Measuring the relationship between Individual and Cultural Traits (ICT) and safety perceptions in manufacturing: Development of a Conceptual Model

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The undersigned, appointed by the dean of the Graduate School, have examined the thesis entitled

MEASURING THE RELATIONSHIP BETWEEN INDIVIDUAL AND CULTURAL TRAITS (ICT) AND SAFETY PERCEPTIONS IN MANUFACTURING: DEVELOPMENT OF A CONCEPTUAL MODEL

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ABSTRACT

Employee safety has always been one of the most important priorities in 'high-risk' industries such as manufacturing. Recent investigations into some of the major industrial accidents have redirected the focus of safety researchers from 'safer technology' to 'human and organizational factors'. Concepts such as safety culture (having a better underlying culture for safety) and safety climate (perceptions of the organization's employees with regards to its safety conditions) have recently received a lot of attention.

Modern organizations are spread across the globe and are comprised of a highly multicultural workforce. Most manufacturing requirements in developed nations are either outsourced or are met through an extension of the organization in economically developing countries with cheaper labor and nearly nonexistent safety regulations (Ali, 2006). While this situation opens up 'cultural challenges' for organization management committed towards maintaining the same underlying safety culture throughout their organization, the exclusion of individual level factors associated with accident rates have seldom been included in a safety culture model.

This study takes the individual level approach in determining a better model for safety culture. It identifies various factors (cultural and non cultural) at the individual level under Individual and Cultural Traits (ICT). A total of 93 manufacturing employees from India and the United States were surveyed online as part of a pilot study. The resulting regression equation shows similarities to previously established factors that are associated with occupational injury rates. Future work using a larger stratified and controlled sample with better variance would provide a better model.

CHAPTER 1 - INTRODUCTION

1.1 Industrial Safety:

Safety is important in every workplace irrespective of the amount of risk involved. Having a safe work place atmosphere is just as important to the management as it is to the employees (Reese, 2008). From the employees' point of view, an occupational injury would mean a burden both socially and financially, and to the management it would mean- a decrease in efficiency and productivity. This accounts for a growing emphasis on industrial safety alongside industrial development. Despite growing stress on the importance of safety, an estimated 2.34 million people lost their lives globally in workplace related injuries and diseases in the year 2008 (ILO, 2011). Figure 1 shows the division of these numbers worldwide. The United States, a developed nation with some of the world's most advanced safety equipment and safety regulations, reported a total of 5,214 fatalities from work related incidents and diseases in the same year (BLS, 2009). These numbers demonstrate that safety cannot be achieved by just improving equipment or technology. There is a need to explore other factors that might influence occupational safety all over the world (Reese, 2008; O'Toole, 2002).

Manufacturing is particular is one of the highest risk industries based on the number of injuries and fatalities reported in insurance and government records between 2005 and 2008 (ILO, 2011). Especially in developing countries these numbers have always been higher when compared to their developed counterparts. The relatively high numbers in developing countries are due to a number of reasons

including lack of regulations, low automation, improper training, and lack of required education (Morehouse, 1986a).

			Occupational injuries reported to ILO		Occupational injuries causing at least 4 days absence			
Region	**Economically active population**	**Total employment**	**Fatal**	**at least 4 days absence**	**Fatal injuries**	**Lower limit (0.12)**	**Upper limit (0.08)**	**Average**
High income countries (global)	494 365 003	465 270 658	11 850	4 959 039	14 090	11 732 104	17 598 156	14 665 130
LMIC Africa Region	251 588 449	98 984 676	759	46 616	44 699	37 248 941	55 873 412	46 561 176
LMIC Americas Region	315 509 490	225 696 648	1 944	657 580	25 534	7 092 881	10 639 321	8 866 101
LMIC Eastern Mediterranean Region	152 610 995	123 065 822	0	0	17 912	14 926 339	22 389 509	18 657 924
LMIC European Region	213 740 690	188 216 100	6 777	325 004	16 191	14 474 533	21 711 800	18 093 167
LMIC South-East Asia and Western Pacific Regions	642 390 831	205 151 369	81	1 676	83 096	69 247 025	103 870 537	86 558 781
High income countries (global)	921 078 060	886 578 687	193	43 756	119 058	99 215 356	148 823 034	124 019 195
Total	**2 991 283 518**	**2 192 963 960**	**21 604**	**6 033 671**	**320 580**	**253 937 179**	**380 905 768**	**317 421 474**

Figure 1: Injuries (fatal and non fatal) caused by occupational accidents and work-related diseases around the world based on World Health Organization (WHO) regional groupings (International Labor Organization, 2011). (LMIC – Low and Middle Income Countries).

1.1.1 Overview of the manufacturing industry:

The United States is the world's largest manufacturing economy, employing nearly 12 million Americans in the production of $1.6 trillion in manufactured products which accounts for 18 percent of the world's manufactured goods (US department of commerce, 2010). The Manufacturing industry covers organizations engaged in the mechanical, physical, or chemical transformation of materials, substances, or components into new products. The assembling of component parts of manufactured products is considered manufacturing, except construction (United States census bureau, 2010). This covers a variety of sub industries including: aerospace products and parts, chemicals, computer and electronic products, food, machinery, motor vehicles and parts, pharmaceutical and medicine, printing, steel, textile, textile products and apparel (BLS, 2012a). Some of these sub-industries have higher levels of occupational hazards than the others based on the type of end products they manufacture.

All the employees of a manufacturing plant can be considered as manufacturing workers. But the term generally refers to the shop level employees who are involved in the actual handling of the machinery or who are truly responsible for the final products. They are classified based on the tasks they perform. The general terminology in use to sort these employees is helpers/production workers, inspectors, testers, sorters, weighers, machinists, purchase agents (except wholesale) and team assemblers. A high school diploma or equivalent is sufficient to start working as a manufacturing worker in the United States (BLS, 2012a) but there is no such requirement in developing countries (Tybout, 2000). Daily operations in a manufacturing facility involved in production include working with power driven

machinery or material handling equipment (BLS, 2012a). Specialized positions require training but most of it is provided on the job (BLS, 2012a).

1.1.2 Safety in the manufacturing industry:

According to the 2009 Survey of Occupational Injuries and Illnesses by the Bureau of Labor Statistics, 4.3 out of every 100 employees suffer a work related injury in the manufacturing sector annually (BLS, 2009). The National Safety Council (NSC) still considers accidents and their consequences to be a major cause of concern in this area (Reese, 2008). Manufacturing, along with other industries in the United States, is regulated for safety risks by the Occupational Safety and Health Administration (OSHA). Failure to comply with OSHA guidelines may result in fines and penalties. The establishment of OSHA in 1971 decreased the number of work place incidents in the United States (OSHA, 2006). Similar regulatory bodies such as the Health and Safety Executive (HSE) in the United Kingdom play an important role in reducing the number of incidents at workplaces by maintaining strict guidelines. However there is still a need for such regulatory organizations in most other countries (Mohamed et. al., 2009).

Globalization has turned manufacturing into a truly multinational enterprise. Most industries in developed nations are either extending or outsourcing their operations in the area of manufacturing to developing nations in the search of cheaper labor. Yet most developing nations lack safety regulations and have consistently had higher number of occupational accidents (International Labor Organization, 2011). This places a heavy burden on management of an organization that aims at lowering the number of unsafe incidents. The safety culture model in existence at facilities in

developed countries may not fit the new location or the new employees (Mearns & Yule, 2009).

In order to comply with regulations set by regulatory authorities and improve safety, a majority of manufacturing organizations in developed nations have focused on reducing injuries through improvements in engineering controls and attending to physical conditions of the work environment (O' Toole, 2002). The absence of similar regulatory bodies in low income countries helps management view safety only as an option (Tybout, 2000). Thus, there are differences in occupational safety perspectives between developed and developing nations.

Further, reports on some of the major industrial accidents have shifted the focus of safety researchers in this area away from solely engineering controls or the physical work environment to considering other factors related to human perceptions and safety behavior. For example, a report on the Bhopal gas tragedy of 1984 identifies negligence, bypassing safety standards, insufficient safety training, and lack of awareness regarding safety principles to be some of the major reasons behind the disaster (Morehouse, 1986a)(Morehouse, 1986a). This example highlights the importance of understanding the employees' point of view towards safety conditions in their organizations. Organizations looking to improve their safety situation are showing more interest in safety management systems, which incorporate employees' perspectives. Developing a safety culture model that can be easily implemented throughout an organization worldwide would help increase safety climate (perceptions of employees towards safety conditions of their organization) and reduce the number of incidents.

Previous researchers in the area of occupational safety have primarily focused on improving the safety perceptions of employees of an organization that would in

turn have a positive impact on accident reduction (Cooper & Phillips, 2004; Isla Díaz & Díaz Cabrera, 1997; Zohar, 1980, 2000). However, the reasons behind differences seen in employee perceptions of safety have not been included. Only group level factors were included in models and individual factors have not been considered.

There have been attempts to see if an individual's culture plays a role in shaping their safety perceptions. However, the culture considered here has only been at the national level (Mohamed, Ali and Tam, 2009; Mearns and Yule, 2009). Considering geographical boundaries and defining culture at the country level has seen a lot of opposition in the wake of growing globalization (Straub et. al., 2002). As today's workforces are highly multicultural, considering all employees to be a part of a national culture that they may or may not represent does not seem to be useful (Straub, Loch, Evaristo, Karahanna, & Srite, 2002). Immigrants who move from one country to another in search of work often form a major part of any nation's work force while maintaining their original cultural values (Myers & Tan, 2002).

An effective safety culture model, which takes into consideration the entire workforce making space for every classification (regional factors, immigrants, individual level variations such as age, experience, gender role, etc.), is nowhere to be seen in the literature. A way to take into account each employee's perceptions with regards to the safety conditions of his/her organization is also absent.

1.2 Problem Statement:

Globalization has a high impact on today's manufacturing sector. In industries, which involve such high risk, safety should be considered a high priority (Artis, 2007). Employees with a positive attitude towards safety are less likely to be involved in work place related accidents in manufacturing (Clarke and Cooper, 2004;

Zohar, 2000, 2004). Previous researchers have concentrated on factors such as management's concern for employees' safety, level of risk involved, safety training, and safety management systems that have an effect on safety perceptions of employees (Lee, 1998; Williams, Dobson, & Walters, 1989; Zohar, 1980). However, an explanation as to why there are variations in perceptions of safety amongst employees in the same workplace has not been provided. Moreover, any corrective measures to improve the safety perceptions of employees are also missing. One of the most common factors in previous safety climate research has been the role of organizational culture, especially management's concern for its employees' safety (F.W. Guldenmund, 2000). However, most of these evaluations of factors related to safety climate have been confined to developed nations.

1.3 Purpose:

Having a proper culture for safety has been seen as a means of reducing the number of accidents in high-risk sectors such as manufacturing (Cooper, 2000). The existing models of safety culture have failed to incorporate the needs of a constantly growing multicultural workforce. This also rules out the possibility of these models being of any help to multinational manufacturing companies that are expanding into other nations. Additionally, these models have not accounted for individual differences in safety perception within a single organization. Therefore, the main objectives of this research were to: 1) Measure cultural and individual traits at an individual level (Individual and Cultural Traits) by proposing a model utilizing the concept of Social Identity Theory (SIT) and, 2) Measure the relationship between Individual and Cultural Traits (ICT) of an employee and the perception of that

employee towards safety conditions in his/her organization, in order to modify an existing safety culture model into an ICT based model.

For the purposes of this study, the term "Social Identity" refers to the individual's sense of belonging to a particular group (or groups) of which he/she is a member and exhibiting traits that are common to members of that group (Tajfel, 1982). This becomes a means of categorizing everyone into either in-group (belonging to the same group) or out-group (belonging to a different group) with regards to showing traits of the group. Individual and Cultural Traits (ICT) refers to the various traits exhibited by an individual by being a part of a variety of such groups. For example, in previous research, employees who are older than 51 can be classified as an age group ICT; this group generally tends to follow most safety policies and as a result the chances of them being involved in an accident is very low (Gyekye and Salminen, 2009). For this study, Individual and Cultural Traits (ICTs) were used as a means to identify different layers of culture in an individual. Each of the layers that have been used to form the ICT model (e.g., age, education, personality, etc) has previously been linked to occupational safety.

1.4 Research questions and Hypotheses:

The research model (Figure 2) was created reflecting the hypotheses that as organizational culture plays an important role in affecting safety perceptions of employees (Clarke, 2003; Janssens, Brett, & Smith, 1995), and organizational culture is influenced by national culture (G. H. Hofstede, 2001). National culture has been shown to be related to be related to individual level cultural factors such as personality culture (G. Hofstede & McCrae, 2004), race/ethnicity, language (Boas, 1940), and religion (Foucault & Carrette, 1999). Individual level factors which have

been previously associated with industrial safety such as age (Bureau of Labor Statistics (BLS), 2009) and experience (Keyserling, 1983) have also been represented as a part of ICT as they are measurable across nations. The model consists of three main factors: Organizational culture, Employees' safety perceptions (safety climate) and ICT.

For the purpose of this study, the various traits gained by an individual by being part of various cultures and sub cultures and traits gained by being part of groups, will be referred to as 'Individual and Cultural Traits' (ICT).

This model is designed to answer the following research questions:

1. How can Individual level traits (both cultural and non cultural) be represented/defined in a conceptual model to relate to safety in manufacturing?
2. Do the Individual and Cultural Traits (ICT) of employees predict their attitudes towards safety in their organization?

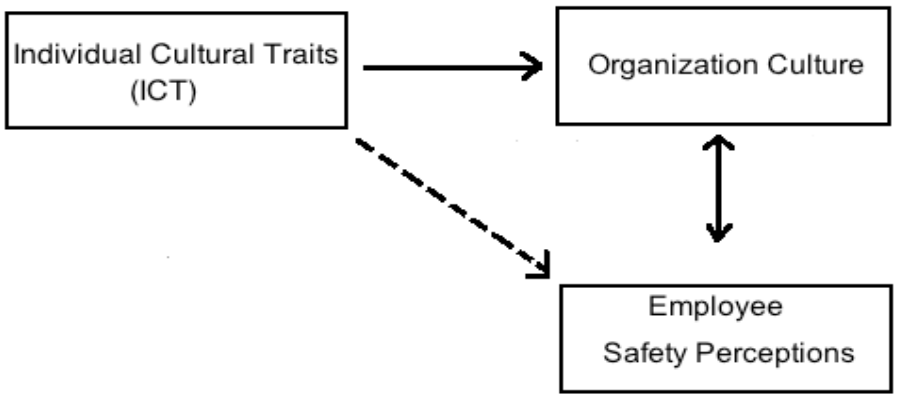

Figure 2: Research model: ICTs are known to effect organizational culture. Safety climate or employee's safety perceptions are also known to have an effect on organizational culture. These previously established relationships are shown as solid

arrows in the model. The goal of this research is to evaluate the relationships between ICT and employee safety perceptions; a dotted arrow in the model indicates this.

To answer research question one, a theory-based model that takes into account several individual level factors (cultural and demographic) is proposed. This model is based on Social Identity Theory and though loosely discussed by Straub et al., (2002) in relation to Information systems, has never been actually conceptualized or measured. The factors used in the model vary with the situation being looked at. Hence, as this situation is related to industrial safety only those values, which have previously exhibited a relation with safety, were used. To the best of our knowledge be the first time such an attempt at measuring culture utilizing this theory is being made. Compared to previous researches where only one or two of these traits have been examined with respect to safety, this method proposes a safety culture model that will include ICT and can be actually measured.

The following hypotheses were tested utilizing a pilot study in order to answer research question two.

1. Workers who are high on an individuality scale will report lower safety climate scores when compared to the ones higher on the collectivism scale. This is hypothesized because workers who are high on the individualism scale prefer working alone and are firm on deadlines (Hofstede, 1980). This tendency might result in unsafe behavior.
2. Workers who are high on the masculinity scale will report lower safety climate scores as compared to the ones who are high on the feminity scale. Employees who are high on the masculinity scale consider advancement in their position more important and are prepared to work in high-risk conditions

in order to prove their 'masculinity' (Hofstede, 1980). Since level of risk in the workplace is considered to be a factor affecting safety climate (Zohar, 1980), these employees are more likely to be involved in an unsafe incident.

3. Other ICTs being measured as part of the study will have significant associations with safety climate scores as these have previously been known to effect industrial accident rates (BLS, 2009). While an increase in age and income of employees tend tends to make them more careless and hence are expected to show a decrease in safety perception value, an increase in experience and education are expected to have a positive impact on the same. Based on political view and language, if the language being used at work is not the language spoken by the employee at home, it might result in unsafe incidents, religion and race/ethnicity was chosen as it can be possible that the improper tolerance for religious beliefs of other employees might cause accidents and hence are also believed to be associated with employees' views on safety at their organization (Rao, 2012).

1.5 Research Justification:

Cultural Ergonomics, a relatively new area under human factors has been chosen to be the background of this study because this research deals with proposing a multicultural model for safety culture. However, instead of the general national culture based approach, which is fairly common in this area, a newer approach of concentrating on culture at the individual level is used. The amount of criticism that the national culture theory has received (Myers and Tan, 2002; Straub et. al.,) and the importance of each single individual when it comes to organizational safety were reasons behind this choice.

