig. (2-tailed)	.352	.129	.010	.162	.262	.068	

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

*. Correlation is significant at the 0.05 level (2-tailed).

Organization Commitment Correlations

		OC1	OC2	OC3	OC4	OC5	OC6
OC1	Pearson Correlation	1					
	Sig. (2-tailed)						
OC2	Pearson Correlation	.401**	1				
	Sig. (2-tailed)	.000					
OC3	Pearson Correlation	.431**	.631**	1			
	Sig. (2-tailed)	.000	.000				
OC4	Pearson Correlation	.240**	.518**	.477**	1		
	Sig. (2-tailed)	.000	.000	.000			
OC5	Pearson Correlation	.336**	.636**	.608**	.515**	1	
	Sig. (2-tailed)	.000	.000	.000	.000		
OC6	Pearson Correlation	.271**	.479**	.460**	.396**	.579**	1
	Sig. (2-tailed)	.000	.000	.000	.000	.000	

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

Emotional Exhaustion Correlations

		EX1	EX2	EX3	EX4	EX5	EX6	EX7
EX1	Pearson Correlation	1						
	Sig. (2-tailed)							
EX2	Pearson Correlation	.574**	1					
	Sig. (2-tailed)	.000						
EX3	Pearson Correlation	.405**	.474**	1				
	Sig. (2-tailed)	.000	.000					
EX4	Pearson Correlation	.451**	.443**	.664**	1			
	Sig. (2-tailed)	.000	.000	.000				
EX5	Pearson Correlation	.361**	.364**	.580**	.602**	1		
	Sig. (2-tailed)	.000	.000	.000	.000			
EX6	Pearson Correlation	-.234**	-.236**	-.163**	-.043	-.097	1	
	Sig. (2-tailed)	.000	.000	.006	.470	.105		
EX7	Pearson Correlation	.203**	.228**	.301**	.305**	.304**	-.039	1
	Sig. (2-tailed)	.001	.000	.000	.000	.000	.517	

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

Turnover Intention Correlations

		TI1	TI2	TI3	TI4
TI1	Pearson Correlation	1			
	Sig. (2-tailed)				
TI2	Pearson Correlation	.614**	1		
	Sig. (2-tailed)	.000			
TI3	Pearson Correlation	.576**	.543**	1	
	Sig. (2-tailed)	.000	.000		
TI4	Pearson Correlation	.449**	.392**	.389**	1
	Sig. (2-tailed)	.000	.000	.000	

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

Safety Motivation Correlations

		SM1	SM2	SM3	SM4	SM5	SM6
SM1	Pearson Correlation	1					
	Sig. (2-tailed)						
SM2	Pearson Correlation	.663**	1				
	Sig. (2-tailed)	.000					
SM3	Pearson Correlation	.561**	.695**	1			
	Sig. (2-tailed)	.000	.000				
SM4	Pearson Correlation	.316**	.266**	.349**	1		
	Sig. (2-tailed)	.000	.000	.000			
SM5	Pearson Correlation	.610**	.606**	.773**	.446**	1	
	Sig. (2-tailed)	.000	.000	.000	.000		
SM6	Pearson Correlation	.584**	.650**	.653**	.344**	.785**	1
	Sig. (2-tailed)	.000	.000	.000	.000	.000	

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

Self-Report Unsafe behavior Correlations

		SRU1	SRU2	SRU3	SRU4	SRU5	SRU6	SRU7
SRU1	Pearson Correlation	1						
	Sig. (2-tailed)							
SRU2	Pearson Correlation	.059	1					
	Sig. (2-tailed)	.322						
SRU3	Pearson Correlation	.229**	.511**	1				
	Sig. (2-tailed)	.000	.000					
SRU4	Pearson Correlation	.276**	.433**	.610**	1			
	Sig. (2-tailed)	.000	.000	.000				
SRU5	Pearson Correlation	.143*	.324**	.494**	.577**	1		
	Sig. (2-tailed)	.016	.000	.000	.000			
SRU6	Pearson Correlation	.234**	.267**	.295**	.244**	.281**	1	
	Sig. (2-tailed)	.000	.000	.000	.000	.000		
SRU7	Pearson Correlation	.082	.553**	.401**	.353**	.273**	.280**	1
	Sig. (2-tailed)	.169	.000	.000	.000	.000	.000	

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

*. Correlation is significant at the 0.05 level (2-tailed).

