

Determination of Safety Climate/Culture in Power Plants Using NOSACQ.



Thesis Submitted to

Superior College, Lahore

In Partial fulfillment of the

Requirement for the Degree of

Master of Philosophy in Environment, Health & Safety

By

Mian Farooq Bilal

Roll No. MSEH-F15-007.

Session: 2015-2017

Registration NO. MSEH-F15-007

Superior College, Lahore

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Approved By: _____

Prof. Dr. Kamran Moosa

Prof. Research Supervisor

Program Manager, Research Degrees

Thesis Submitted to



The Superior College

Lahore, Pakistan

**DECLARATION TO BE FILLED BY THE STUDENT AT THE TIME OF
SUBMISSION OF THESIS TO THE SUPERVISOR AND/OR FOR
EXTERNAL EVALUATION**

Section 1: Particular of the Student		
1.1	Full Name	Mian Farooq Bilal
1.2	Father Name	Mian Bilal Rasool
1.3	Roll No.	MSEH-F15-007
1.4	Program	Environment, Health & Safety

Section 1: Particular of the Thesis		
2.1	Title	Determination of Safety Climate in Power Plants Using NOSACQ (Case Study)
2.2	Supervisor Name	Dr. Kamran Moosa
2.3	Date of Completion	December 2017



The Superior College

Lahore, Pakistan

SUPERVISOR'S CERTIFICATE ON THESIS SUBMITTED BY A STUDENT

Section 1: Particulars of the Supervisor		
1.1	Full Name	PIQC Campus
1.2	Address	The Superior College, PIQC Campus, Lahore.

Section 1: Particular of the Student		
2.1	Full Name	Mian Farooq Bilal
2.2	Father Name	Mian Bilal Rasool
2.3	Roll No.	MSEH-F15-007
2.4	Program	Environment, Health & Safety

Section 3: Particular of the Thesis		
3.1	Title	Determination of Safety Climate/Culture in Power Plants Using NOSACQ
3.2	Supervisor Name	Dr. Kamran Moosa
3.3	Date of Completion	December 2017

I certify that:

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DEDICATION

This work is dedicated to my Teacher of Life, Professors of Supervisor, Colleagues,
family and friends who encouraged me to face any challenge.

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All praises are for Almighty Allah, The most beneficent. The source of all knowledge who guides us in darkness and helps in difficulties. He bestowed us with a potential and ability to contribute a little knowledge to mankind.

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ABSTRACT

This study is carried out on two private Power Plants of Pakistan, aiming to evaluate safety climate / culture of the power industry of Punjab. As per the Pakistan Economic Survey 2012-13, energy disruptions have hampered Pakistan's economic growth in recent years. Based on current scenarios and situation of the country with regards to power/energy, government is hugely focusing on the fulfilling of energy needs. For the contentment of energy numerous power plants are in construction / installation phase and others that achieved Commercial Operation Date are in Operational Phase. The Study encircles newer plants that are operating on baggage/coal as fuel. Although evaluating safety climate/culture is a complex process and has several schools of thoughts around it, for focused results this study was carried out deploying triangulation concept (Site Visit – Survey – Interview).

Throught literature review was performed at initial stage of study to learn international standing of Safety Culture, Climate and the Methodologies used for evaluating safety climate/culture of different organzaitions. NOSACQ 50 methodologys was considered best fit. The Nordic Occupational Safety Climate Questionnaire (NOSACQ-50) is an analytic and intervention tool which can be used to evaluate the status and progress of safety climate in an organization and further compare it to available benchmarking of similar industries at national and international level. (NOSACQ-50 database, 2010) the Nordic Safety Climate Questionnaire (NOSACQ-50) was developed by a Nordic network of occupational safety researchers. Based on theories and practice of what characterizes safety climate, seven dimensions were drawn up to form the basis of the 50 questions in the questionnaire and is based on organizational theory, safety climate theory, psychological theory, previous research, results acquired through studies and the continuous development process of the questionnaire. The study shows difference in safety climate perceived by leader and worker of the same organization and variation in safety climate /culture of organization studied in light of international benchmarks.