Social identification theory was used to specifically model the ICT concept, as it would allow for the flexibility of adding more nation specific cultural groups where and when required. This is possible from the understanding of the theory which suggests that people belonging to a particular group identify themselves to be a part of it and different from others who do not belong to it (Tajfel, 1982). Hence adding local and regional groups which are only active in a particular nation would be easier. The factors included in this model (age, experience, personality, language, income, religion, educational background, race and political orientation) are some of the more common groups people associate themselves with all around the world. With nearly 798 fatal injuries suffered by foreign-born employees in the United States in 2010 alone (BLS, 20112b), the importance of giving more importance to individual culture when it comes to safety models becomes highly important.

Another important reason behind the requirement of a safety culture model that can be used on a diverse population is the growing importance of culturally diverse nations such as India in the high-risk field of manufacturing. With the lack of a proper safety governing body and weak safety rules at the organization level (Mohamed, 2009) the implementation of such a model may be useful in bringing down the industrial fatality rate in such countries. Moreover, small-scale industries, which form the backbone of the manufacturing sector, would also be able to gain from this model.

1.6 Document Overview:

The remaining thesis contains a literature review (Chapter 2), methodology (Chapter 3), results and discussion (Chapter 4).

Chapter 2 will be a review of literature covering all the relevant information needed for this study. The main objective of this section is to provide a foundation and review of existing work, which will help understand the links between various terms used in this study.

Chapter 3 explains the methods used in creating a model of the final survey to be used in the study. Three previously established surveys are used in this study. This section helps in understanding the reasons behind selecting these particular survey instruments and the necessary changes made in order to better fit the study population.

The next chapter (4) will consist of the results followed by a discussion that will also consist of limitations of the current study, recommendations for future work and the study's contribution.

CHAPTER 2 - LITERATURE REVIEW

2.1 Overview:

This review of literature contains topics relevant to the study and helps in providing the necessary links needed to support the hypotheses. First, a review of organizational culture is presented. The concepts of safety culture and safety climate highlighting the differences between the two are presented. This is followed by an explanation of Cooper's model that forms the base for this study. Second, cultural ergonomics is presented with an emphasis on its relation to the area of industrial safety. This is followed by social identity theory and its role as a means of measuring culture at the individual level is discussed. Finally, the use of Individual Culture Traits (ICT) to modify Cooper's safety culture model resulting in a multicultural model of safety is provided.

2.2 Organizational culture:

Organizational culture can be defined as an "umbrella" concept that gives a helicopter view of one's organization (F.W. Guldenmund, 2000). Before going further into understanding the various levels of organizational culture, it is necessary to acknowledge the term organizational climate and its relationship with organizational culture. Even though both these concepts were successively developed and in fact the term 'climate' was replaced by the term 'culture' in research gradually (F.W. Guldenmund, 2000), there are a few notable differences between the two. While organizational culture refers to the beliefs and values of people, work, organization and the community common to most people in the organization, organizational climate refers to the common behavioral traits and expression of feelings by the organization's members (Ekvall, 1996). Some researchers also believe that

organizational culture gives a broader and deeper meaning to organizational climate (Schein, 1990)

According to Schein (1990) there are three different levels at which culture is visible in a group:

Observable Artifacts: This level refers to the 'look and feel' of the organization. The physical layout, the ways in which employees of the organization interact with one another, the way in which they dress and the ways in which they express themselves and react to one another. These are facts that are visible as soon as one enters the organization.

Values: Interviews and questionnaires are the general methods used to identify values. They help in understanding why the members of the organization think the way they do. These are the visible values, ideologies and philosophies amongst he employees of the organization.

Basic underlying assumptions: This refers to the basic, underlying, subconscious assumptions of the organization. The only way they can be brought out is by conducting more intensive observation using more focused questions. These actually start as values but as time goes by they get taken for granted and finally forgotten.

Even though organization culture, or corporate culture, reflects the common attitudes, values and beliefs of an organization, it is not necessarily true that all members react similarly to a given situation (Williams et, al., 1989). Further, though the overall observable artifacts or 'cultural theme' in an organization may be somewhat similar, the values may vary from division to division, workgroup to workgroup and from individual to individual. Each section or department may have different priorities amongst safety and production (Williams, Dobson, & Walters,

1989). This phenomenon results in the formation of 'subgroups' within the main group. Some believe that having 'subgroups' within the same organization is actually a blessing in disguise as it helps improve performance by competition (Pidgeon, 1998). For example, two teams working on the same project would compete in order to prove that their team is better than the other. In doing so they might either increase their work pace in order to succeed or bypass safety processes n order to win and hence resulting in an unsafe environment.

2.3 Safety Culture:

Safety culture as a term was first seen in the report on the 1986 Chernobyl disaster by the 1987 OECD Nuclear Agency (INSAG, 1988). Since then it has been discussed widely in the light of industrial accidents of higher and lower magnitude (Cox & Flin, 1998; Pidgeon, 1998). The importance of this term has grown ever since as the most important priority in organizations that hold safety as their main priority (Cullen, 1990).

The descriptive and multi-utility nature of the concept of safety culture prevents it from being defined in a specific way (Cox and Cheyne, 2000). Guldenmund (2000) in his extensive and exhaustive summary of various studies conducted in the areas of safety culture and safety climate provides a list of definitions. He notes that even though most of these definitions related to safety culture suggest a similar understanding of the term, a majority of the researchers only define the term in order to better fit their methods of exploration of it. Cooper (2000) on the other hand suggests the definition adapted by the UK Health and Safety Commission (Health and Safety Commission, 1993), which reflects both the "interpretative" and "functionalist" views as the most appropriate. An 'interpretative'

view refers to letting the definition slowly emerge from experiences in the 'field', whereas a 'functional' view is more of a practical approach where the meaning is adapted to a particular function, which here refers to organizational safety. For the purpose of this research the definition being used here is a mixture of both the views. The HSC defines safety culture as a product of individual and group values, attitudes, and patterns of behavior, which result in a commitment towards the organization's safety policy.

2.3.1 Models of safety culture:

Various models depicting what an organization should follow in order to achieve positive safety culture are present throughout literature (Clarke, 2003; Cox & Cheyne, 2000; Fernández-Muñiz, Montes-Peón, & Vázquez-Ordás, 2007; Lee, 1998). Some claim accident reduction to be a means to prove that the safety culture of that organization is performing well (Clarke, 2003). Self-assessment and getting a regulator from an external agency to perform a safety culture assessment are other ways to understand where the organization stands on safety. In fact having a proper model for safety culture in place has been shown to effectively reduce the number of incidents that would otherwise occur in an organization (F.W. Guldenmund, 2000). However, there could be a variety of confounding factors associated with a reduction in the number of incidents, and we may not be able to determine the directionality of the relationship between safety culture models in an organization and the accident rate, thus accident reduction cannot be used as a certain indicator of strong safety culture (Cooper, 2000).

In addition to measures of safety culture effectiveness, a number of models identifying contributing factors to safety culture, have been presented in the literature

with the aim of attaining a single model that can be used worldwide. However, none of the existing models have been able to achieve that as of yet (Frank W Guldenmund, 2010).

Most the available safety culture models are based on Schein's (1990) three-layered model for culture visibility in a group (see Section 2.2) (Cooper, 2000). Guldenmund (1998) and Furnham and Gunter (1993) both based their conceptual models on Schein's model. However, both of their models are conceptual and have never been practically implemented. Berends (1995), proposed a model similar to the previous models but he assumes climate to be a replacement of culture. While these models were complex and lacked any clear information on the main factors used in defining safety culture, they were able to establish the importance of the concept. The model developed by Johnson (1985) is the only one containing any reference to cultural traits. He used both Schein's (1990) model and Hofstede's (1990) dimensions in creating a cultural tool. However, the inability of Johnson's model to measure and account for differences between employees' cultures within the organization makes its usage limited.

Based on a review of these existing models, it is clear that none of the models have been able to clearly define safety culture. They have not been able to bring out a proper relation between safety climate and safety culture. Some even assumed that both meant the same (Berends, 1995). Finally none of the models could be implemented or used at more than one organizational level (e.g. shop floor level).

2.3.2 Cooper's model of safety culture:

For this study, Cooper's model was used as a model of safety culture, but based on the results of this work it was modified to fit a more culturally diverse background in different countries.

In contrast to the other safety culture models, Cooper's (2000) model can be used to obtain a measurement of safety culture at many different levels in an organization. This model uses a reciprocal view of safety culture, which takes accident-causing factors into consideration and then aims to prevent them from happening. This idea builds on other established accident causation models that also identify the reciprocal relationship between psychological, situational and behavioral factors (Heinrich et. al., 1980; Reason, 1993)The concept of reciprocal determinism (Bandura, 1986) states that people are neither controlled by their environments completely nor are completely self-determinant, but in reality they influence each other (G.F., Davies & Powell, 1992). Figure 3 shows Bandura's reciprocal model.

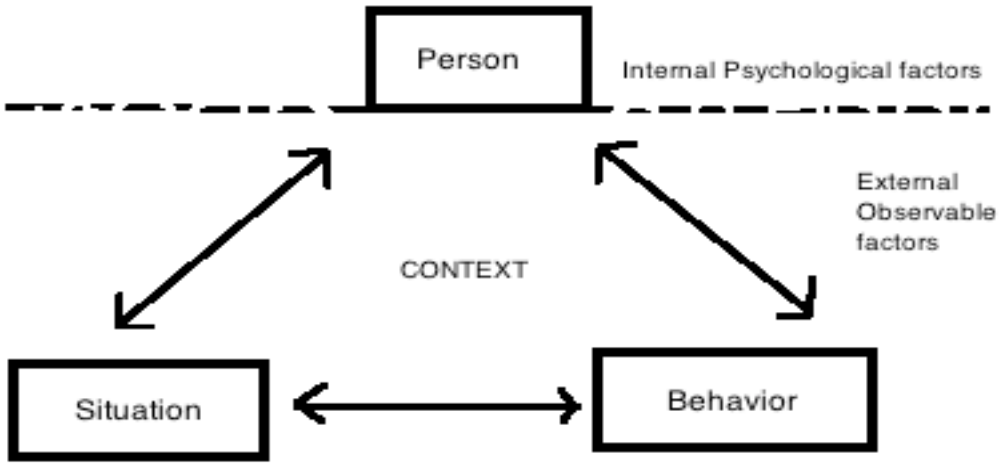

Figure **3:** Bandura's (1986) model of reciprocal determinism

Cooper's safety culture model (2000) can be divided into two major segments (Figure 4), which can be further classified in a total of three major elements. Each of these elements can be measured individually making it easier to reach a measurement of safety culture unlike other models. The segments are as follows:

2.3.2.1 Internal psychological factors:

Person (Safety Climate):

This section deals with the subjective factors at the person level. Here they refer to attitudes and perceptions that are present 'inside' the employee. Safety climate or safety perceptions of employees' fall under this section. These can be measured by using a safety perceptions/safety climate survey.

2.3.2.2 External observable factors:

This section contains two subsections, which represent the factors outside the employee. They are those factors responsible for affecting safety but are not related to the employee directly. They can be broken down further as:

Situation (Safety Management System):

This relates to the ongoing safety measures of the organization. It includes inspections, safety regulations in place and similar methods implemented by management in order to maintain a check on the safety of the organization. An objective safety audit, which is generally conducted in organizations periodically, can be used to measure this area.

Behavior (Safety behavior):

This section is for on going safety behaviors that can be observed. It can be measured by using checklists from time to time.

This model of safety culture provides a means to integrate all the different processes that are related to organizational safety. This model also helps in comparing safety numbers between different branches and departments within the same organization, as it is easy to quantify.

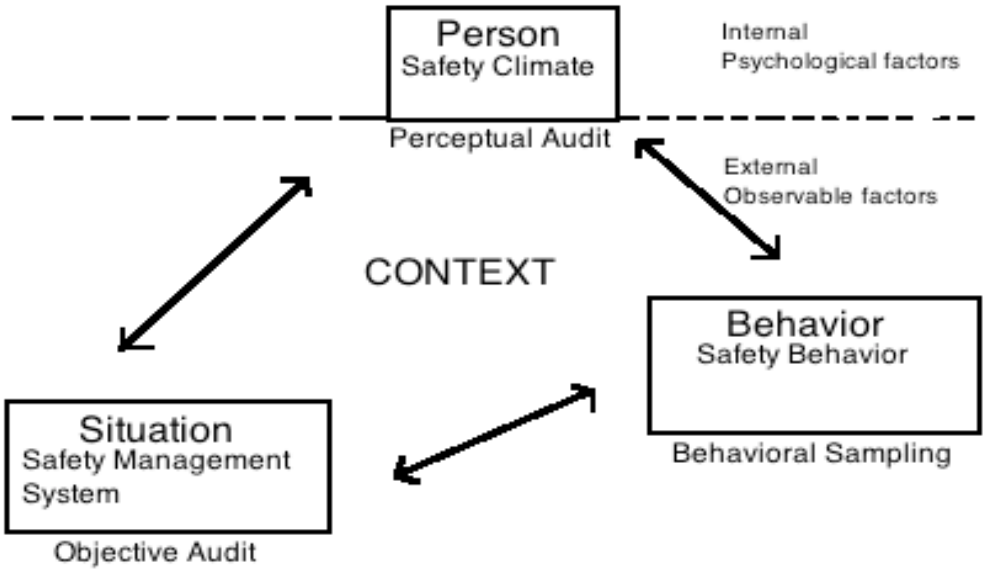

Figure 4: Cooper's (2000) safety culture model. The three main components are person (safety climate, situation (safety management system) and behavior (safety behavior). All three can be measured easily on their own making it easy to quantify safety culture.

2.4 Safety climate:

Safety climate as a term first appeared slightly before the term safety culture. The first paper on safety climate was a study by Keenan et al. (1951), which looked into the self-reported ratings of members of an automobile plant (as cited in Guldenmund, 2000). Zohar (1980) is credited with making the term more popular. He studied 20 organizations in Israel using a 40-item scale in order to understand the

concept of safety climate. Similar approaches towards defining safety climate were made by various researchers in their respective fields. A list of these researchers and the populations they studied has been produced in Table 2.1 (Guldenmund, 2000) below.

In terms of identifying a standard definition for safety climate, literature in the field of safety has never been clear on the definition of safety climate. Hence the best way to give a general description of the concept would be using the commonalities in the definitions available in literature so far. After a review of various definitions as stated in Table 2.1, for the purpose of this research, safety climate has been defined as the set of common perceptions that the employees of an organization share with regards to the safety condition of that particular organization.

Table 1: Definitions of safety climate and overview of surveyed population (Adapted with permission from F. W. Guldenmund (2000). Safety Science 34, 215-257.)

Reference	**Population**	**Definition**
Zohar (1980)	20 Israeli industrial organizations (steel, food processing, chemical and textile industry); 400 respondents	A summary of molar perceptions that employees share about their work environments.
Glennon (1982a, b)	Line managers from eight Australian companies (bauxite, mining, sawmilling and logging, metal forming, petroleum refining, cement manufacture and general engineering and manufacturing); 198 respondents	Employees perceptions of the many characteristics of their organization that have a direct impact upon their behavior to reduce or eliminate danger; A special kind of organizational climate
Brown and Holmes (1986)	10 American manufacturing and produce companies; 425	A set of perceptions or beliefs held by an individual and/or group

	respondents	about a particular entity
DeDobbeleer and Beland (1991)	9 construction sites; 272 respondents	Molar perceptions people have of their work settings
Cooper and Phillips (1994)	Personnel of a packaging production plant; 374 (pre) and 187 (post) respondents	Safety climate is concerned with the shared perceptions and beliefs that workers hold regarding safety in their work place
Niskanen (1994)	Workers and management in maintenance, construction and central repair shops; 1890 (workers) and 562 (supervisors) respondents	Safety climate refers to 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
Coyle et al. (1995)	Workforce of two organizations "involved in the provision of health care and social services to the elderly" (incl. office, nursing and social work duties); a total of 434 respondents	The objective measurement of attitudes and perceptions toward occupational health and safety issues
Cabrera et al. (1997)	Employees of several companies at three European airports (ground handling divisions from four airlines, one fuel company, two airport authorities); totaling 389 respondents	The shared perceptions of organizational members about their work environment and, more precisely, about their organizational safety policies
Williamson et al. (1989)	7 workplaces, covering heavy and light industry and outdoor workers, totaling 660 respondents	Safety climate is a summary concept describing the safety ethic in an organization or workplace which is referred in employees' beliefs about safety

2.4.1 Safety culture vs. Safety climate:

Zhang et al. (2002) compared the differences between safety culture and safety climate to that of the differences between psychological traits and states as discussed

by Spielberger, 1966. They state that safety culture is similar to 'traits' or 'enduring characteristics' (such as introversion or extroversion) and safety climate to 'states' or 'circumstantial factors' (such as anxiety or anger) that elicit psychological reactions. Thus, safety climate refers to a temporary state and can change with changes in the organization's operational or economic circumstances. Whereas safety culture is more of a consistent way in which the organization reflects on safety issues. Guldenmund (2000) makes similar claims. He suggests that 'perceptions' are more associated with climate whereas 'attitudes' are associated with culture.