Maintenance Error Correlations

		ME1	ME2	ME3	ME4	ME5	ME6	ME7	ME8	ME9
ME1	Pearson Correlation	1								
	Sig. (2-tailed)									
ME2	Pearson Correlation	.371**	1							
	Sig. (2-tailed)	.000								
ME3	Pearson Correlation	.361**	.345**	1						
	Sig. (2-tailed)	.000	.000							
ME4	Pearson Correlation	.442**	.271**	.465**	1					
	Sig. (2-tailed)	.000	.000	.000						
ME5	Pearson Correlation	.415**	.193**	.268**	.442**	1				
	Sig. (2-tailed)	.000	.001	.000	.000					
ME6	Pearson Correlation	.314**	.058	.238**	.287**	.528**	1			
	Sig. (2-tailed)	.000	.332	.000	.000	.000				
ME7	Pearson Correlation	.349**	.050	.255**	.249**	.467**	.504**	1		
	Sig. (2-tailed)	.000	.402	.000	.000	.000	.000			
ME8	Pearson Correlation	.292**	.264**	.177**	.208**	.265**	.225**	.296**	1	
	Sig. (2-tailed)	.000	.000	.003	.000	.000	.000	.000		
ME9	Pearson Correlation	.351**	.209**	.298**	.267**	.344**	.198**	.337**	.256**	1
	Sig. (2-tailed)	.000	.000	.000	.000	.000	.001	.000	.000	

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

Violation Correlations

		Vio1	Vio2	Vio3	Vio4	Vio5	Vio6	Vio7	Vio8	Vio9	Vio10	Vio11	Vio12
Vio1	Pearson Correlation	1											
	Sig. (2-tailed)												
Vio2	Pearson Correlation	.175**	1										
	Sig. (2-tailed)	.003											
Vio3	Pearson Correlation	.211**	.503**	1									
	Sig. (2-tailed)	.000	.000										
Vio4	Pearson Correlation	.113	.455**	.445**	1								
	Sig. (2-tailed)	.057	.000	.000									
Vio5	Pearson Correlation	.213**	.445**	.396**	.525**	1							
	Sig. (2-tailed)	.000	.000	.000	.000								
Vio6	Pearson Correlation	.151*	.338**	.364**	.573**	.552**	1						
	Sig. (2-tailed)	.011	.000	.000	.000	.000							
Vio7	Pearson Correlation	.149*	.324**	.351**	.363**	.502**	.503**	1					
	Sig. (2-tailed)	.012	.000	.000	.000	.000	.000						
Vio8	Pearson Correlation	.115	.400**	.362**	.467**	.475**	.435**	.532**	1				
	Sig. (2-tailed)	.053	.000	.000	.000	.000	.000	.000					
Vio9	Pearson Correlation	.140*	.361**	.401**	.411**	.393**	.373**	.326**	.526**	1			
	Sig. (2-tailed)	.018	.000	.000	.000	.000	.000	.000	.000				
Vio10	Pearson Correlation	.153**	.347**	.297**	.385**	.518**	.419**	.357**	.359**	.416**	1		
	Sig. (2-tailed)	.010	.000	.000	.000	.000	.000	.000	.000	.000			
Vio11	Pearson Correlation	.088	.230**	.260**	.360**	.379**	.431**	.274**	.410**	.426**	.357**	1	
	Sig. (2-tailed)	.140	.000	.000	.000	.000	.000	.000	.000	.000	.000		
Vio12	Pearson Correlation	.155**	.297**	.279**	.393**	.414**	.343**	.250**	.339**	.432**	.435**	.578**	1
	Sig. (2-tailed)	.009	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	