The Leaders of the organization perceived Safety climate/culture of the organztion mush higher to the one perceived by the worker, the people on gorund executing work.

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List of Abbreviations

DIM	Dimension
EHS	Environment Health & Safety
NOSACQ	The Nordic Occupational Safety-climate Questionnaire

CHAPTER ONE

INTRODUCTION

1. Introduction/Background

Safety-climate is considered to be the perceptions that has been developed by Manager and work party from policies, procedures and work practices related to safety. The Safety-climate is a psychological feature of employees' i.e (feel that they developed), that is compareable to the bahaviourial changes that appears in employees, related to their safety in workplaces. Though there is no solitary, globally single defined fixed definition of safety-climate, the key agreement that is there related to management sustenance for safety and the over-all significance given to it within the organization are crucial characteristics of safety-climate. The notion of work / safety-climate and how workers observe the safety-climate of their relevant active workplace was highlighted as an issue about 20 years ago, at that explicit time, it can be said that the Managemental decisions, experienced safety staff in a particular organization is the main cause by which injuries can be controlled easily i.e (the risk of injuries in an organization can be minimized by taking the particular safety measures) (Jhonson. E. S., 2007) there should be a stronge communicational understanding between the Management and the employess' the workforce and by keeping the common house keepings.(Gillen et al. 2001). The by-product of this consideration caused in the formation of numerous quantifiable questionnaires. Researchers recognized psychometric physiognomies (dependability, concept validity, content legitimacy) for these instruments, but noteworthy insufficiencies continued with admiration to the creation of the relationship between safety-climate and safety connected results by Cooper & Phillips (cited in Jhonson,

2007). In short, the responsible employees' of an organisation plays the role of contributing factor and thus helps in the reduction of accidents in particular organisation by determining the safety-climate. It is the responsibility of devoted employees towards the safety-climate of organizationa and its safety performance to provide an early warning of potential safety system failure.(Cooper M. D & Phillips R.A. 2004).It has been argued that poor attitude of management towards safety is the major reasons of safety problems and proceed towards accidents. Per Winter 1995 implementation of safe work practices is dependent of expectation of employees. The vicissitudes in the worklife of employees and vicissitudes in the business atmosphere internal and also external has brought great revolution in the organizational behavior. (Evans et.al., 2007) and many scholars recommended that gauging employee behavior towards-safety can be useful for measuring safety-climate and ultimately safety-climate overwhelms many of the boundaries of old-style safety measures and can bring improvement in safety programs. (Glendon A.i., & Litherland D.K 2001). The safety of workplace is very important for both management and for the employees' also for years and years. Donald and Canter (1994) according to them the risk and accidents takes place in a workplace is generally related to the safety-climate of that particular workplace (Siu wt.al., 2004) and safety performance measurement is a crucial part of achieving efficiency in continuous improvement Kumar A., Jain N.K., Patel P., (2015). Assessment, describing the improving safety-climate is usually considered a proactive / practical tactic to management and appropriate identification of factors that affect safety-climate must serve to identify situations that may cause major incident, so safety-climate serve as opportunities to prevent flaws to become the root causes of accidents in the future. Recent academic interest in the size of the security environment, has led to a proliferation of assessment instruments, usually in the form of a self-report questionnaire administered as a broad survey of the various components, principally the

energy industry. (R. Flin et al., 2000). Validity is the measure of true test. Although the main concern in this study is safety-climate but the factors effecting safety-climate has not been focused much and the testing of hypothesis is used for safety-related results and outcomes (David et.al 2003). A constructive safety-climate will consequently rise the regularity of safety performance / conduct among employee(s) exposed to corporeal or psychosocial strain. This might happen when to- management demostarte safety is significant within the group by financing. Investment in employee safety & Health foster shared insights of an organization's primacies with admiration to employee(s) well-being (Mearns, Hope, Ford, & Tetrick, 2010).