2.4.2 Measuring safety climate:

In most organizations whenever an accident occurs, employees claim to have had an idea that it would occur along with the reasons for it (Ryan, 2009). This shows the importance of taking into consideration the views of the employees, with regards to their organization's safety issues.

The idea of using a survey tool to measure the perceptions of employees for safety was originally proposed by Zohar (1980). He developed an approach with strong content validity by using factors from safety literature from organizations with poor safety records (Mueller et al., 1999). The initial eight factors originally measured by Zohar included: perceived importance of safety training programs; perceived management attitude towards safety; perceived effects of safe conduct on promotion, perceived level of risk at the workplace; perceived effects of required work pace on safety; perceived status of safety officer; perceived effects of safe conduct on social status; and perceived status of safety committee. Though a number of models were developed to measure safety climate following Zohar (1980), most of them either replicated his model or used a modification of his version (R. L. Brown & Holmes,

1986; Coyle, Sleeman, & Adams, 1995; Lee, 1998). For this study Zohar's (1980) model was used to measure safety climate. However, a modified version of his survey by Mueller, DaSilva, Townsend, & Tetrick, (1999) which has been adapted to fit the manufacturing sector in particular has been used here. The modifications made are shown in Appendix 2. The four factors are as follows:

Rewards for working safely:

OSHA (Occupational Safety and Health Administration) in the United States (U.S.) often recognizes employers for their outstanding safety policies. Most organizations implement incentive programs in house to encourage employees to behave safely. A study conducted by McAfee & Winn, (1989), showed that most of these safety incentive programs are usually successful. Similar programs are absent in small-scale industries worldwide and thus this work aims to evaluate the potential relationships between of culture and these programs.

Effect of safe behavior on social status:

This is another important factor in assessing the safety climate of an organization. Zohar, (1980) suggests in his study that safety officers who worked in a safer organization had a higher position than their counterparts in less safe organizations. In some organizations in developing nations, safe behavior, which delays the production process, is not seen as necessary (Tybout, 2000).

Effect of required work pace on safety:

Work pace is the most important factor in some industries. Many studies have found relationships between safety perceptions and pace of work at their workplaces to be important (Dedobbeleer & Béland, 1991; Ryan, 2009; Zohar, 2000). Giving more importance to completion of work than safety can prove harmful to the employees both physically and mentally. Understanding this factor and its

relationship with various cultural factors may improve understanding of whether work pace causes similar effects across organizations worldwide.

Management's attitude towards safety:

Management's commitment to safety has been seen shown to affect the perceptions of employees in a number of studies (Zohar, 2002). For organizations showing higher safety standards, the management is seen to be more involved in the safety processes itself (Cohen, 1977). A review conducted by (Flin et. al., 2000) showed 72% of the 18 studies conducted on safety climate have suggested management to be an important factor. Moreover, since this research has a cultural component and management styles are known to change with culture (Janssens et al., 1995) this an important factor for the proposed research.

2.5 Cultural ergonomics:

Simply put, culture is a set of perceptions, thoughts, feelings and behaviors that a group develops in common as they solve problems together over a period of time (Cooper, 2000). Cultural ergonomics is a relatively new area of research and theory that addresses the influence of culture on ergonomics. As a sub division of human factors, it has become mostly important in understanding the various associations that different cultural viewpoints have on fields of management (Janssens et al., 1995), language and communication (Mearns et al., 1998) and training (Kaplan, 2004) in a workplace setting. It has become an increasingly important area of interest with growing globalization.

2.5.1 Measuring culture:

Given the complex nature of culture there have been various means of measuring it in literature. In general culture refers to national culture unless specified

otherwise. Short summaries of each of the various national culture classifications so far available in literature are presented below.

Geert Hofstede: Hofstede's theory of cultural dimensions is perhaps the most popular amongst the classifications. He used data extracted from two rounds of surveys conducted at IBM between 1968 and 1972. The dimensions listed by him are: Individualism/collectivism, Power Distance, Masculinity/Femininity, Uncertainty Avoidance, and Long-Term/Short-Term.

Edward T. Hall: He proposed a model based on determining the right response rather than sending the right message. Hofstede (2001) classified this as a theoretical model. His factors include: Context - High/Low, Message – Fast/Slow, Time – Polychronic/Monochronic, Information flow.

As observed widely, the most common tool used by researchers performing cross-cultural research amongst the above mentioned is Hofstede's Value Survey Module (VSM) in order to measure the five cultural traits proposed by him. A number of researchers (Fiske, 2002a; Shulruf, Hattie, & Dixon, 2007) argue and he himself (G. H. Hofstede, 2001) states that this method fails in measuring culture at an individual level, rather it measures these cultural traits at a population level. Moreover, previous research trying to relate cultural values (national) and safety used the VSM but ended up with completely different results. While Mohamed et al., (2009) found a relationship between national culture and safety within the same nation, Mearns and Yule (2009) failed to establish the same using surveys based on the VSM between two nations.

2.5.2 Individual and Cultural Traits (ICT):

Hofstede, (1980) has helped establish national culture as a means of measuring culture, which has since been used in various areas of industrial research. It has even

spread to the area of occupational safety. It's relation to safety perceptions of employees of the same nation (Mohamed et. al., 2009) and between two nations (Mearns & Yule, 2009) have been looked into. However, national culture can only be measured at the national level which would means it is not effective when regional differences between the same nation need to be measured. Additionally, every employee is responsible for safety and can cause an accident if not properly practicing safety regulations. Also, with normally two people working on a single machine in developing countries and single person operating automated machinery in the developed nations (Tybout, 2000), the chance of an accident occurring generally depends on the individuals and even though safety is a group construct understanding it at the person level becomes important.

Considering the viewpoint of the Individual and Cultural Traits (ICT) becomes even more important. While some of these factors have been shown to directly influence accident rates (BLS, 2012b), others have been shown to influence indirectly (Artis, 2007). However, these factors have not been included in the models of safety culture so far. Based on the definition of culture, people sharing similar traits should be grouped as a culture. Hence some of these groups can be considered as cultural traits at an individual level.

One of the most important cultural traits being considered in this model is personality culture. Personality traits (Individualism/Collectivism and Masculinity/Femininity) that have previously been shown to be correlated with national culture dimensions proposed by Hofstede (Hofstede and McCrae, 2004) have been used here to reflect on a person scale to assess cultural dimensions.

Other factors, which can be considered as cultures by definition and show some relation to occupational accidents, can also be measured and included in a

model of Individual and Cultural Traits. For example, age forms an individual trait and has been linked to rates of fatal accidents in occupational settings (Figure 5). Employees aged 65 and above have an incidence rate three times higher than other age ranges. However, none of the existing models of safety culture have this type of individual cultural trait. By incorporating age as a cultural trait, special training sessions could better target the safety needs, behaviors, and perceptions of people in specific sub-cultural groups, for example older workers above age 65.

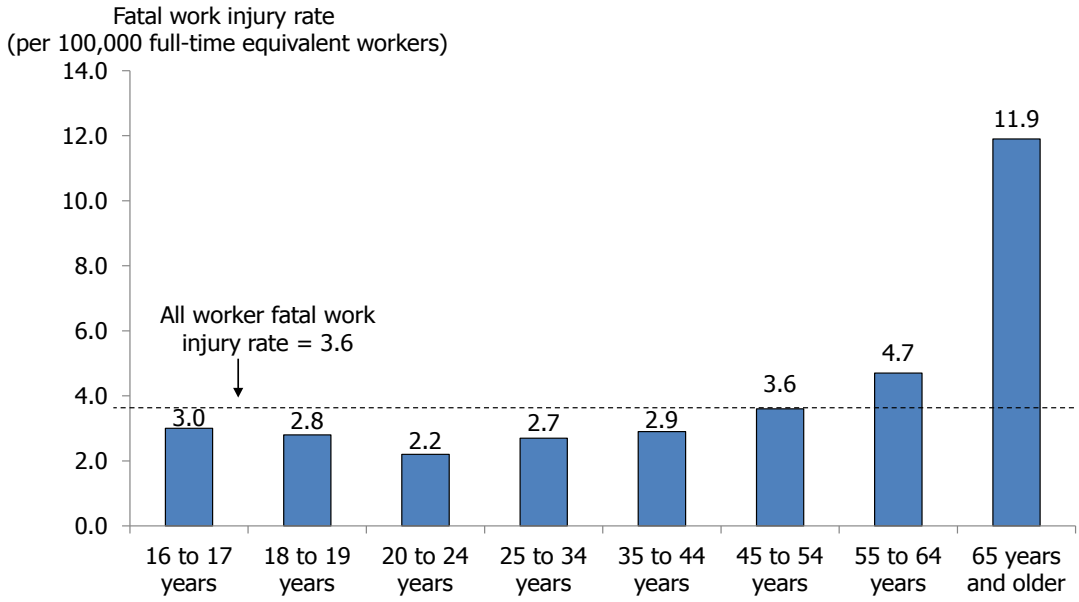

Figure 5: Injury rates of employees of the United States in 2010 by age group. Source: U.S. bureau of labor statistics, U.S., department of labor, 2012.

The manufacturing industry is one of the highest contributors to injuries and fatalities in the world (ILO, 2012). Thus, a safety culture model is needed which is simple to understand and able to be implemented in nations that lack safety regulations. Further, small-scale industries that form the major portion of manufacturing in developing countries need to be able to utilize any safety culture model that is developed. Another important factor that played a role in the selection

process is the ability to measure safety culture quantitatively. The model, which comes closest and actually has some room for the addition of cultural factors, is the reciprocal model of safety culture proposed by Cooper (2000).

In summary, to date there have been numerous studies that have proposed a model for safety culture (Ali, Abdullah, & Subramaniam, 2009; Cox & Cheyne, 2000; Lee, 1998) but none of them have looked into the possibility of adding a culture component in order to make it more widely applicable. Given the relationship between safety climate and safety culture, two studies have looked into the possibility of culture having an effect on safety climate. One of them was able to show that national culture is related to safety climate of a nation (Mohamed et. al., 2009) but not the other (Mearns & Yule, 2009). Both studies considered the same national culture and have managed to reach different conclusions. Moreover, important individual factors such as age (Mitchell, 1988) and race (Artis, 2007) that have been shown to have a significant impact on safety have not been included as part of existing models or survey studies. If a relation is established between ICT and safety perceptions of employees (safety climate), it could be used in a safety culture model. If the model becomes successful in helping understand the importance of including various ICT, it can help improve safety conditions in the manufacturing sector not just in the United States but also all over the world.

CHAPTER 3 – METHODOLOGY

3.1 Research Design:

The overall aim of the proposed thesis research is to measure the links between Individual and Cultural Traits (ICT) and safety perceptions of employees (safety climate) in the manufacturing industry. The proposed research will make contributions to the areas of ergonomics (occupational safety) and industrial engineering as well as manufacturing sector in particular. Establishing a relationship between ICT and safety perceptions of employees forms the basis for a long-term goal of proposing a general safety culture model.

3.2 Conceptual model:

Based on the literature reviewed in relation to both national culture and safety perceptions a conceptual model guiding this research is presented in Figure 2. This model builds on previous cultural research, which suggests that organizational culture forms a common factor in identifying a relationship between cultural values and safety perceptions of employees. Here the term 'cultural values' refers to Individual and Cultural Traits (ICT). Once the relationship is measured, this model will be used to propose an ICT-based safety culture model by modifying Cooper's model (Cooper, 2000). It will be used to relate ICT to safety climate (safety perceptions) at the person (safety climate) level in Cooper's (2000) model.

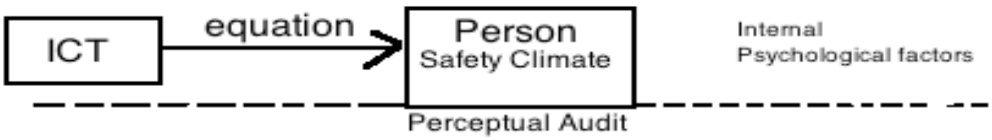

Figure 6: Model equation would be used to relate to ICT as shown at the person (safety climate) level.

3.3 Methods:

3.3.1 Approach

In order to identify relationships between ICT and safety perceptions, a pilot survey study will be conducted using a convenience sample of employees from manufacturing organizations in the United States (U.S.) and India (due to their differences in national culture values as measured by Hofstede's dimensions. For example, the mean Individualism score is reported as 48 for India and 91 for the U.S. (Hofstede, 2001)). This was done in order to show that ICT commonly are present irrespective of national culture. Surveys are considered as a good tool to use when measuring behavior, attitudes and beliefs (Weisberg, Krosnick, & Bowen, 1996). The usage of surveys is further justified, as the population to be examined is large. Moreover, the survey instruments used do not take much time to complete and hence will minimize the burden on participants and any interruption to the flow of work at their respective organizations.

The surveys were administered in the form of an online questionnaire using SurveyMonkey ("surveymonkey," 2012). This makes it easier to cover more than one organization and reduces the risk of management bias or influence, as the responses will be completely anonymous. There was consistent explanation the purpose of the study and details on how to complete the survey on the very first page of the online survey.

3.3.2 Measures

A total of three sections form the survey tool being discussed here. The first and second sections are comprised of previously published instruments (SCQ, PAQ and AICS), which were selected to ensure the measurement of safety climate and

personality culture (masculinity/femininity, individualism/collectivism). The third section consists of individual data (age, experience with the organization, education, and household income) and cultural trait data (language of communication at home, political orientation, race/ethnicity and religion), which were collected as the other sections of individual and cultural traits. The survey set was reviewed by two experts in manufacturing from the department of Industrial and Manufacturing Systems Engineering (IMSE) and two experts from the Department of Anthropology at the University of Missouri for relevance to manufacturing and cultural studies, respectively. Based on pre-pilot tests with two students from the department of IMSE, it was expected that the entire survey would take no longer than fifteen minutes to complete.

In the manufacturing industry safety perceptions of employees (safety climate) have previously been measured with the help of questionnaire surveys (Zohar, 1980). Similarly, cultural values have been measured using questionnaires (Lonner, Berry, & Hofstede, 1980). For the proposed research several of these existing questionnaires were combined and adapted to fit a manufacturing context in order to create and overall survey of ICT and safety perceptions. Specifically, the following survey instruments were used.

3.3.2.1 Safety Climate Questionnaire (SCQ):

In order to assess safety climate, the Safety Climate Questionnaire was used (Zohar, 1980). The SCQ was originally developed by Zohar (1980) for Israeli workers, but was adapted more recently by Mueller et al. (1999) to edit wording to fit an American population. The modified four-factor version from the originally proposed six-factor version is shown in Figure 7. The SCQ consists of four factors

that address different aspects of safety climate: rewards for working safely, Management's attitude towards safety, effect of required work pace on safety, and effect of safe behavior on social status. It consists of 33 items and respondents are asked to indicate the current situation of safety at their workplace on a scale from 1(strongly agree) to 6 (strongly disagree). This particular survey tool was chosen as it was created specifically for a manufacturing scenario. Moreover the survey has successfully been modified to fit a variety of countries and industries (R.L. Brown & Holmes, 1986; Cooper, Phillips, Sutherland, & Makin, 1994; Isla Diaz & Diaz Cabrera, 1997).