**. Correlation is significant at the 0.01 level (2-tailed).
*. Correlation is significant at the 0.05 level (2-tailed).

APPENDIX D: EFA RESULTS

KMO, Communalities, and Total Variance Explained for a Principal Axis Factoring EFA with 14 Factors and Promax Rotation

KMO and Bartlett's Test		
Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.885
Bartlett's Test of Sphericity	Approx. Chi-Square	12667.218
	df	2415
	Sig.	.000

Communalities		
	Initial	Extraction
Sup2	.599	.467
Sup3	.729	.682
Sup4	.731	.647
Sup5	.753	.723
Sup6	.582	.530
Sup7	.710	.660
Sup8	.597	.518
Sup9	.722	.653
SF3	.487	.479
SF4	.521	.458
SF5	.566	.574
Com1	.683	.615
Com2	.727	.727
Com3	.743	.710
Com4	.704	.630
Com6	.671	.564
Com7	.681	.612
Rec1	.578	.486
Rec2	.765	.778
Rec3	.732	.704
Rec4	.717	.672
Rec5	.676	.645
Co1	.678	.736
Co2	.657	.694
Co3	.608	.554

Tra1	.646	.550
Tra5	.699	.701
Tra6	.699	.645
Tra7	.721	.675
JS1	.682	.609
JS2	.764	.680
JS3	.723	.683
JS4	.598	.543
JS5	.736	.655
JS6	.695	.641
OC2	.723	.656
OC3	.698	.610
OC4	.649	.520
OC5	.739	.665
EX1	.561	.481
EX2	.610	.568
EX3	.650	.618
EX4	.685	.643
EX5	.660	.630
TI1	.690	.651
TI2	.639	.634
TI3	.581	.586
SM1	.653	.566
SM2	.720	.678
SM3	.796	.746
SM5	.822	.768
SM6	.745	.688
SRU3	.580	.575
SRU4	.661	.719
SRU5	.555	.461
ME1	.596	.503
ME3	.514	.326
ME4	.579	.516
ME5	.614	.606
ME6	.537	.500
ME7	.525	.420
Vio2	.544	.435

Vio3	.574	.525
Vio4	.581	.530
Vio5	.667	.611
Vio6	.632	.564
Vio7	.638	.535
Vio8	.695	.597
Vio9	.583	.431
Vio10	.480	.432
Extraction Method: Principal Axis Factoring.		

Total Variance Explained

Factor	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings[a]
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total
1	17.357	24.796	24.796	16.981	24.259	24.259	11.292
2	5.695	8.136	32.932	5.270	7.528	31.787	10.567
3	3.894	5.563	38.495	3.524	5.035	36.822	9.221
4	3.474	4.963	43.459	3.107	4.438	41.260	6.671
5	2.328	3.326	46.785	1.948	2.783	44.043	4.790
6	2.228	3.183	49.968	1.868	2.669	46.712	9.322
7	2.082	2.975	52.943	1.629	2.327	49.039	6.720
8	1.955	2.792	55.735	1.549	2.213	51.251	4.593
9	1.844	2.635	58.370	1.434	2.049	53.300	6.868
10	1.615	2.307	60.677	1.217	1.739	55.039	3.724
11	1.518	2.169	62.846	1.072	1.531	56.570	6.731
12	1.253	1.790	64.636	.864	1.234	57.805	4.978
13	1.119	1.598	66.234	.754	1.077	58.882	10.277
14	1.097	1.568	67.801	.676	.965	59.847	7.679
15	.985	1.407	69.209				
16	.888	1.269	70.478				
17	.881	1.259	71.737				
18	.841	1.202	72.938				
19	.819	1.170	74.108				
20	.803	1.148	75.256				
21	.734	1.048	76.304				
22	.680	.971	77.275				