This study is carried out around power sector of Pakistan and aimed to providing an evaluation of safety-climate / culture of the power industry of Punjab, because as per the Pakistan Economic Survey 2012-13, energy disruptions have hampered Pakistan's economic growth in recent years. Pakistan has been facing a shortfall in demand for electricity from around 5000-5500 MW from 2007, which has led to long hours of power cuts in both urban & rural areas. (Pakistan Energy Vision 2035). In addition, since the initial 2000s, the energy division (especially its electricity subsector) received more attention because of the rapid growth of demand. The government put every effort to solve the problem even the crisis is not over. Based on the country's energy crisis, the government and the private sector are making efforts and investing in the electricity sector to overcome the crisis in the country, for which many power plants are being built throughout the country and several are being installed In the Punjab region. Based on the tremendous development emphasis was given the focus to determine the security climate of the energy sector as employee welfare and security has considered as one of the important measures of the functioning of an organization.

This study is providing an evaluation of safety-climate / culture of the power industry of Punjab, this study will provide areas of focus to current facilities and will be a guidance

document for the newly installed power plants. The purpose of this research is to evaluate the safety-climate/culture of 2 power plants located in Punjab Region of Pakistan. A collective review of safety-climate for the Power industry in Punjab was carried out, that will identify areas of focus. Based on the outcomes recommendations were made to for improving the existing safety-climate further will be a reference document of safety-climate of power industry. The study defined in this research addressed the need for constant study of the capability of safety-climate to forecast safety-related consequences.

This research investigated the associations between seven different dimensions of safety-climate (the management that must be able to improve the safety priority, giving proper rights to management of safety, management of safety dealing fairly, providing riskfree and proper safety to employees', importance of workers' safety, learn about the safety through stronge communication, and belives of workers' in management of safety system), three dimensions were related to management and remaining 4 were related to worker's behavior and perception by using the questioner. The Nordic Occupational Safety-climate Questionnaire (NOSACQ-50) was used in this research that is an analytic and this analytical tool thus helps in maintaining the safety-climate, and it also helps in the advancement of any organization. It is also a benchmarking instrument at a multiple level starting form a small group upto an organzniation and move to national &ninternational level. (NOSACQ-50 database, 2010) the Nordic Safety-climate Questionnaire (NOSACQ-50) was developed by a Nordic network of occupational safety researchers. Based on theories and practice of what characterizes safety-climate, seven dimensions were drawn up to form the basis of the 50 questions in the questionnaire and is based on organizational theory, safety-climate theory, behavioural theory, research that has already been conducted, results that take possession of studies and the development of process of the survey that remain

continuous. It was built on employee (n=300) replies to the questioner from different 5 power plants in Punjab region, observations of safe behavior, and interviews. In addition, the outcomes of the surveys were analyzed, through determining the mean of each dimension and a radar charts were generated;

- Overall of the organizational Safety-climate,
- Leaders safety-climate only,
- Workers Safety-climate only,

Organizational Worker's & Leaders Safety-climate Comparison will be generated in results and discussions:

The Leader Safety-climate of the organization will be compared with benchmark data of Energy sector available,

The Worker Safety-climate of the organization will be compared with Worker benchmark data of Energy sector available,

Question wise Worker versus Leader comparison for each dimension;

That results can be utilize by newly installed power plants to identify most focus area and strengthen the safety culture and climate.

This research shows the results of this specific study through a explanation of the: (a) theoretic context; (b) approaches used to achieve study objectives; (c) outcomes from this specific study/research; and (d) a conversation of the significance and utilization of foremost deductions.

This Safety-climate determination process will help organization to involve employees getting feedback in managing EHS management systems, as the process of this will require continues measuring and monitoring of the safety-climate year after year, that will bring continuous improvement in the safety system. This practice will not only help that organization to identify the areas that require focus, areas that require minor/slight improvements and areas / process that are going well and are should be

sustained. This collected data/information can be further used as a reference data for upcoming and in operation power plants. This is not a commonly known adopted practice in the region of study, all the power plants considered in the study were not aware of this concept and process of safety-climate. This exercise will help organization sustain / improve their EHS management systems. The management of the organization undergoing the process and management of other power plant organization, EHS experts, Students and researchers. This research will be of great support to the:

organization undergoing the process of understanding safety-climate of their organization and improve their EHS management system;

The determination of recommendation will be a reference data for other operation facility in the middle east region.