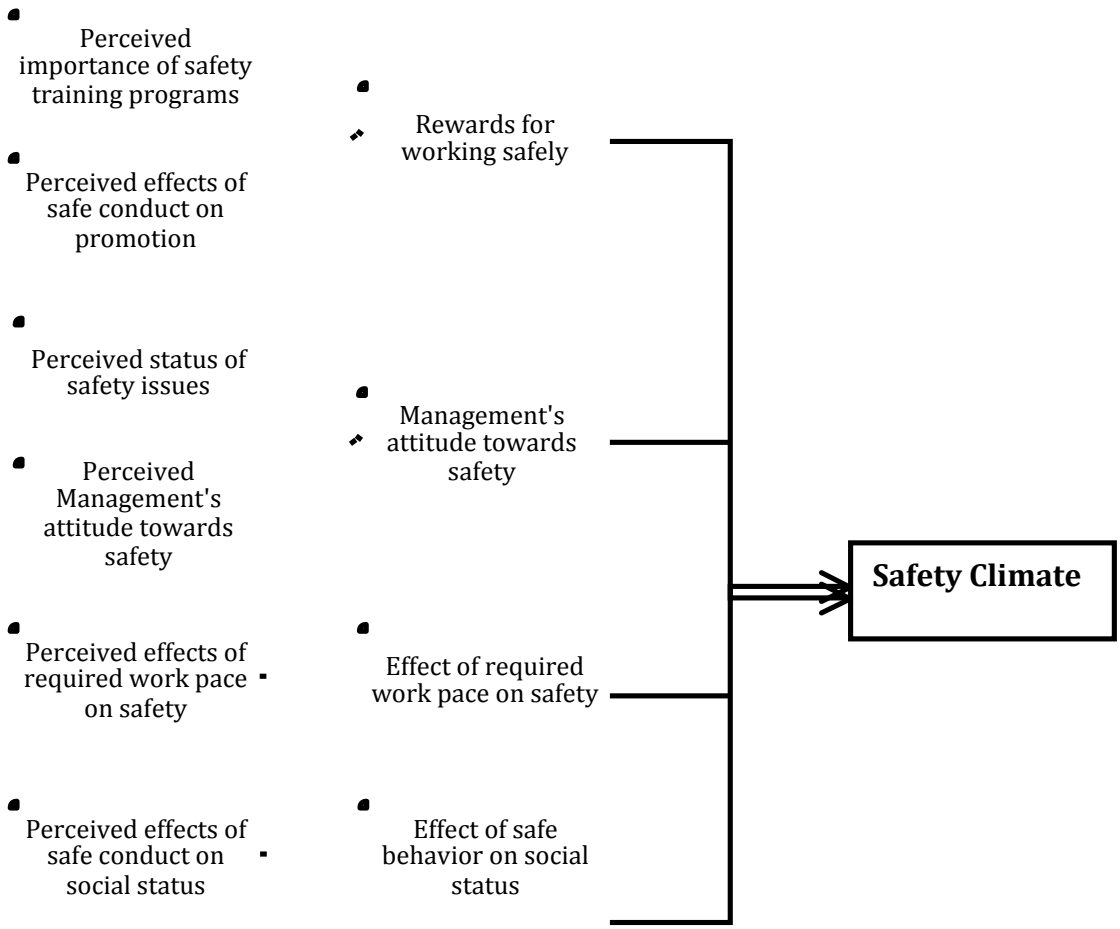

Figure 7: Modified final four-factor model from hypothesized six-factor model (Mueller et al., 1999)

3.3.2.2 Individual and Cultural Traits (ICT) questionnaire:

This section of the survey was used to measure various sub cultures, which were identified to remain constant across the globe irrespective of the country. Two previously published (Shulruf et al., 2007; Spence & Helmreich, 1978) survey tools were used to measure two dimensions of personality culture and an additional seven demographic questions, which individually aim at classifying employees into various individual and cultural traits (age, experience with the organization, religion, economic, political, language and social) were included. In the future if the survey needs to be used in just one nation then these questions will change based on the country the survey is being issued in, so as to better fit the local sub cultures.

The Auckland Individualism and Collectivism scale (AICS):

The Auckland Individualism and Collectivism Scale (AICS) was used to measure Individualism/Collectivism (Shulruf et al., 2007) as a personality trait at the individual level. It consisted of 26 questions that were grouped into two domains, individualism and collectivism. Each question suggests the course of action a person would take in a situation. The respondents were required to answer each question by choosing the frequency with which they perform the specified activity ranging from 'never or almost never (1) to always (6). The two domains were further divided into subscales as shown in Figure 8. In previous research this instrument continuously produces a Cronbach's alpha between .70 and .82 and hence is considered reliable. The tool was chosen specifically due to its proven ability in identifying differences at the individual level in a variety of cultures in the same country (Shulruf et al., 2007).

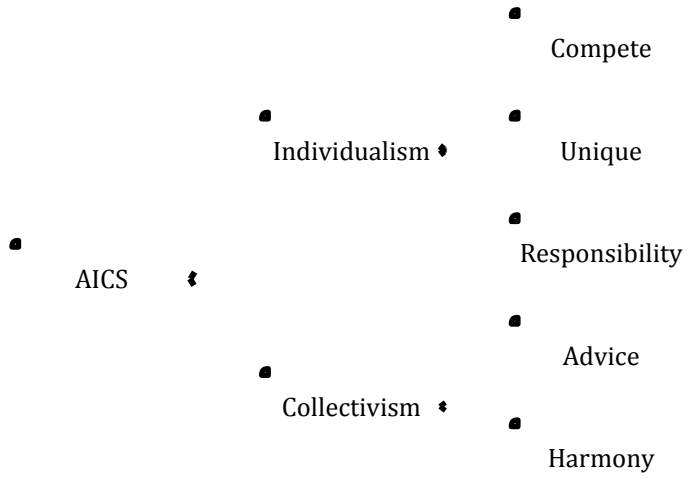

Figure 8: Different subscales of the Auckland Individualism and Collectivism scale (AICS).

Personality Assessment Questionnaire (PAQ):

The Personality Assessment Questionnaire is one of the most commonly used survey tools to measure gender-based personality traits (Eisler, Skidmore, & Ward, 1988). In this study it is used to measure the Masculinity and Femininity trait of personality. Developed by Spence and Helmreich, 1978, it has been used by numerous researchers ever since. The actual scale contains three different scales: Masculinity (M), Femininity (F) and Masculinity – Femininity (M-F). The M-F scale consists of thirteen items that have masculine and feminine on opposite sides of the mid point. In this survey only this M-F scale has been used. This was done to ensure the length of the questionnaire remains easily answerable without compromising the results. This questionnaire has been found to be reliable. Cronbach's alpha values for the three sub sections M, F and M-F were reported to be .85, .82 and .78 respectively (Spence & Helmreich, 1978).

Demographics: Apart from personality traits, this section deals with various other individual and cultural traits that have previously shown to have some impact on

occupational safety. The set of traits has been selected in such a way that they can be measured irrespective of the nation where the measurements are being taken. Each subculture to which the employee might belong to is identified by a question in this section. However, for language, two questions have been used. The section helps in understanding the further subcultures that the employees could belong to inside the national culture. The subculture groups included here are-

- Age: This trait has been included as it is the most common way of classifying employees all over the world. Previous research (Gyekye & Salminen, 2009; Mitchell, 1988) suggests that employees belonging to the younger age group are more prone to accidents when compared to employees of an older age group. However employees aged 65 and above have shown to be the ones with the highest number of fatal accidents (BLS, 2012b).
- Experience

  It is believed that employees with more experience on the job generally make fewer mistakes (Keyserling, 1983). At the same time it has also been seen that employees older than 65 have three times higher fatality rates as shown in Figure 6. Hence, it would be interesting to test the notion that people with less job experience would make more mistakes (HSC, 2012) when compared to people with more experience. It is another general way of classifying employees everywhere and also easy to measure and classify (Correlations between age and experience would be tested as a part of multicollinearity testing).
- Political orientation

  Political influences from outside the organization could be a potential factor affecting occupational safety (K. A. Brown, 1996). Two political viewpoints

are represented on a scale with one on each end. The possibility of employees belonging to different political viewpoints would express different safety climate scores is tested here.

- Economic

  Previous research suggests that wages play an important role for employees to take risks in industries where risk is involved (McLain, 1995). As manufacturing is often related to high risk, the possible hypothesis that employees making more money are actually trading risk for money is tested here as a subculture.

- Language

  When it comes to global workplaces, there is always the question of understanding each other's language amongst employees belonging to different regions geographically. Language has always played an important role in workplace. An understanding of the English language especially in the manufacturing area has become more important as controls and systems are globally labeled in it (K. A. Brown, 1996). Two questions were used to see if there is a difference between naturally English speaking and employees speaking English as a second language.

- Education

  Morehouse, (1986a), in his report on the Bhopal gas tragedy (1984), clearly mentions that employees working without the required educational credentials (not even proper schooling in some cases) generally made more mistakes. However, in the U.S. high school education/GED is the minimum requirement for most manufacturing jobs (BLS, 2012a). Education is thus a differentiating factor between developing and under developed low-income countries as in

the former a majority of the workforce lacks proper educational requirements of the job.

- Race/Ethnicity

  Race and ethnicity have been established as important subcultures in relation to safety research. Previous studies have looked into how race influences occupational safety (Leeth & Ruser, 2006) and specifically in high-risk industries such as construction (Artis, 2007). This study aimed to determine if there is a relation between safety climate and race/ethnicity in manufacturing.

- Religion

  Another important aspect of globalization is bringing people from different religious backgrounds together. It becomes more important to have higher tolerance for co-workers from other religions (Rao, 2012). In a highly multi religious nation such as India (Parboteeah et. al., 2008) religion might influence the ethics which might be associated to safety behavior. A question was placed to see if there is a difference between religious subcultures when it comes to reporting safety climate.

3.3.3 Procedures/Data Collection

The complete set of survey instruments identified above is included in Appendix A, and was administered to employees from manufacturing organizations in the United States (U.S.) and India. The two countries were chosen due to the variations between them in national culture (Lonner et al., 1980). While the U.S. is highly individualistic, India has a more collectivist culture (Hofstede, 1984). As the population is large and obtaining a sample that contains participants from every possible culture would need a lot of time, a convenience sampling method was used to

contact possible participants (friends and acquaintances) from the manufacturing sector. A total of ten organizations were used in this survey. The commonality between these organizations was that they were medium to large-scale organizations involved in electronics manufacturing. The range of employee population in these organizations was from 200 to 1850. This was converted into snowball sampling and the participants identified through convenience sampling were in turn requested to forward recruitment emails to their colleagues and friends within the same organization. Their emails were obtained from Facebook, Linkedin and Orkut (India). They were sent a recruitment email (attached as Appendix 4) requesting them to be a part of the study. The recruitment email consisted of a brief overview of the study and a link to the online survey. The prerequisites to be eligible to participate were that they should be employed by a manufacturing organization and must not have any managerial duties. These were clearly mentioned in the email sent to them. Since the entire survey is in English, it is also necessary for them to be able to communicate (read, write and speak) in English. These details were also mentioned in the recruitment email. In order to obtain a culturally varied sample, the initial convenience sample was chosen from various geographical locations (West, East, South, and North in India; North, East and South in the U.S.) in both the nations. The initial convenience sample was requested to try and request older employees, employees from different religious backgrounds, employees who worked at the shop floor level, etc. to fill the survey in order to try and obtain a variety of responses. The entire survey remained the same for both the nations except for two questions. These two questions (household income and political views) were mentioned as a separate question for the two countries. It was clearly mentioned in the question whether it was for Indian residents or U.S. residents. These questions were coded and later combined

so that the whole sample could be treated as one. This was done in order to have a sample that contained representation of two nations that differed on a national culture basis.

Campus Institutional Review Board (IRB) approval was obtained prior to any data collection. A copy of the approval is provided in Appendix C at the end of this document.

The instructions as well as the importance of doing this study were present on the online survey page along with a consent form clearly stating that the responses wont have any effect on their jobs. Participation was completely voluntary. As the survey was filled out online and was completely anonymous the influence of management is thought to have been minimum. Participants were requested to be accurate with their responses as much as possible. If a sufficient number of responses were not received, another email notification would have been sent out with a new extension date. This was to ensure that people who were not interested in the first email reconsider participating.

3.3.4 Participants:

An online survey was administered to employees of manufacturing organizations in the U.S. and India. The survey was designed and made available on online survey portal SurveyMonkey.com ("surveymonkey," 2012). A link to this online survey was sent out to the sample through a recruitment email. Since the survey was to be filled online, there was no means of identifying the participants. All manufacturing workers irrespective of their job duties were eligible to take the survey except ones with managerial functions. As mentioned above in section 3.3.3, this was made clear in the recruitment email sent out to the possible participants. As

management is also considered as a factor effecting the safety perceptions of employees, this acted as an additional means to ensure that their influence on the survey results remained minimized. The minimum required sample size was determined utilizing power analysis for multiple regression in SAS as 82. The power level specified here was 80 percent. There are a total of nine independent variables. A partial correlation effect size was assumed as 0.30 as a medium effect. A smaller effect size of 0.2 would require more than 190 participants while 0.1 would need above 700 respondents. Confidence interval was assumed as 95% (alpha=0.05).

3.3.5 Data Analysis:

The scores on each safety perception and personality subculture survey instrument being used in the study were calculated according to the criteria established in previous research. SCQ was used to quantify the values for safety perceptions of each respondent in all four factors being measured. A sum of the scores of each employee combined represented his/her perceptions of safety for that organization. Scores on AICS helped determine whether the respondent falls in Individualistic or Collectivistic categories. Similarly scores on the PAQ helped determine the stance of the respondent on the Masculinity/Femininity scale. The answers to the demographic questions were grouped based on their responses. For e.g., all the respondents who chose the same age group were classified as belonging to that particular level of age ICT. A Shapiro-Wilk test was performed on safety climate scores to test for normality. In case the data was not normal, transformations (log, square root, etc.) would have been performed. If these transformations did not work then non-parametric methods would have been used. All the independent variables were then tested for multicollinearity using Variance Inflation Factors.

Stepwise Linear regression analysis was performed with all the independent variables. T tests were used to control the inclusion and exclusion of variables in the model (with p values of .18 for entry and .19 for exit). The equation resulting from this analysis was used to predict safety climate. The same equation was used to modify Cooper's model for safety culture by forming a link between the person (safety climate) component of the model to Individual and Cultural Traits (ICT).

CHAPTER 4: RESULTS AND DISCUSSION

This section presents the results and discussion of the survey study conducted. First the demographics of the survey sample have been presented. This is followed by the step-by-step procedure involved in preparing the data for analysis. This includes treating missing data and testing the dependent variable for normality. This is followed by multicollinearity analysis of independent variables. Finally the hypotheses are tested and a model to predict safety perception score is provided.

4.1 Demographics:

This section provides an overview of the demographics of the participants in the survey. These demographics were collected as a means of measuring various subcultures previously shown to reflect on occupational injury scores. Graphical representation has been used wherever possible and frequency tables have been added to each subculture along with an explanation as to why some subcultures lack proper representation. Table 2 presents the frequency of the various traits measured along with the percentage of population it makes up for that particular trait.

4.1.1 Age:

The sample used for the survey consisted of a total 93 participants. Out of these 93 participants who completed the survey, nine were found to be incompletely filled and so were removed for the final analysis. The final number of participants is 84. The first demographic is age. The graph below depicts the participation based on age groups. Both the graph and the frequency table suggest that a majority of the respondents belonged to the 20 to 29 age group. There has been a modest representation from the age groups 30 to 30 and 40 to 49 but the number drops to just one participant from age groups 50 to 59, 60 to 64 and 65 and above. The online

survey process used here is only not accessible to a majority of seniors in India. Another factor, which may have played a role in less representation of higher age groups, is the retirement age in India that is set at 60.

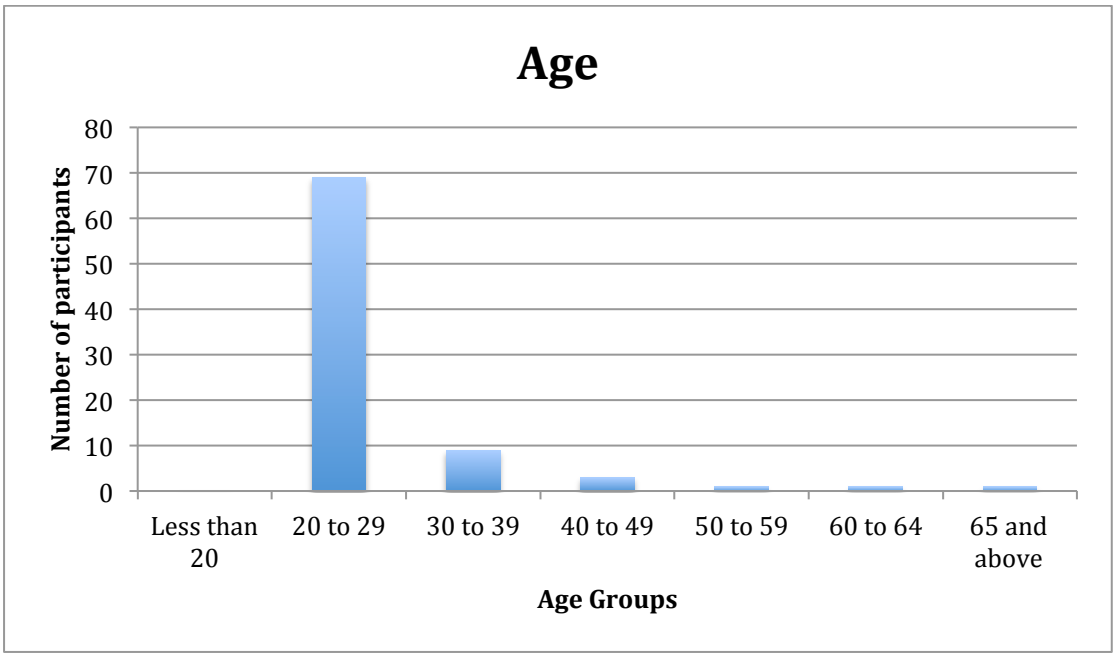

Figure 9: Graph showing the age distribution amongst the participants

4.1.2 Country of residence:

The data on where the participant was living at the time of answering the survey was also collected. This was done to verify that the employees completed the correct question when item choices varied with country of residence (household income: U.S. residents in dollars, Indian residents in Rupees). Figure 10 shows the number of participants in both countries. Thirty-six of the respondents were from the U.S., and a total of 53 participants were from India. Four of the respondents did not provide any answer to this question.