23	.653	.932	78.208				
24	.645	.922	79.130				
25	.630	.900	80.030				
26	.619	.885	80.914				
27	.595	.850	81.764				
28	.585	.835	82.599				
29	.568	.812	83.411				
30	.525	.750	84.161				
31	.505	.722	84.883				
32	.491	.701	85.584				
33	.476	.680	86.265				
34	.469	.670	86.935				
35	.451	.644	87.579				
36	.434	.619	88.198				
37	.421	.602	88.800				
38	.402	.574	89.373				
39	.394	.563	89.936				
40	.386	.551	90.487				
41	.370	.528	91.016				
42	.354	.506	91.522				
43	.343	.490	92.012				
44	.333	.475	92.487				
45	.323	.461	92.948				
46	.320	.457	93.405				
47	.305	.436	93.840				
48	.296	.423	94.263				
49	.277	.396	94.659				
50	.271	.387	95.046				
51	.269	.384	95.430				
52	.255	.364	95.794				
53	.242	.345	96.139				
54	.226	.323	96.463				
55	.217	.310	96.773				
56	.216	.308	97.081				
57	.206	.295	97.376				
58	.190	.272	97.648				
59	.186	.266	97.914				

60	.179	.256	98.170				
61	.169	.242	98.412				
62	.153	.219	98.631				
63	.149	.213	98.844				
64	.140	.200	99.044				
65	.133	.190	99.234				
66	.124	.177	99.411				
67	.117	.167	99.578				
68	.113	.162	99.740				
69	.103	.147	99.887				
70	.079	.113	100.000				
Extraction Method: Principal Axis Factoring.							
a. When factors are correlated, sums of squared loadings cannot be added to obtain a total variance.							

Methods of Factor Extraction

	ML (Promax)	ML (Varimax)	PC (Promax)	PC (Varimax)	PAF (Promax)	PAF (Varimax)
Kaiser-Meyer-Olkin Measure of Sampling Adequacy	0.887	0.875	0.881	0.874	0.885	0.878
All communalities are above	0.35	0.35	0.35	0.35	0.35	0.35
Total variance explained cumulative %	60.813	59.645	68.669	68.115	59.847	59.672
Number of Factors	14	12	13	12	14	12
Nonredundant residuals with absolute values > 0.05	3.00%	3.00%	8.00%	9.00%	3.00%	3.00%
Number of Variables	**69**	**61**	**66**	**62**	**70**	**63**

APPENDIX E: CFA RESULTS

Table E1 Initial Safety Climate CFA Estimates Output

Maximum Likelihood Estimates
Regression Weights: (Group number 1 - Default model)

			Estimate	S.E.	C.R.	P	Label
Sup8	<---	Supervision	0.999	0.081	12.299	***	par_1
Sup7	<---	Supervision	0.997	0.069	14.467	***	par_2
Sup6	<---	Supervision	0.966	0.084	11.457	***	par_3
Sup5	<---	Supervision	1.229	0.083	14.722	***	par_4
Sup3	<---	Supervision	0.898	0.064	14.078	***	par_5
Com6	<---	Communication	1.002	0.081	12.434	***	par_6
Com4	<---	Communication	1.012	0.075	13.453	***	par_7
Com3	<---	Communication	1.15	0.079	14.471	***	par_8
Com2	<---	Communication	1.147	0.081	14.219	***	par_9
Com1	<---	Communication	1.098	0.082	13.387	***	par_10
Rec5	<---	Recognition	1				
Rec4	<---	Recognition	1.019	0.068	15.034	***	par_11
Rec3	<---	Recognition	1.027	0.064	16.052	***	par_12
Rec2	<---	Recognition	1.046	0.064	16.338	***	par_13
Rec1	<---	Recognition	0.77	0.065	11.788	***	par_14
Co3	<---	CoworkerSupport	1				
Co2	<---	CoworkerSupport	1.127	0.098	11.495	***	par_15
Co1	<---	CoworkerSupport	1.202	0.105	11.491	***	par_16
SF5	<---	SafetyFocus	1				
SF4	<---	SafetyFocus	0.998	0.125	7.957	***	par_17
SF3	<---	SafetyFocus	0.887	0.116	7.661	***	par_18
Tra7	<---	Training	1				
Tra6	<---	Training	0.797	0.061	13.16	***	par_19
Tra5	<---	Training	0.973	0.07	13.989	***	par_20
Tra1	<---	Training	0.802	0.063	12.7	***	par_21
Sup9	<---	Supervision	1				
Com7	<---	Communication	1				
Sup2	<---	Supervision	0.785	0.066	11.919	***	par_22
Sup4	<---	Supervision	1.086	0.075	14.397	***	par_38