Students and researcher that plan to work safety-climate

1.1 Objective

The object of working and assess the Safety-climate in power industry in Pakistan;

- The following elements/ Dimension of Safety-climate were access:
 - To Measure the Management Safety priority level, Commitment and Competence in Power Plants
 - To Weigh level of Management Safety Empowerment in Power Plants
 - To Evaluate the level of Management Safety justice in Power Plants
 - To Calculate the level of Workers' Safety Commitment in Power Plants
 - To Judge the level of importance given to Workers' Safety and Riskfree environment in Power Plants
 - To Assess the level of Learning The Safety importance, Communication, and to believe in the co-workers' Safety Capability in Power Plants
 - To Assess the level of Trust and Efficacy of Safety system in Power Plants
- Relate the safety-climate with site visits and interview

- Based on outcome provide recommendation for improving EHS Management system.

1.2 Significance/ Rationale of the study

Pakistan is among those countries with significant shortfall in the production of electricity. Based on the country's energy crisis, government and private sector are making efforts and investing in power sector to overcome the country crisis, for which many power plants are being built across the country and several key power plants are in being installed in Punjab region. As more power Plants, will be commissioned and operationalized in a short window that will create a situation where personnel with less power industrial experience will be entertained and given high ranked jobs. This scenario will be caused due to sudden significant increase in the market need competent experienced Power plant personnel that will not be fully available. This situation will lead to accommodate personnel from different industrial background and lesser experience. This situation can cause high turnover in installed plants and mixed experienced employees in newly installed plants, this situation can lead to incidents with undesired results. As basic understanding the areas that may be impacted first are with weak safety culture. Evaluating, unfolding and cultivating safety-climate is usually viewed as a practical approach to safety management in a pro-active manner. Preferably, descriptions that are relating to safety-climate could aid to recognize the hidden circumstances of key accidents, and subsequently aid as chances to prevent organizational inadequacies that could result to future accidents. Safety-climate is hence claimed to enable analytical safety situational (upcoming / current & historical) monitoring which infers that there is a strong linkage between the accidents that takes place in workplace and the safety environment provided. In this thesis, the safety-climate of the power industries was determined, and recommendations were made to prevent the future accidents by developing positive safety-climate.

CHAPTER TWO

2.1. Introduction

The section includes the review of previously done works / available literature based on only valid and reliable arguments. APA citation protocol is utilized in review of this section advised style for referencing for the thesis.

2.2 Literature Review

2.2.1 Safety Culture & Safety-climate

2.2.1.1 Safety:

Safety in the workplace/location means ensuring and sustaining a condition free from injuries/illness and activity associated hazards. Proper methods, developments and procedures that will let employees to work without worrying about the safety. Evans, et.al. (2007)

2.2.1.2 Safety Culture

The safety culture can be defined the behavioural changes among the individuals (i.e. 'what the individuals do '), and the different circumstances of company (i.e. 'which facilities the organization has'). HSE. (2005)

2.2.1.3 History of Safety Culture:

Health & Safety executive talks and provides a historical tour of work done on safety culture in their studies that are tagged as 'safety culture, the primary made its presence in the International Nuclear Energy Agency's, the preliminary report subsequent to the

Chernobyl disaster (IAEA, 1986). From then investigations into foremost accidents like off the King's Cross fire (Fennell, 1988), Piper-Alpha (Cullen, 1990) and the Herald of Free Enterprise (Justice Sheen, 1987) have determined discrepancies in the organizational edifices and safety management arrangements, pitching the standing of safety-culture into the spotlight. HSE. (2005)