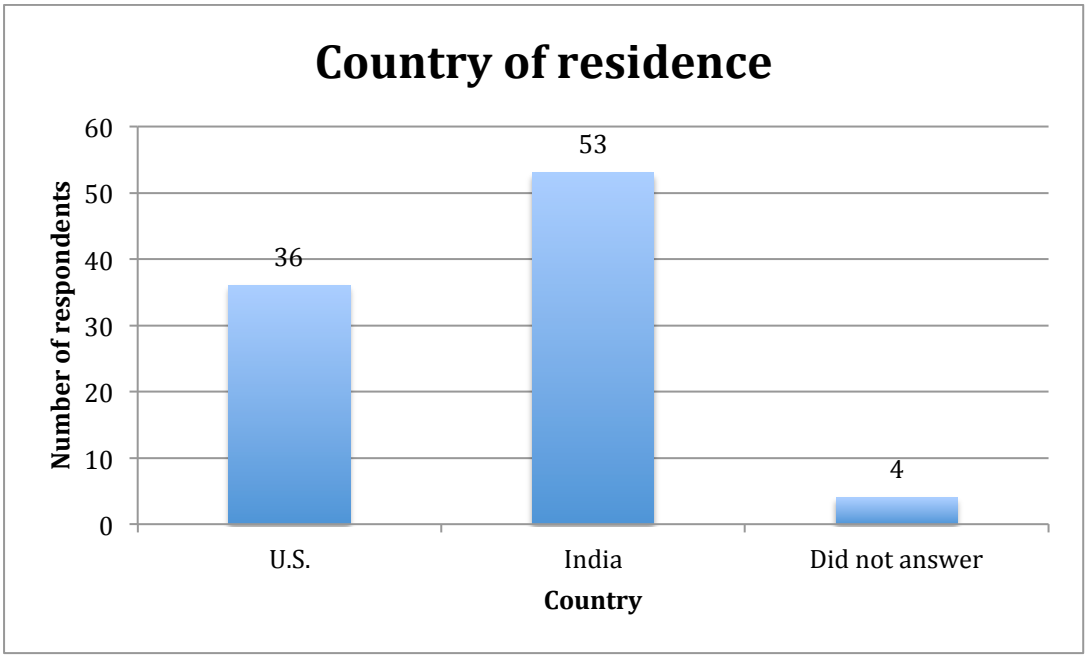

Figure 10: Graph showing country of residence (before deleting incomplete data)

4.1.3 Language:

Respondents were asked two questions related to language. The first question was to know if English was their primary language and the second one was to see if they used the language at home. The first question was left unanswered by most participants. Hence the second question was used in the analysis. While twenty-seven participants responded that they spoke English at home, sixty said otherwise. Four participants left the question unanswered. Figure 11 shows the distribution. While English was the main language of communication in the U.S., six responded to the option 'No' suggesting they did not use English at home suggesting they could possibly be from a different nation working in the U.S. or are citizens whose roots are from a different nation.

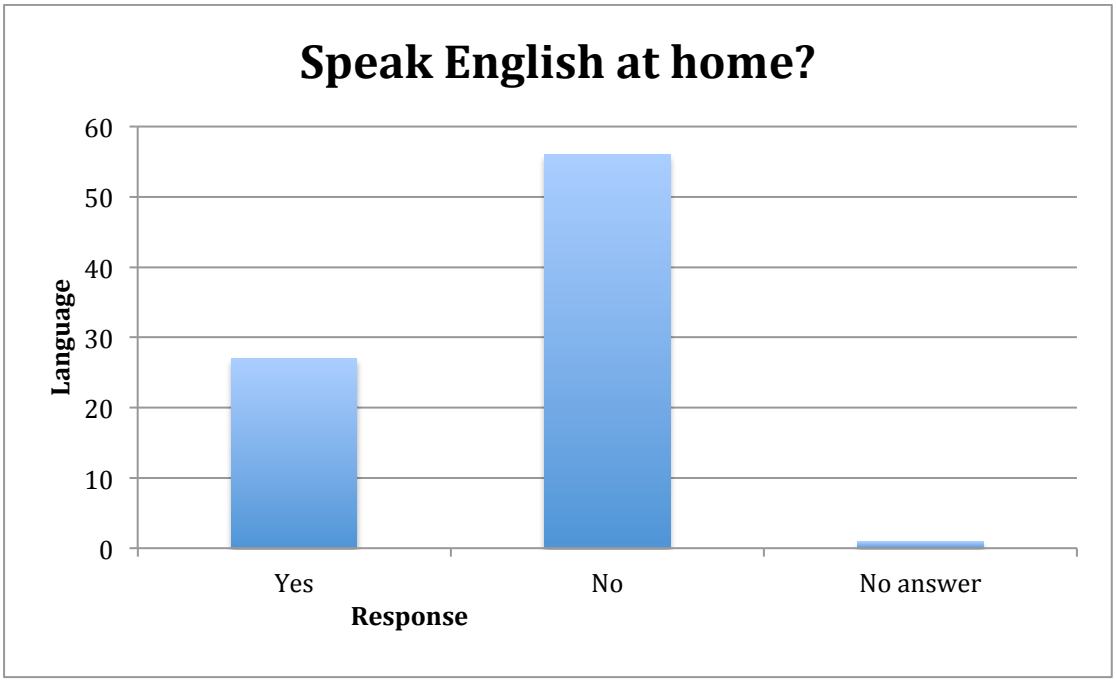

Figure 11: Language sample

4.1.4 Educational background:

The respondents were asked about their educational background. Two responded as having a high school/GED. There was only one participant with an associate's degree. Out of the remaining respondents, 42 of them reported as having completed a bachelor's degree and 45 of them a Masters' degree. These were the numbers before deleting the incomplete responses. As the educational system is similar between India and the U.S. the same options were provided for both the populations. Figure 12 shows the distribution of educational qualifications amongst the participants.

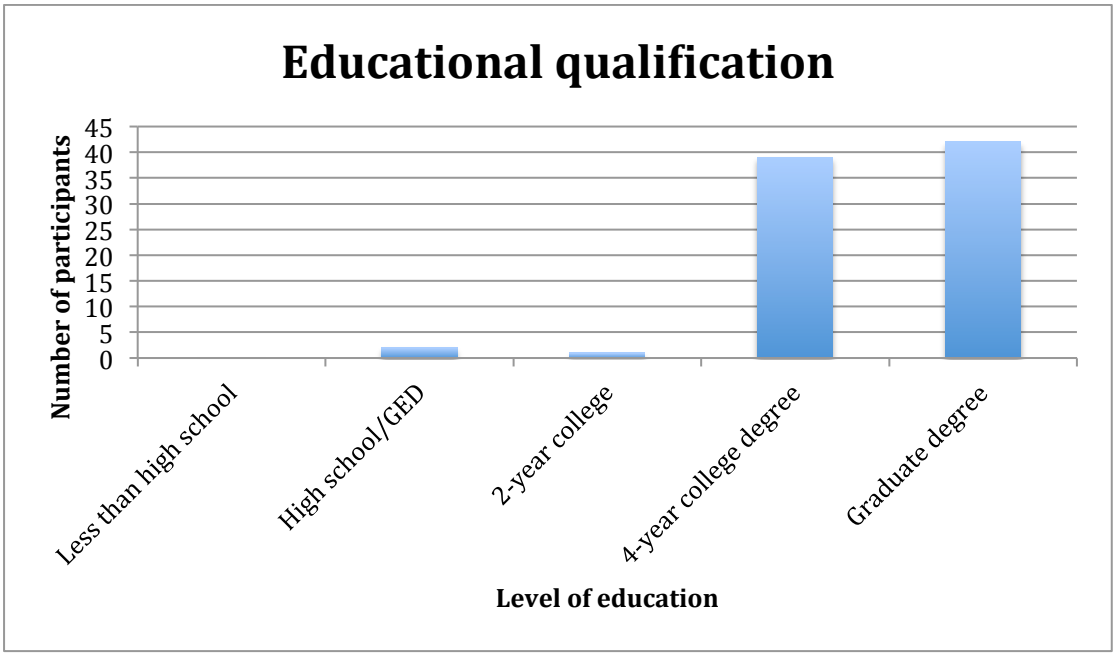

Figure 12: Educational qualifications of the participants

Again as the survey was conducted online to facilitate collection of data from two nations, the possibility of employees taking part in the survey with a high school education is low, especially in India where Internet access may be limited.

4.1.5: Religion:

A question was asked on which religion the participants represented to classify the sample based on their religion. All the world's major religions were included in the options. Ninety participants (before removal of incomplete data) answered this question. While a majority of them said they represented Hinduism (67), there were representations from other religions as well. A total of 11 Christians (5 Catholic, 3 protestant and 3 other), 7 Muslim, 1 Buddhist participated in the survey. Three of the participants responded as belonging to no religion.

4.1.6: Household income:

The survey also consisted of a question aimed at household income. However, since the currency used in the two nations being investigated is different, the question was broken up into two different questions, each specifically aimed at one population. Later both these questions were combined using a common code. While the Indian population ranged from reporting earning less than 96,000 Rupees a month to more than 500,000 Rupees a year, the population from the United States reported an annual income from $20,000 and below to $90,000 and above. The categories were created to reflect similar levels of income in the two nations.

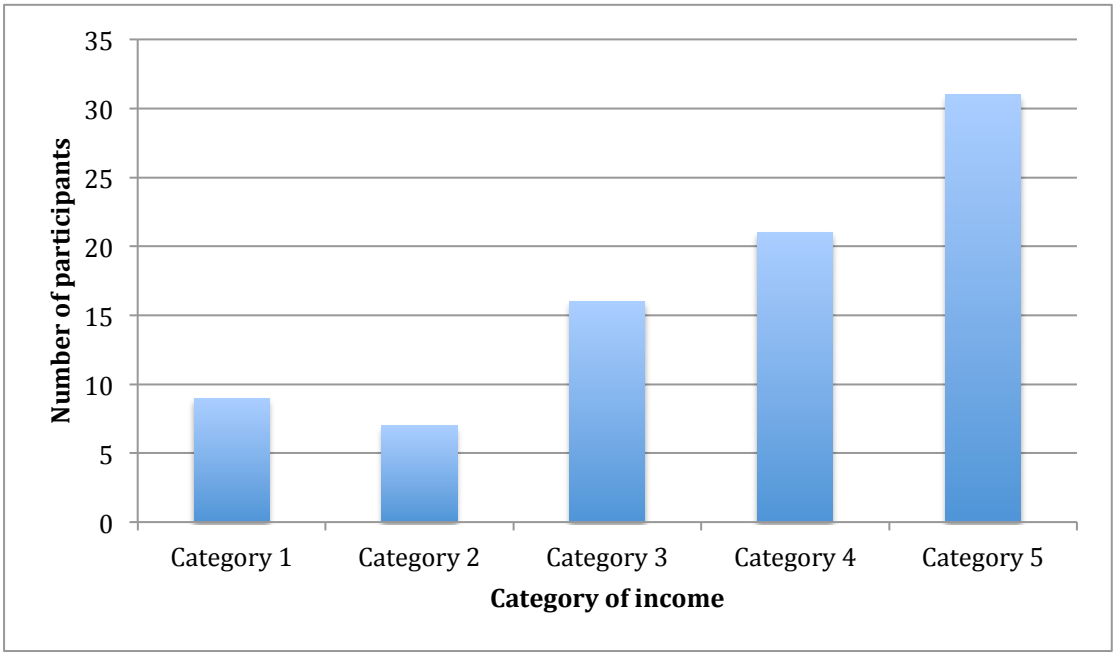

Figure 13: Household Income: Categories 1: $0 to $20,000 (U.S.) Rupees 0 to Rupees 96,000 (India); 2: $20,000 to $40,000 (U.S.) Rupees 96,000 to Rupees 1,50,000 (India); 3: $40,000 to $60,000 (U.S.) Rupees 1,50,000 to Rupees 3,00,000 (India); 4: $60,000 to $90,000 (U.S.) Rupees 3,00,000 to Rupees 5,00,000 (India); 5: $90,000 and above (U.S.) Rupees 5,00,000 and above (India) (General classification which would seem similar was used).

4.1.7: Experience:

An open-ended question aimed at work experience was also put forward in the survey. The responses from the participants were converted into decimal numbers (years) and used in the analysis. The range of work experience in the same organization ranged from as low as four months to 25 years. A total of 86 participants responded to this question.

4.1.8: Personality demographics:

One of the aims of this study was to determine if there is a relationship between personality types categories and safety perceptions. Two previously established survey instruments AICS and PAQ were also added to the survey in order to classify the participants on their personality scores. Details of these instruments and their validity have already been discussed (see section 3.3.2.2).

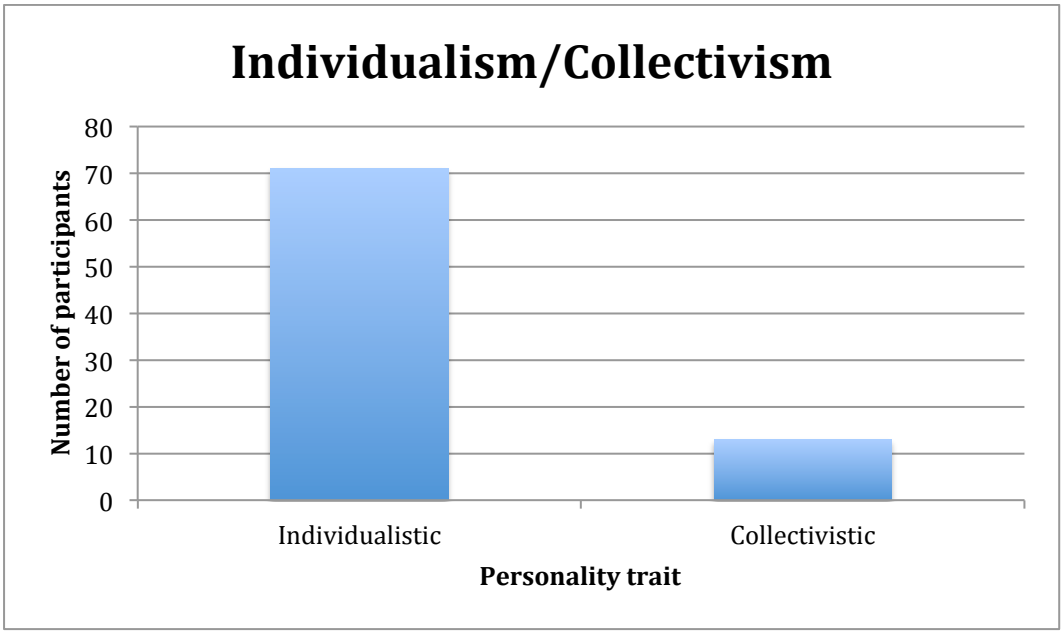

Figure 14: Individualism and Collectivism responses

Table 2: Frequency of independent variables

Factor	Frequency	Percent
Age		
Less than 20	0	0
20 to 29	69	82.1
30 to 39	9	10.7
40 to 49	3	3.6
50 to 59	1	1.2
60 to 64	1	1.2
65 and above	1	1.2
Language		
English	27	32.1
Not English	56	66.7
No answer	1	1.2
Individualism/Collectivism		
Individualism	71	84.5
Collectivism	13	15.5
Masculinity/Femininity		
Masculinity	51	60.7
Femininity	33	39.3
Race/Ethnicity		
American Indian or Alaska native	1	1.2
Asian	69	82.1
Black or African American	2	2.4
Caucasian or White	3	3.6
Hispanic or Latino	1	1.2
Native Hawaiian or Pacific Islander	0	0
Other	8	9.5
Religion		
Christian – catholic	5	6
Christian – Protestant	3	3.6
Christian – other	3	3.6
Jewish	0	0
Muslim	7	8.3
Hindu	62	73.8
Buddhist	1	1.2
Other	0	0
None	3	3.6
Educational background		
Less than high school	0	0
High school/GED	2	2.4
2 year college	1	1.2
4 year bachelor's degree	39	46.4
Graduate degree	42	50.0

71 respondents' scores when calculated put them on the Individualistic subculture. Considering more respondents from the Collectivistic nation India (Lonner et al., 1980) the results might suggest that the personality may not reflect national culture in this sample. Another reason for the higher number of individualists could be the growing modernization in developing nations (Ahluwalia, 1991).

Another personality trait measure as a part of the survey is Masculinity and Femininity. PAQ a standard instrument used to measure gender roles has been used here. After coding, the total number of respondents reporting masculine nature was 51 and the number of respondents reporting feminine nature was 33. Figure 15 shows the plot of these values.