Covariances: (Group number 1 - Default model)

			Estimate	S.E.	C.R.	P	Label
Supervision	<-->	Communication	0.527	0.069	7.631	***	par_23
Supervision	<-->	Recognition	0.644	0.084	7.679	***	par_24
Supervision	<-->	CoworkerSupport	0.118	0.035	3.37	***	par_25
Supervision	<-->	SafetyFocus	0.213	0.064	3.332	***	par_26
Supervision	<-->	Training	0.665	0.085	7.87	***	par_27
Communication	<-->	Recognition	0.742	0.093	7.99	***	par_28
Communication	<-->	CoworkerSupport	0.138	0.037	3.686	***	par_29
Communication	<-->	SafetyFocus	0.295	0.07	4.212	***	par_30
Communication	<-->	Training	0.719	0.091	7.896	***	par_31
Recognition	<-->	CoworkerSupport	0.107	0.045	2.358	0.018	par_32
Recognition	<-->	SafetyFocus	0.306	0.086	3.576	***	par_33
Recognition	<-->	Training	0.818	0.107	7.666	***	par_34
CoworkerSupport	<-->	SafetyFocus	0.023	0.042	0.551	0.582	par_35
CoworkerSupport	<-->	Training	0.163	0.045	3.591	***	par_36
SafetyFocus	<-->	Training	0.419	0.088	4.77	***	par_37

* p < 0.001, **p < 0.05

Table E2 Initial Employee Turnover CFA Estimates Output

Regression Weights: (Group number 1 - Default model)

			Estimate	S.E.	C.R.	P	Label
JS1	<---	JobSat	1				
JS2	<---	JobSat	1.089	0.093	11.66	***	par_1
JS3	<---	JobSat	1.076	0.091	11.763	***	par_2
JS4	<---	JobSat	1.303	0.124	10.481	***	par_3
JS5	<---	JobSat	1.566	0.13	12.054	***	par_4
JS6	<---	JobSat	1.476	0.123	12.028	***	par_5
OC2	<---	OrgComt	1				
OC3	<---	OrgComt	1.032	0.074	13.862	***	par_6
OC4	<---	OrgComt	0.751	0.073	10.259	***	par_7
OC5	<---	OrgComt	0.98	0.071	13.887	***	par_8
TI1	<---	TurnInt	1				
TI2	<---	TurnInt	1.022	0.089	11.53	***	par_9
TI3	<---	TurnInt	0.977	0.083	11.753	***	par_10
EX1	<---	EmoEx	1				
EX2	<---	EmoEx	1.091	0.151	7.242	***	par_11
EX3	<---	EmoEx	1.664	0.189	8.794	***	par_12
EX4	<---	EmoEx	1.496	0.17	8.796	***	par_13
EX5	<---	EmoEx	1.495	0.176	8.515	***	par_14

Covariances: (Group number 1 - Default model)

			Estimate	S.E.	C.R.	P	Label
JobSat	<-->	OrgComt	0.359	0.048	7.476	***	par_15
JobSat	<-->	TurnInt	0.291	0.048	6.08	***	par_16
JobSat	<-->	EmoEx	0.178	0.033	5.444	***	par_17
OrgComt	<-->	TurnInt	0.549	0.079	6.911	***	par_18
OrgComt	<-->	EmoEx	0.3	0.053	5.649	***	par_19
TurnInt	<-->	EmoEx	0.372	0.063	5.87	***	par_20

* $p < 0.001$

Table E3 Initial Safety Performance CFA Estimates Output

Regression Weights: (Group number 1 - Default model)

			Estimate	S.E.	C.R.	P	Label
Violations	<---	Unsafe_Acts	1				
Errors	<---	Unsafe_Acts	0.681	0.193	3.531	***	par_15
Vio2	<---	Violations	1				
Vio3	<---	Violations	1.027	0.125	8.188	***	par_1
Vio4	<---	Violations	0.995	0.106	9.395	***	par_2
Vio5	<---	Violations	0.923	0.096	9.628	***	par_3
Vio6	<---	Violations	0.86	0.092	9.324	***	par_4
Vio7	<---	Violations	1.018	0.119	8.585	***	par_5
Vio8	<---	Violations	0.844	0.093	9.093	***	par_6
Vio10	<---	Violations	0.672	0.08	8.407	***	par_7
ME1	<---	Errors	1				
ME3	<---	Errors	0.67	0.103	6.517	***	par_8
ME4	<---	Errors	0.768	0.096	7.966	***	par_9
ME5	<---	Errors	0.762	0.083	9.225	***	par_10
ME6	<---	Errors	0.474	0.058	8.222	***	par_11
ME7	<---	Errors	0.482	0.059	8.22	***	par_12
SRU3	<---	RepUnsafe	1				
SRU4	<---	RepUnsafe	1.033	0.098	10.497	***	par_13
SRU5	<---	RepUnsafe	0.807	0.081	10.01	***	par_14
Vio9	<---	Violations	0.638	0.076	8.387	***	par_17

Covariances: (Group number 1 - Default model)

			Estimate	S.E.	C.R.	P	Label
RepUnsafe	<-->	Unsafe_Acts	-0.186	0.043	-4.341	***	par_16

* P < 0.001

APPENDIX F: ASSESSMENT OF NORMALITY

Table F1 Output Assessment of Normality for Safety Climate CFA Model

Variable	min	max	skew	c.r.	kurtosis	c.r.
Tra1	1.000	5.000	-.934	-6.416	.074	.255
Tra5	1.000	5.000	-.530	-3.637	-.869	-2.985
Tra6	1.000	5.000	-.918	-6.302	.234	.803
Tra7	1.000	5.000	-.180	-1.234	-1.153	-3.961
SF3	1.000	5.000	.230	1.582	-1.293	-4.439
SF4	1.000	5.000	-.185	-1.268	-1.247	-4.281
SF5	1.000	5.000	-.217	-1.491	-1.227	-4.213
Co1	1.000	5.000	-1.143	-7.849	1.647	5.655
Co2	1.000	5.000	-1.369	-9.402	2.507	8.609
Co3	1.000	5.000	-1.257	-8.631	1.644	5.646
Rec1	1.000	5.000	.368	2.525	-1.004	-3.447
Rec2	1.000	5.000	.249	1.709	-1.239	-4.255
Rec3	1.000	5.000	-.161	-1.108	-1.281	-4.398
Rec4	1.000	5.000	-.048	-.329	-1.368	-4.697
Rec5	1.000	5.000	.328	2.254	-1.222	-4.196
Com1	1.000	5.000	-.545	-3.742	-.642	-2.205
Com2	1.000	5.000	-.148	-1.016	-1.051	-3.609
Com3	1.000	5.000	-.374	-2.572	-.909	-3.121
Com4	1.000	5.000	-.280	-1.926	-.825	-2.832
Com6	1.000	5.000	-.262	-1.799	-.942	-3.234
Com7	1.000	5.000	-.783	-5.376	-.242	-.832
Sup2	1.000	5.000	-1.063	-7.302	.984	3.380
Sup3	1.000	5.000	-1.264	-8.683	1.553	5.332
Sup4	1.000	5.000	-.712	-4.891	-.365	-1.254
Sup5	1.000	5.000	-.659	-4.527	-.691	-2.374
Sup6	1.000	5.000	-.563	-3.863	-.735	-2.525
Sup7	1.000	5.000	-.860	-5.909	.157	.541
Sup8	1.000	5.000	-.733	-5.034	-.374	-1.285
Sup9	1.000	5.000	-.944	-6.480	.290	.995
Multivariate					162.151	32.165

c.r. = critical ratio

Table F2 Output Assessment of Normality for Employee Turnover CFA Model

Assessment of normality (Group number 1)