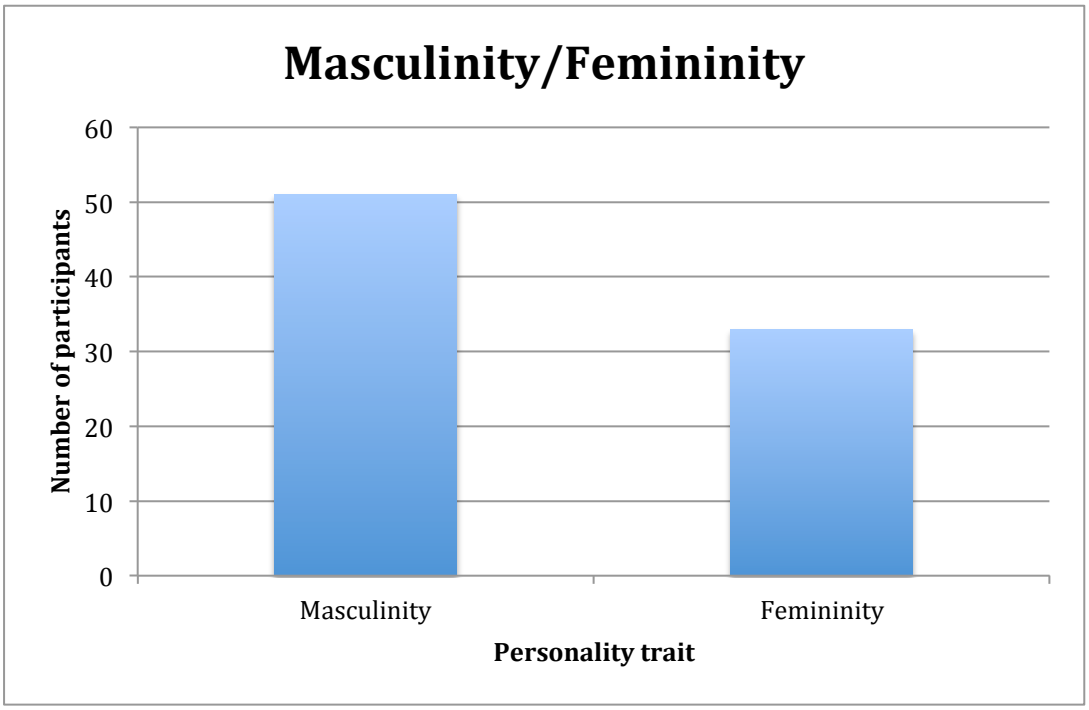

Figure 15: Masculinity and Femininity responses

4.2 Data preparation:

After visually inspecting the data, it was clear that 9 of them did not complete the entire survey. Hence they were deleted from the final list. The final data sample used in the analysis was 84.

4.2.1 Missing survey data:

Some of the survey responses were missing. This could potentially be due to the length of the survey. As this could pose an issue during analysis, the missing data was filled using Expectation Maximization algorithm on Statistical Package for Social Sciences version 19 (SPSS). Safety perceptions, AICS and PAQ data were first tested using Little's MCAR test to see if the missing data was completely at random. The Chi-square statistic is used for testing whether the data is missing completely at random. Once verified, the missing data fields were filled using the Expectation Maximization algorithm. The results of the MCAR test have been mentioned in Table 3 below, which suggest that in all three cases the data is missing completely at random. In the demographic data 'political views' was separated into two different questions targeting both Indian and U.S. populations. However as most respondents chose not to answer this question, the subculture had to be removed.

Table 3: Little's MCAR test results:

Safety perception scores	Chi-Square = 357.688	DF = 393	Sig. = .899
AICS scores	Chi-Square = 240.879	DF = 216	Sig. = .118
PAQ scores	Chi-Square = 18.225	DF = 24	Sig. = .792

4.2.2 Safety perceptions, AICS and PAQ scores:

In order to obtain a respondent's safety perception score, all of his/her responses were totaled. This sum represents the score on safety perceptions scale. Similarly, for the AICS data, each employee was given a code (I: Individualistic; C: Collectivistic) based on his score on the instrument. Means of the scores were calculated for PAQ and the participants were classified into two groups based on the sum of their responses (M-Masculine; F-Feminine).

4.2.3: Coding the data:

The AICS data was coded in terms of 1 and 0 (Individualism: 0; Collectivism: 1) and similarly PAQ data was coded in to numbers (Masculine: 1; Feminine: 0) as both these variables are dichotomous. Once the coding for these instruments was complete, safety perception scores, AICS scores, PAQ scores and demographic values for all the participants were combined into one file.

4.2.4: Normality test:

The dependent variable here is 'safety perception score'. Before proceeding to analyzing the data, the dependent variable was tested for normality. The data was found to be normal. Figure 16 and 17 how the normal plot and histogram of the same. A Shapiro - Wilk test on the safety perception scores (dependent variable) resulted in a 'p' value of 0.424. This suggests that the null hypothesis of the sample being from a normal population cannot be rejected, as the 'p' value is greater than the assumed value of 0.05 for 'α'.

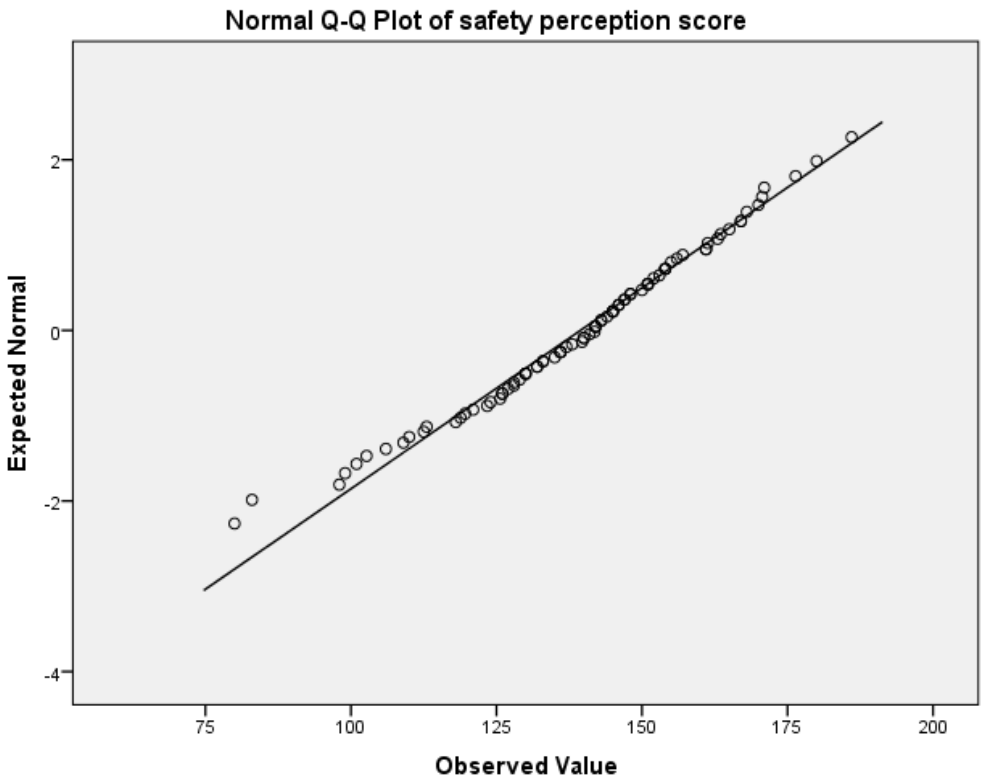

Figure 16: Normality plot for safety perceptions scores (dependent variable)

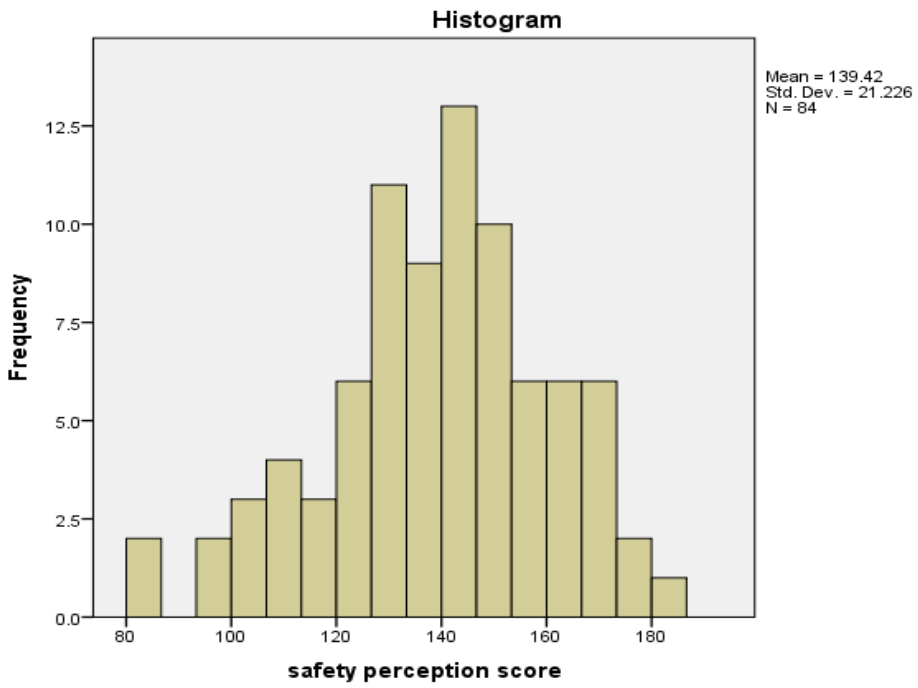

Figure 17: Histogram showing distribution of safety perception scores in the sample.

4.2.5: Multicollinearity:

It becomes important to test for multicollinearity when there is a possibility of two of the independent variables in the model being used to predict the dependent variable might be interrelated. The independent variables were checked for multicollinearity using SPSS. There was multicollinearity found between Experience and all of the Age groups, some of the race/ethnicity (Asian, White and Latino), Religion (Christian, Muslim and Hindu) and Education (high school/GED) (groups with VIF value 3 and above). Table 4 contains the table from SPSS showing the test.

Table 4: Test for multicollinearity using experience as the dependent variable.

Coefficients[a]

Model		Collinearity Statistics	
		Tolerance	VIF
1	Age (20-29)	.091	10.970
	Age (30-39)	.136	7.363
	Age (40-49)	.242	4.130
	Age (50-59)	.152	6.567
	English Speaker	.784	1.276
	Asian	.541	1.850
	Afro American	.323	3.098
	White	.311	3.214
	Latino	.647	1.545
	Christian	.133	7.491
	Muslim	.216	4.637
	Hindu	.109	9.212
	Buddhist	.564	1.774
	High School	.172	5.816
	College degree	.672	1.489
	0-20000	.698	1.434
	20000-40000	.600	1.666
	40000-60000	.572	1.747
	60000-90000	.699	1.431
	Ind/Col	.610	1.640
	Mas/Fem	.720	1.390

a. Dependent Variable: Experience

Table 5: After removing highly collinear vales

Coefficients[a]

Model		Collinearity Statistics	
		Tolerance	VIF
1	Age (40-49)	.757	1.320
	Age (50-59)	.425	2.351
	English Speaker	.822	1.216
	Asian	.561	1.783
	Afro American	.381	2.624
	White	.619	1.616
	Latino	.813	1.231
	Muslim	.928	1.077
	Buddhist	.809	1.236
	College degree	.735	1.360
	0-20000	.760	1.316
	20000-40000	.625	1.601
	40000-60000	.613	1.632
	60000-90000	.727	1.376
	Ind/Col	.682	1.467
	Mas/Fem	.793	1.261

a. Dependent Variable: Experience

Table 4 clearly shows that there is multicollinearity amongst the independent variables (VIF above 3). The method to reduce multicollinearity applied here is to remove some of the variables that show high Collinearity with 'Experience'. The final table when tested for multicollinearity is as follows in Table 5. The table

clearly shows the values of VIF to be below 3 indicating there is no more Multicollearity.

4.3 Research Question 1:

The first research question was "How can Individual level traits (both cultural and non cultural) be represented/defined in a conceptual model to relate to safety in manufacturing?

National culture measures certain traits, which are common to people living in a certain geographical location (G. H. Hofstede, 1984). This method, which has been made popular by Hofstede in 1980, proved effective in a number of fields and was used as means to explain national differences. However, the theory has a number of limitations. While considering geographical boundaries it does not define who would form a part of the nation. The immigrants and people of a different national origin who form a considerable number of the population are neglected. Measuring these traits of national culture is not possible at the individual level and also cannot be used to measure difference between different groups amongst the same nation (Hofstede, 2001). With growing globalization the national and geographical boundaries are slowly melting. Not just this but the number of people living in nations far away from their own is also going up. The need for a different method that can consider these groups too has always existed.

In order to answer research question one a conceptual model that instead of assuming geographical boundaries, assumes common traits, which already exist and do not change with nation has been proposed. There have been two different types of individual level traits that are a part of the model. The traits that reflect common cultural ideas were listed as 'Individual Cultural Traits' and the ones that just reflect

more of a demographic are termed as 'Individual Traits'. Both these traits are important at the individual level in relation to safety (see 4.1). In place of considering an individual to be a part of a culture, the various cultures an individual can be a part of are utilized to form a model. Various factors, which at an individual level can be used to categorize a population, were researched. These categories were used to create a model as shown in Figure 18. Based on Social Identification Theory (see section 1.4 and 1.5), the model is general in nature and can be used to measure various traits in any nation or across nations.

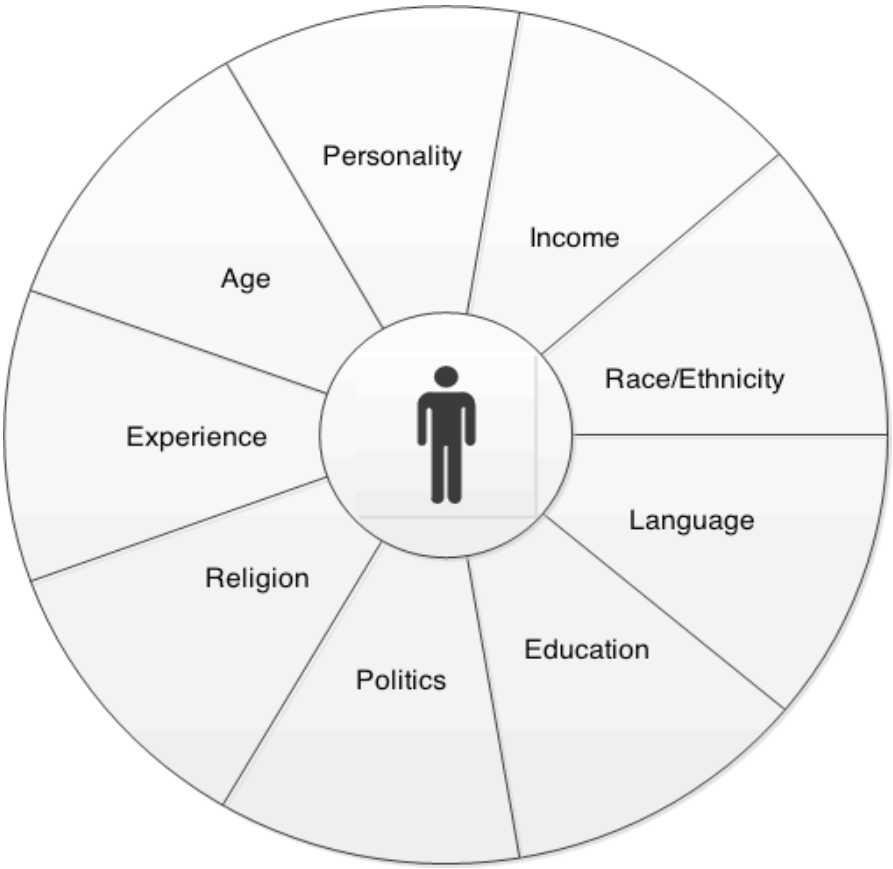

Figure 18: Individual and Cultural Traits (ICT) model: The sections represent the various ICT surrounding a person. For this study specifically the culture traits identified were personality, politics, language, race/ethnicity, and religion. The individual level traits were age, experience, household income and education.

4.3.1: Limitations:

The model used here is at its initial stage. This is the first time it has ever been conceptualized. Each trait has been assumed as a section of a circle and represents various traits a person could be a part of. For the purpose of this thesis all the traits have been considered equally important. The association of each trait would possibly change based on the situation being considered. Another limitation would be the possibility of more traits being included. For the purpose of this research nine have been included and all of them have been chosen with respect to occupational injuries. Though aimed at generalizing the concept of measuring culture, measurement of this model becomes complicated when used for more than one nation.

Considering the interaction between traits and including these relations in the model would be the next step in further refining the idea.

4.4 Research Question 2:

In order to answer research question 2 (Do the Individual and Cultural Traits (ICT) of the employees reflect their attitudes towards safety in their organization?) the following hypothesis were tested:

It was hypothesized that employees who are individualistic in nature would show higher safety perception scores when compared to employees of collectivistic nature. This hypothesis was tested by collecting data on safety perception scores, and AICS was used to see whether they were Individualistic or Collectivistic in nature. T-tests were conducted to see if there were significant differences between Individualistic and Collectivistic participants with regards to their safety perception scores.

Table 6: Mean and standard deviation for Individualistic and Collectivistic samples.

Dependent Variable	Individualistic sample means (Standard deviation)	Collectivistic sample means (Standard deviation)
Safety perception scores	140.61 (20.779)	132.91 (23.311)

There was a difference between means of Individualistic and collectivistic natured samples (Figure 19). However, the difference was not significant (t= 1.206, p value= 0.231). Which suggests that the safety perceptions of the Individualistic and Collectivistic samples were not different and thus does not support the hypothesis.

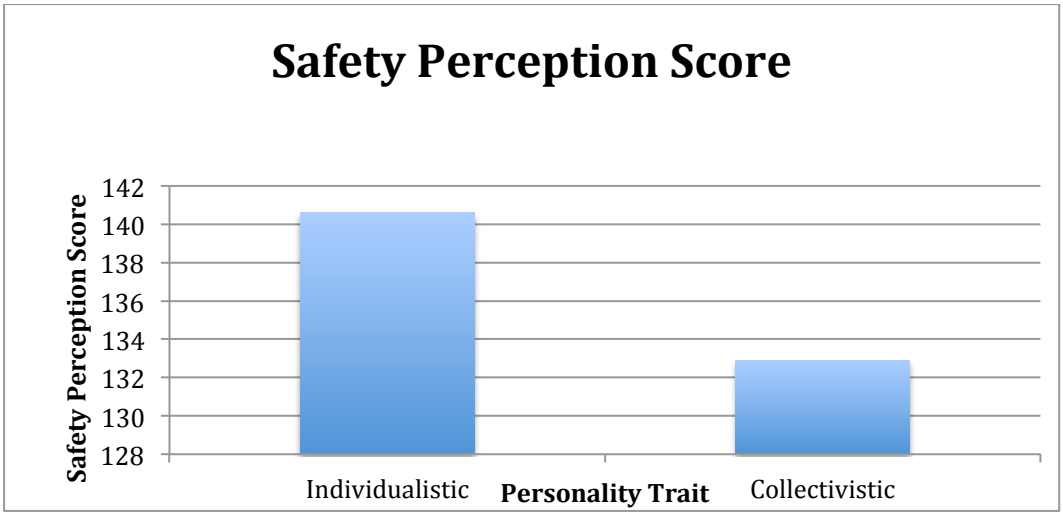

Figure 19: Safety perception scores for both Individualistic and Collectivistic samples.

It was also hypothesized that the sample exhibiting Masculine nature would have lower Safety perception scores when compared to Feminine natured sample. There was no significant relationship between both samples and Safety perception scores as tested by an independent two-tail t test (t= 0.133, p-value= 0.894), This shows that irrespective of belonging to a masculine personality or a feminine

personality, both samples have an equal perception of safety. Figure 20 shows a comparison of means of both the samples.

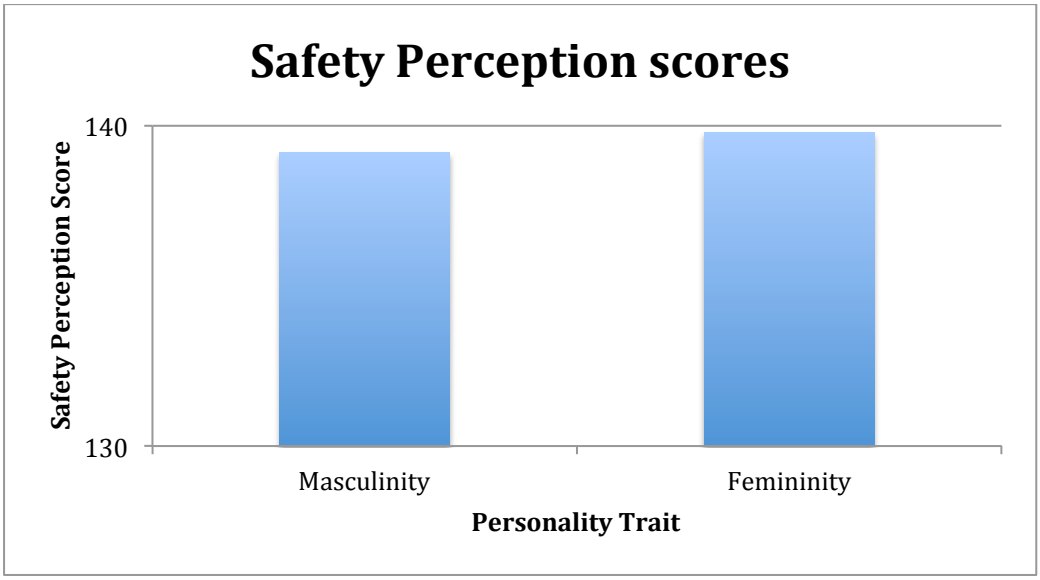

Figure 20: Safety perception scores of both Masculine and Feminine samples

4.5: Final model of safety culture

A linear regression was run using both dependent and independent variables. Table 4 shows the list of the independent variables and dependent variable used in the model.

Table 7: List of independent and dependent variables as used in the model

Dependent Variable	Independent variables
Safety perception scores	Individualism/Collectivism
	Masculinity/Femininity
	Age
	Experience
	Religion
	Education
	Race/Ethnicity
	Language

When a stepwise regression model was run using all the independent variables as shown in the figure, only one variable experience (p=0.024), was shown to be

significant at 95% confidence interval. Two other factors race/ethnicity and education were found to be the next closest with 'p' values at 0.078 and 0.145. The variables are included or removed in the model through a series of T tests. The significance level to enter and exit was set 0.18 to 0.19. Table 8 shows the result of the analysis.

Table 8: Complete Stepwise regression model:

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	140.818	2.227		63.225	.000
	White	-39.207	11.786	-.345	-3.327	.001
2	(Constant)	140.397	2.183		64.323	.000
	White	-50.151	12.501	-.441	-4.012	.000
	High School	34.095	15.216	.246	2.241	.028
3	(Constant)	140.805	2.189		64.336	.000
	White	-55.159	12.921	-.485	-4.269	.000
	High School	47.896	18.009	.346	2.659	.009
	Afro American	-23.410	16.585	-.169	-1.411	.162
4	(Constant)	138.696	2.554		54.316	.000
	White	-60.623	13.273	-.533	-4.567	.000
	High School	47.896	17.849	.346	2.683	.009
	Afro American	-28.873	16.804	-.209	-1.718	.090
	English Speaker	7.572	4.839	.168	1.565	.122
5	(Constant)	138.696	2.536		54.680	.000
	White	-53.268	14.143	-.469	-3.766	.000
	High School	25.832	23.454	.187	1.101	.274
	Afro American	-43.583	19.580	-.315	-2.226	.029
	English Speaker	7.572	4.807	.168	1.575	.119
	Age (50-59)	51.482	35.826	.265	1.437	.155
6	(Constant)	138.696	2.540		54.607	.000
	White	-44.657	11.802	-.393	-3.784	.000
	Afro American	-43.583	19.607	-.315	-2.223	.029
	English Speaker	7.572	4.813	.168	1.573	.120
	Age (50-59)	77.314	27.119	.397	2.851	.006
7	(Constant)	142.014	3.338		42.545	.000
	White	-32.645	14.139	-.287	-2.309	.024
	Afro American	-46.005	19.514	-.332	-2.358	.021
	English Speaker	7.880	4.778	.174	1.649	.103
	Age (50-59)	94.155	29.105	.484	3.235	.002
	Experience	-1.203	.794	-.198	-1.515	.134
8	(Constant)	141.923	3.317		42.789	.000
	White	-36.718	14.335	-.323	-2.561	.012
	Afro American	-45.394	19.391	-.328	-2.341	.022
	English Speaker	7.432	4.758	.165	1.562	.122
	Age (50-59)	95.185	28.925	.489	3.291	.002
	Experience	-1.276	.791	-.210	-1.615	.110
	Age (40-49)	16.701	11.736	.147	1.423	.159

a. Dependent Variable: safety perception score

The last step of the regression analysis gives us the general model for this pilot study. Safety perception score is given by:

Safety Perception Score =	**141.923**
	- 36.728 (White)
	- 45.394 (African American)
	+ 7.432 (English Speaking)
	+ 95.185 (Age (50 - 59))
	- 1.276 (Experience)
+ 16.701 (Age (40 – 49))	

The final equation reflects the general idea behind the model. In this pilot study as the sample size is small and there is not much variance, the model only gives a representative value. The equation is shown to have a 'p' value of 0.000 (F value = 4.621), which includes the three factors. As the value is less than that of '$\alpha = 0.05$' the overall model is statistically significant (Table 15). The adequacy of the model was checked by calculating R^2 and adjusted R^2 values. The R^2 value was 0.265 while the adjusted R^2 value was 0.207. While R^2 gives the fit for the data, adjusted R^2 is a modified value of R^2 that adjusts for the number of explanatory terms in the model. An adjusted R^2 value of 0.207 suggests that a variance of 20.7% has been explained by the model that is considered to be a good number in social sciences (Anderson-Spercher, 1994).

According to the model, if everything else is held constant then African American employees would report 45.394 points lower on the safety perception score

when compared to White/Caucasian employees. Similarly, Employees who speak English at home would report 7.432 points higher on the safety perception scale when compared to non-English speaking people.

4.6 Final model:

Now that the equation relating safety perception score to ICT has been obtained it can be used in modifying the model of safety culture. If safety perceptions of each employee could be predicted, then it could be used to calculate the safety climate. This in turn could be used in the model as shown in Figure 21.

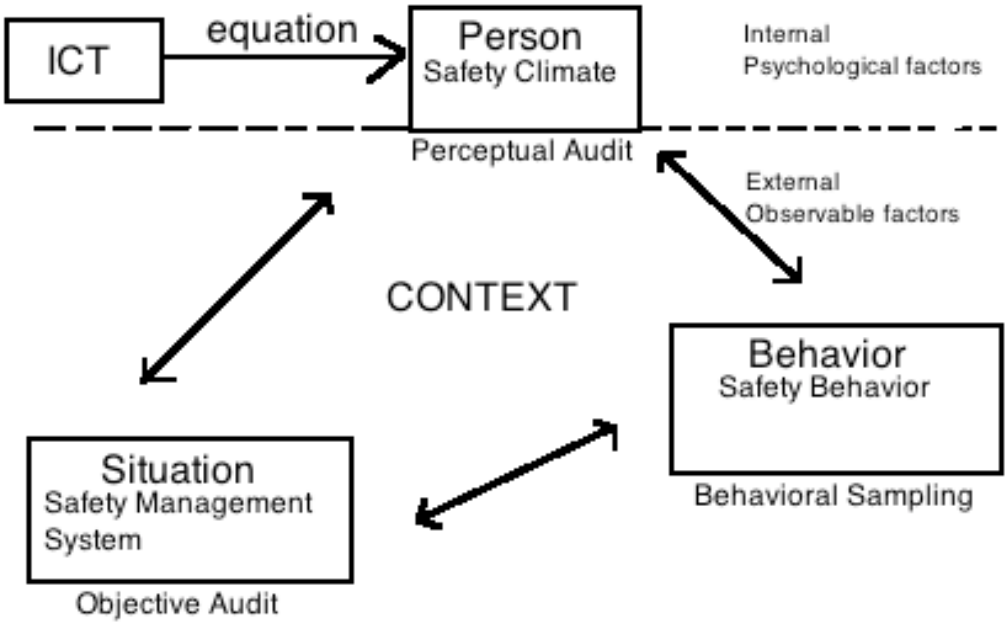

Figure 21: Final model showing how ICT could be used to replace safety climate

4.7 Conclusion and Discussion:

The main contribution of this study is the importance of ICT in the area of safety perceptions. The work proposes a general method to collect various individual level traits (cultural and non cultural) that can be useful in predicting safety perceptions of employees. The pilot study results also help in highlighting the

importance of considering these traits in terms of safety. The final conceptual model helps understand why pursuing this study further could be an important contribution to the area of occupational safety.

Though one of the main aims of the research was to show that personality culture was also linked to safety perceptions of employees, the pilot study conducted fails to show evidence in that direction. Both Masculinity/Femininity and Individualism/Feminism did not show any significant evidence that they could be related to safety perception scores. However, as safety perception scores are known to be related to injury rates in organizations (O'Toole, 2002) and this pilot study was able to include some of the individual and cultural factors that have been shown in previous research to influence injury rates, there is a need to pursue this idea further. The model suggests race (White, African American), experience, and older age groups to be factors that are associated with safety perception scores. This stands in accordance with injury rates in manufacturing (BLS, 2012a) and previous research studies, which have shown evidence that such associations might exist (Artis, (2007); Gyekye & Salminen (2009), K. A. Brown, (1996); Keyserling(1983)). However, this pilot study had a number of limitations that need to be addressed in future work. One of the major limitations is the inability to control for organizational culture. As organizational culture plays an important role in shaping employees' safety perceptions (Janssens et al., 1995), controlling for organizational would allow for isolation of ICT relationships to safety perceptions without potential confounding influence of organizational culture. Another limitation of this study is that convenient and snowball-sampling methods have been used. As most employees referred to their colleagues and friends in the same organization but mostly from their age group, or experience level, there is uneven variance in the sample.

Another limitation of the study is that the survey is being conducted in English and this makes it accessible only to employees who can communicate (speak, read and write) in English. This leaves out a large population of manufacturing employees in India especially from small-scale industries. The variance seen could be partially explained by this fact as well. If the study needs to be done in a non-English speaking nation a recommendation would be to have the questionnaires converted to the language they would understand. However, if the sample contains any illiterate employees, the better option would be to explain the questions and help them fill in personally.

Similarly, immigrant workers would be left unaccounted for in the U.S. Performing the survey within one organization using samples from its branches in different states would have been a better approach. An online survey would not be accessible to a major population if the survey in future were being aimed at developing nations. Hence conducting a paper based survey is always preferred in this case and if there is a need for an online survey, the best way to do it would be to be present at the organization and make sure every employee finds access to a computer in order to complete the survey.

4.8 Future Work:

If this research were to be done again, there are certain important criteria to be considered. First, would be selection of a proper sampling method. Conducting the survey in one organization would be preferable as this would help in controlling for organizational culture of the participants. This is important as every organization has different safety standards. By controlling organizational culture, the probability of the differences in safety perception scores obtained from the organization's employees

being a result of bad safety principles of the organization is low. Thus, controlling organizational culture would allow for more direct assessment of the relationship between ICT and safety perceptions without any confounding effects related to differences in organizational culture and associated safety principles and practices. Choosing a medium level or small scale industry would be even better as it would be easier to interact with most of the employees. As exhibited by previous researchers, when it comes to safety related research, it is always better to have a higher sample size (Guldenmund (2000); (Mearns and Yule, (2009)). As the numbers of factors that influence safety are high, a larger sample size would have more possibility in obtaining representations from all the factors. It would be good to try and collect data from all the members of the organization (production employees). This would ensure that we have the opinion of all the employees and not just a fraction that may or may not represent the organization completely. The next suggestion is to try and obtain a proper variance in the sample preferably using methods such as stratified sampling, which would allow for sampling of each of the sub sections independently. One of the main reasons why this study was not successful at certain levels is the lack of variance. If possible targeting a group of organizations that are similar in organizational styles would be better. Conducting interviews and trying to talk to the employees and understanding the actual reasons behind these safety perception scores is also important. Conducting separate survey on managerial employees would also be something to look into in the future. This would give an idea on why according to them the scores are lower or higher. This would also help in providing suggestions to other organizations if the results turn out as expected. With a proper sample size, a good variance and data from organizations from the same nation would definitely help predict a stronger model.

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APPENDICES

Appendix 1:

Survey model

Employee's Safety Perceptions Questionnaire

The surveys you are about to fill are part of a safety and personality analysis research being conducted by a graduate student from the University of Missouri, Columbia. The main aim of this research is to understand the relationships between your personality and the way you feel about the safety situation at your workplace.

The survey is completely anonymous and that means there is no possible way of identifying you based on your answers. Only pooled data will be shown in the publication purposes if needed. This again means there is no means of identifying you personally. So please be completely honest in your responses. More over giving your opinion on the safety survey helps identify the issues related to safety you might be facing.

Hence we would like to request you once again to please take part in the survey and mark your replies honestly.

This is completely voluntary and will not affect your employment with the organization if you choose not to participate.

You are free to skip any questions you feel you are not comfortable in answering.

Thank you.

CONSENT:

Please click "NEXT" marking your agreement to take part in the survey. If you decide not to participate simply close this window. You can exit the survey at any point of time.

I agree to take part in the survey

PART 1: Employees' safety perceptions

This section includes descriptive sentences collected from various sources. All you have to do is to indicate how much you agree or disagree with each such sentence. That means how much it is true in your case.

In order to mark your answer, please select the appropriate number below each question.