Variable	min	max	skew	c.r.	kurtosis	c.r.
EX5	1.000	5.000	.764	5.248	-.396	-1.360
EX4	1.000	5.000	.937	6.435	.142	.486
EX3	1.000	5.000	.724	4.970	-.543	-1.865
EX2	1.000	5.000	.266	1.827	-.854	-2.932
EX1	1.000	5.000	.262	1.798	-.699	-2.399
TI3	1.000	5.000	.279	1.917	-1.161	-3.988
TI2	1.000	5.000	.269	1.851	-1.307	-4.487
TI1	1.000	5.000	1.148	7.881	.356	1.222
OC5	1.000	5.000	1.254	8.614	.886	3.043
OC4	1.000	5.000	.917	6.295	.223	.766
OC3	1.000	5.000	.940	6.455	.058	.200
OC2	1.000	5.000	.975	6.698	.382	1.310
JS6	1.000	5.000	1.049	7.206	.680	2.336
JS5	1.000	5.000	1.017	6.985	.427	1.466
JS4	1.000	5.000	.889	6.108	.463	1.588
JS3	1.000	5.000	1.349	9.266	2.192	7.529
JS2	1.000	5.000	1.852	12.719	4.585	15.745
JS1	1.000	5.000	1.740	11.947	3.998	13.730
Multivariate					102.858	32.243

c.r. = critical ratio

Table F3 Output Assessment of Normality for Safety Motivation CFA Model

Assessment of normality (Group number 1)

Variable	min	max	skew	c.r.	kurtosis	c.r.
SM6	3.000	5.000	-2.996	-20.575	8.748	30.041
SM5	2.000	5.000	-2.843	-19.526	9.857	33.849
SM3	3.000	5.000	-2.444	-16.782	5.338	18.329
SM2	2.000	5.000	-3.144	-21.592	11.349	38.972
SM1	2.000	5.000	-2.326	-15.975	6.093	20.922
Multivariate					121.499	122.148

c.r. = critical ratio

Table F4 Output Assessment of Normality for Safety Performance CFA Model

Assessment of normality (Group number 1)

Variable	min	max	skew	c.r.	kurtosis	c.r.
SRU5	1.000	5.000	-1.135	-7.792	1.209	4.150
SRU4	1.000	5.000	-.975	-6.696	.748	2.569
SRU3	1.000	5.000	-1.128	-7.748	.699	2.401
ME7	1.000	3.000	2.271	15.599	4.383	15.052
ME6	1.000	4.000	3.131	21.501	10.884	37.373
ME5	1.000	4.000	1.770	12.153	2.623	9.007
ME4	1.000	5.000	1.416	9.723	1.576	5.412
ME3	1.000	5.000	.730	5.011	.128	.440
ME1	1.000	5.000	.762	5.235	-.267	-.917
Vio10	1.000	5.000	2.719	18.671	8.104	27.830
Vio9	1.000	5.000	2.879	19.771	9.101	31.253
Vio8	1.000	5.000	2.079	14.277	4.495	15.435
Vio7	1.000	5.000	1.356	9.313	1.024	3.518
Vio6	1.000	5.000	2.396	16.457	5.075	17.429
Vio5	1.000	5.000	2.563	17.604	6.549	22.487
Vio4	1.000	5.000	2.176	14.947	4.051	13.911
Vio3	1.000	5.000	1.196	8.214	.338	1.160
Vio2	1.000	5.000	1.338	9.192	1.027	3.527
Multivariate					232.704	72.946

c.r. = critical ratio

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