1. Being reprimanded for a safety violation causes a worker to behave more safely.
   Strongly Disagree 1 2 3 4 5 6 Strongly Agree N/A
2. Where I work workers who violate safety regulations irritate their fellow workers even when no harm has resulted.
   Strongly Disagree 1 2 3 4 5 6 Strongly Agree N/A
3. Workers who behave safely have a higher chance of promotion than those who don't.
   Strongly Disagree 1 2 3 4 5 6 Strongly Agree N/A
4. My supervisor values workers' suggestions for correcting safety hazards.
   Strongly Disagree 1 2 3 4 5 6 Strongly Agree N/A
5. Our management is well informed about safety issues in this plant.
   Strongly Disagree 1 2 3 4 5 6 Strongly Agree N/A
6. In this organization good performance depends on safety training.
   Strongly Disagree 1 2 3 4 5 6 Strongly Agree N/A
7. Employees in my work group remind each other of the need to follow safety regulations.
   Strongly Disagree 1 2 3 4 5 6 Strongly Agree N/A
8. The best workers in the group expect other workers to behave safely.
   Strongly Disagree 1 2 3 4 5 6 Strongly Agree N/A
9. My job duties often interfere with my ability to comply with safety regulations.
   Strongly Disagree 1 2 3 4 5 6 Strongly Agree N/A
10. The protection of employees from exposure to occupational hazards is a high priority of the management where I work.
    Strongly Disagree 1 2 3 4 5 6 Strongly Agree N/A
11. Management in this organization is willing to invest money and effort to improve the safety level in the work place.
    Strongly Disagree 1 2 3 4 5 6 Strongly Agree N/A

12. My supervisor negatively evaluates workers who behave recklessly.

    Strongly Disagree 1 2 3 4 5 6 Strongly Agree N/A

13. Our management acts quickly to correct safety issues.

    Strongly Disagree 1 2 3 4 5 6 Strongly Agree N/A

14. The reward system at my work place promotes high performance even if it means acting unsafely.

    Strongly Disagree 1 2 3 4 5 6 Strongly Agree N/A

15. Where I work, there is a safety committee.

    Strongly Disagree 1 2 3 4 5 6 Strongly Agree N/A

16. Managers in this factory try to reduce risk levels as much as possible.

    Strongly Disagree 1 2 3 4 5 6 Strongly Agree N/A

17. Being involved in safety issues has a high priority in my organization.

    Strongly Disagree 1 2 3 4 5 6 Strongly Agree N/A

18. When a worker violates safety regulations, it has an adverse effect on the supervisor's evaluation of the worker even when it doesn't result in any apparent damage.

    Strongly Disagree 1 2 3 4 5 6 Strongly Agree N/A

19. Management views safety regulations violations very seriously even when they don't result in apparent damage.

    Strongly Disagree 1 2 3 4 5 6 Strongly Agree N/A

20. In my facility, compliance with safety regulations is part of employees' annual written evaluations.

    Strongly Disagree 1 2 3 4 5 6 Strongly Agree N/A

21. Safety issues are assigned high priority in management meetings in this organization.

    Strongly Disagree 1 2 3 4 5 6 Strongly Agree N/A

22. Management is willing to invest money and effort to improve the safety level.

    Strongly Disagree 1 2 3 4 5 6 Strongly Agree N/A

23. When a manager realizes that a hazardous situation has been found, he immediately attempts to put it under control.

    Strongly Disagree 1 2 3 4 5 6 Strongly Agree N/A

24. Workers who work safely try to emphasize it and make sure others appreciate it.

    Strongly Disagree 1 2 3 4 5 6 Strongly Agree N/A

25. In this organization a worker's safety record is one of the main factors in promotion decisions.

    Strongly Disagree 1 2 3 4 5 6 Strongly Agree N/A

26. Workers who use personal protection equipment are considered conscientious.

    Strongly Disagree 1 2 3 4 5 6 Strongly Agree N/A

27. Workers who behave safely have a higher chance of promotion than those who don't.

    Strongly Disagree 1 2 3 4 5 6 Strongly Agree N/A

28. Within this organization, workers who take safety-training courses have a better chance of promotion than those who don't.

    Strongly Disagree 1 2 3 4 5 6 Strongly Agree N/A

29. In this organization being involved in an accident has an adverse effect on a worker's reputation.

    Strongly Disagree 1 2 3 4 5 6 Strongly Agree N/A

30. Plant management in this factory is always willing to adopt new ideas in improving the safety level.

    Strongly Disagree 1 2 3 4 5 6 Strongly Agree N/A

31. Reporting safety violations is a common practice where I work.

    Strongly Disagree 1 2 3 4 5 6 Strongly Agree N/A

32. In this organization good performance depends on safety training.

    Strongly Disagree 1 2 3 4 5 6 Strongly Agree N/A

33. When a safety regulation is issued we are expected to follow it.

    Strongly Disagree 1 2 3 4 5 6 Strongly Agree N/A

PART 2: Individual and Cultural Traits Questionnaire

This Questionnaire contains two sections based on general behavior.

Section 1: This section is to find out how you think or behave in regard to yourself and to groups to which you belong. Please read the following questions and answer each question by indicating **how often** you would think or behave as described in each of the following items.

	Never or almost never	**Rarely**	**Occasionally**	**Often**	**Very often**	**Always**
1. I define myself as a competitive person.						
2. I enjoy being unique and different from others.						
3. Before I make a major decision I seek advice from people close to me.						
4. Even when I strongly disagree with my group members, I avoid an argument.						
5. I consult with superiors on work related matters.						
6. I believe that competition is a law of nature.						
7. I prefer competitive rather than non-competitive recreational activities						
8. Before taking a major trip I consult with my friends						
9. I sacrifice my self-interest for the benefit of my group						
10. I consider my friends' opinions before taking important actions						
11. I like to be accurate when I communicate						
12. I consider myself as a unique person separate from others						
13. It is important to consult close friends and get their ideas before making a decision						

	Never or almost never	Rarely	Occasionally	Often	Very often	Always
14. Without competition, I believe, it is not possible to have a good society						
15. I ask the advice of my friends before making career related decisions						
16. I prefer using indirect language rather than upsetting my friends by telling them directly what they might not like to hear						
17. It is important for me to act as an independent person						
18. I discuss job related problems with my parents/partner						
19. I take responsibility for my own actions						
20. I do not reveal my thoughts when it might initiate a dispute						
21. I try to achieve better grades (results) than my peers (co-workers)						
22. My personal identity independent is very important to me						
23. I enjoy working in situations involving competition with others						
24. I consult my family before making an important decision						
25. Winning is very important to me						
26. I see myself as “my own person”						

Section 2:

The items below inquire about what kind of person you think you are. Each item consists of a PAIR of characteristics, with the letters A-F in between. For example,

Not at all artistic	A...B...C...D…E…F	Very artistic

Each pair describes contradictory characteristics - that is, you cannot be both at the same time, such as very artistic and not at all artistic. The letters form a scale between the two extremes. Choose circle a letter, which describes where YOU fall on the scale. For example, if you think that you have no artistic ability, you would choose A. If you think that you are pretty good, you might choose D.

1. Not at all aggressive	A…B…C…D…E…F	Very Aggressive
2. Very submissive	A…B…C…D…E…F	Very Dominant
3. Very excitable in a major crisis	A…B…C…D…E…F	Not at all excitable in a major crisis
4. Highly needful of approval	A…B…C…D…E…F	Indifferent to others' approval
5. Feelings easily hurt	A…B…C…D…E…F	Feelings not easily hurt
6. Cries very easily	A…B…C…D…E…F	Never cries
7. Strong need for security	A…B…C…D…E…F	Very little need for security

PART 3: Demographic questions

For questions 4,5,6 and 7 please read and answer the appropriate question. If it says 'for U.S. residents' only then Indian residents skip to the next question. The same applies for the U.S residents only too.

1. Where do you currently reside?
   a. United States (U.S.)
   b. India

2. What is your age?
   a. Less than 20
   b. 20 to 29
   c. 30 to 39
   d. 40 to 49
   e. 50 to 60
   f. 60 to 64
   g. 65 and above

3. How long have you worked for your current employer?

   _____ Years

4. Where would you place yourself politically (United States (US) residents only)?
   Very Liberal 1 2 3 4 5 6 Very Conservative

N/A

5. Which political party would you associate yourself with (Indian residents only)?
   a. Communist party (CPI and CPM)
   b. National Congress Party (NCP)
   c. Indian National Congress (INC)
   d. Bahujan Samaj Party (BSP)
   e. Regional Party
   f. Bharatiya Janata Party (BJP)
   N/A

6. What is your annual household income (US residents only)?
   a. $20,000 and below
   b. $20,000 - $40,000
   c. $40,000 - $60,000
   d. $60,000 - $90,000
   e. $90,000 and above

7. What is your annual household income (Indian residents only)?
   a. Rs. 96,000 and below
   b. Rs. 96,000 – Rs. 150,000

c. Rs. 150,000 – Rs. 300,000
d. Rs. 300,000 – Rs. 500,000
e. Rs. 500,000 and above

8. Is English your primary language?

9. What is your educational background?

a. Less than high school
b. High school/GED
c. 2-year college degree (Associates)
d. Bachelor's degree (Bachelors: BA, BS)
e. Graduate degree (Master's)

10. Please specify your race/ethnicity

a. American Indian or Alaska Native
b. Asian
c. Black or African American
d. Caucasian or white
e. Hispanic or Latino
f. Native Hawaiian or other Pacific Islander
g. Other

11. Do you speak English at home? (Yes/No)

12. What is your religious background?

a. Christian – Catholic
b. Christian – Protestant
c. Christian – Other
d. Jewish
e. Muslim
f. Hindu
g. Buddhist
h. Other _____
i. None

Appendix 2:

Changes made to Zohar's (1980) items:

(Reproduced from Mueller et al., 1999 with permission)

#	Original Item	New Item	Comment
1	When a member of the safety committee approaches a worker and warns him, it really affects his behavior	Being reprimanded for a safety violation causes a worker to behave safely	
2	Workers who violate safety regulations aggravate their fellow workers even when no harm has resulted	Where I work, workers who violate safety regulations irritate their fellow workers even when no harm has resulted	
3	The risk level of my job concerns me quite a bit		Deleted – risk perception
4	Workers who behave safely have a higher chance for promotion than those who don't	Workers who behave safely have a higher chance for promotion than those who don't	
5	I usually inform my supervisor about safety hazards because they appreciate it and try to correct it	My supervisor values worker's suggestions for correcting safety hazards	Original was double-barreled
6	Our general plan manager is well informed about safety issues in this plant	Our management is well informed about safety issues in this plant	
7	The investment of money and effort in safety training programs is a worthy investment because it improves workers performance on the job	In this organization, good performance depends on safety training	Original reflects a belief
8	The best guys in our department care about safety and they want other workers to behave according to regulations	Employees in my group remind each other of the need to follow safety regulations -And-	Original item is double barreled; split into two

		The best workers in the group except other workers to behave safely	items
9	Work under a premium system has nothing to do with accidents. There are simply safe workers and unsafe ones.	My job duties often interfere with my ability to comply with safety regulations	Original item reflects a belief
10	The safety officer has much influence on what's happening in our factory	The protection of workers from exposure to occupational hazards is a high priority with management where I work	Researchers believed that few organizations had a safety officer
11	Plant management in this factory is willing to invest money and effort to improve the safety level in here	Management in this organization is willing to invest money and effort to improve the safety level in the workplace	
12	My safety training really helps me both in my work and at home		Original item reflects a belief
13	Reckless behavior results in a negative evaluation of supervisors towards that worker	My supervisor negatively evaluates workers who behave recklessly	
14	Our management is well informed about safety problems and it quickly acts to correct them	Our management acts quickly to correct safety issues	Original item is double barreled
15	My chance for being involved in an accident is quite large		
16	Because I am working under a premium system I do things so fast that I have no time to care for my safety	The reward system at my job promotes high performance even if it means acting unsafely	"Premium system" was changed because the researchers felt that the

			wording was confusing
17	The safety committee in our plant has a very positive effect on what is happening here	Where I work, there is a safety committee	The researchers felt that safety committee were uncommon in most organizations
18	Managers in this factory really care and try to reduce risk levels as much as possible	Managers in this factory try to reduce risk levels as much as possible	
19	I would like to become a member of our plant safety committee because it would give me more status	Being involved in safety issues has a high priority in my organization	
20	When a worker violates safety regulations it has an adverse effect on his supervisor's evaluation of him even when no harm was caused	When a worker violates safety regulations, it has an adverse effect on the supervisor's evaluation of the worker even when no harm was caused	
21	Our managers view safety regulation violations very seriously even when they have resulted in no apparent damage	Management views safety regulation violations very seriously even when they don't result in any apparent damage	
22	I am sure it is only a matter of time for me to get involved in an accident		Original item reflects a belief
23	When the safety officer has a negative opinion of someone it affects his supervisor's evaluation	In my facility, compliance with safety regulations is part of employees' annual written evaluations	
24	I think safety issues are assigned high priority in management	Safety issues are assigned high priority in management	Original item reflects a

	meetings	meetings in this organization	belief
25	The efforts invested in organizing safety training programs really pay back to the company	Management is willing to invest money and effort to improve safety level	
26	The safety problems in my job are very serious		Original item reflects a belief
27	When a manager realizes that a hazardous situation has been found he immediately attempts to put it under control	When a manager realizes that a hazardous situation has been found he immediately attempts to put it under control	
28	Workers who work safely try to emphasize it and make sure others appreciate it	Workers who work safely try to emphasize it and make sure others appreciate it	
29	Workers who take safety training courses are less involved in accidents than those who don't		Original item reflects a belief
30	One of the main factors affecting workers' evaluation for promotion is whether they were involved in an accident	In this organization, a worker's safety record is one of the main factors in promotion decision	
31	Workers who use personal protective equipment are not considered to be cowards but rather good and tidy workers	Workers who use personal protective equipment are considered to be conscientious	
32	Department managers usually remember who were involved in an accident and take it into consideration	Workers who behave safely have a higher chance for promotion than those who don't	Original item was vague
33	Workers who take safety training courses have a better chance for promotion than those who don't	Within this organization, workers who take safety training courses have a better chance for promotion than those who don't take safety training	

34	Compared to other facilities I think this one is rather dangerous		Original item reflects a belief
35	Being involved in an accident has an adverse effect on the worker's reputation	In this organization, Being involved in an accident has an adverse effect on the worker's reputation	
36	Plant management in this factory is always willing to adopt new ideas for improving the safety level	Plant management in this factory is always willing to adopt new ideas for improving the safety level	
37	Workers who don't work under a premium system can work more carefully		Original item reflects a belief
38	When a worker confronts a dangerous situation in his work environment he reports t to the safety officer	Reporting safety violations is a common place practice where I work	
39	Workers who take safety training courses are doing a better job than those who don't	In this organization, performance depends on safety training	
40	When the safety officer issues a safety regulation, we take it into consideration and behave accordingly	When a safety regulation is issued, we are expected to follow it	

Appendix 3:

Approval letter from the Campus Institutional Review Board (CIRB)

Campus Institutional Review Board
University of Missouri-Columbia

485 McReynolds Hall
Columbia, MO 65211-1150
PHONE: (573) 882-9585
FAX: (573) 884-0663

July 16, 2012

Principal Investigator: Valluru, Charan Teja
Department: University Stores

Your Exempt Amendment to project entitled *Towards a multicultural Safety Culture model: Measuring the relationships between Individual Cultural Traits (ICT) and Safety perceptions of employees in a manufacturing organization.* was reviewed and approved by the MU Campus Institutional Review Board according to terms and conditions described below:

IRB Project Number	1198240
Initial Application Approval Date	November 18, 2011
Approval Date of this Review	July 16, 2012
IRB Expiration Date	November 18, 2012
Level of Review	Exempt
Project Status	Active - Open to Enrollment
Risk Level	Minimal Risk

The principal investigator (PI) is responsible for all aspects and conduct of this study. The PI must comply with the following conditions of the approval:

1. No subjects may be involved in any study procedure prior to the IRB approval date or after the expiration date.
2. All unanticipated problems, serious adverse events, and deviations must be reported to the IRB within 5 days.
3. All modifications must be IRB approved by submitting the Exempt Amendment prior to implementation unless they are intended to reduce risk.
4. All recruitment materials and methods must be approved by the IRB prior to being used.
5. The Annual Exempt Certification Form must be submitted to the IRB for review and approval at least 30 days prior to the project expiration date.
6. Maintain all research records for a period of seven years from the project completion date.
7. Utilize the IRB stamped document informing subjects of the research and other approved research documents located within the document storage section of eIRB.

If you have any questions, please contact the Campus IRB at 573-882-9585 or umcresearchcirb@missouri.edu.

Thank you,

Charles Borduin, PhD
Campus IRB Chair

Appendix 4: Recruitment email:

Hello,

I am looking for participants for my research study. You are receiving this email because you are an employee of the manufacturing sector. Your email address was either obtained from your friends or colleagues or social networking websites such as Linkedin, Facebook or Orkut.

The main aim of this research is to understand the relationships between your personality and the way you feel about the safety situation at your workplace.

The survey is completely anonymous and that means there is no possible way of identifying you based on your answers. To take part in this study, all you would be doing is to fill out a survey online. The entire survey process will not take more than 10 minutes of your time. To be able to take part in this study, you must be/have been employed by a manufacturing organization, be proficient in English both verbal and written. You must also not be carrying any managerial functions.

If you are interested in participating please click on the link provided below, which will direct you to the survey site.
https://www.surveymonkey.com/s/FKF6J6V

Participation in this survey is voluntary and you can decide to stop completing the survey at any time by simply closing the browser window.

Please disregard this email if you have decided not to participate.
If you have any more questions or concerns with respect to the survey please feel free to contact me:
Charan Teja Valluru,
Graduate student, IMSE,
University of Missouri, Columbia.
Phone: 573 256 9724
Email: ctvrkf@mail.missouri.edu