2.2.1.4 Safety-Climate

The terminology **safety-climate** is used to denote to pattern of behaving of employees (i.e. 'feel they developed'), that is comparable to the behavioural changes that appears in employees, related to their safety in workplaces. Although there is no solitary, generally putative definition(s) of safety-climate, but the wide-ranging agreement that already exists that is, organizational sustenance for safety and the cumulative values & preference furnished to safety by any organization(s) are key characteristics of safety-climate. David M. D. et. al., (2003) Safety-climate can be considered to be a subgroup of organizational climate. Denison (1996) stated that organizational climate, "...portrays organizational environments as being rooted in the organization's value system but tends to present these social environments in relatively static terms, describing them in terms of fixed (and broadly applicable) sets of dimensions. Thus, climate is often considered as relatively temporary, subject to direct control, and largely limited to those aspects of the social environment that are consciously perceived by organizational members." Cited in Evans, et.al. (2007).

2.2.1.4 History of safety-climate:

The notion used for safety-climate and the workers observed/preceived value for the safety-climate of their work-place/area was upstretched as an problem approximately 20 (twenty) years ago, at that very time, it can be said that the Managemental decisions, experienced safety staff in a particular organization is the main cause by which injuries

can be controlled easily i.e (the risk of injuries in an organization can be minimized by taking the particular safety measures) (Jhonson. E. S., 2007) there should be a stronge communicational understanding between the Management and the employess' the workforce and by keeping the common house keepings. (Gillen et al. 2001). The by-product raised concern / problem / issue resulted in the development of several questionnaires. Scholars recognized psychometric characteristics (dependability, concept legitimacy, content legitimacy) for the developed Tools/instruments, but noteworthy insufficiencies continued with respect to the creation relationship between safety-climate and safety-related results by Cooper & Phillips (cited in Jhonson, 2007)

2.1.1.5 Relationship between Safety-climate & Safety Culture

Regardless of the variances that exists between safety-climate and culture, the mentioned two are utilized in an interchangeably manner in the provided literature. Both of the mentioned concepts have their backgrounds in two quite different theoretical and methodical traditions: "Climate from a psychometric institution, and culture from a sociological and anthropological tradition". Kvalheim A.S., et.al., (2016) The factoring involving to just define the concept of culture along with the insentient nature of the elementary norms make it hard to inspiration culture directly. Another way to tactic such changes would be by observing at the connected thought of climate, which defines the communal the preceptions that has been developed by Manager and work party from policies, procedures and work practices related to safety, both official and un-offical (Reichers & Schneider, 1990). The variances that exists between the safety-climate and Safety-culture principlally argued at a great scale both within safety science(s) and at organizational status (Guldenmund 2000; Reichers & Schneider, 1990). However, the two concepts are considered close to each other that is drivern from the perceived understanding of employees created over time, where culture is considered more of a abstract and is a strong build than the climate that is easy to be

manipulated. (Guldenmund, 2000). In Schein's understanding, "organizational climate is a surface appearance of the deeper cultural levels and a reflection of leaders' attempts to implant culture" (Schein, 2004). Thus, climate is an entry way to work on/with the culture, as it is a measurable concept that is knotted to the formation of culture. K.J. Nielsen (2014).

2.2.2 Organizational Climate

Organizational climate characteristically comprises several different discrete assessments of the work environment James & James, 1989 cited in (David M. D. et. al., 2003). These assessments consist of valuations or reasoning assessments of multiple core magnitudes or features of the workroom, for instance, innovation, participation, message and leadership. At the time when these evaluations are taken into account in combination that are powerful in defining series of employee behaviours and the overall considerations of the organization. Schneider, 1975 cited in (David M. D. et. al., 2003)

2.2.3. Different Studies and factors for determining safety-climate:

The approach to evaluate any work place's safety-climate is accounted as a proactive tactic to manage organization's safety, as the trends are allotting a reasonable added emphasis on considering it as a early sign/alarm in relation to the occurrence of a high potential event, it has been evaluated that there is a added need to judgmentally assessing the ongoing practices to determine the cautionary signals of risk to organizations. (S.A. Kvalheim et al. 2016). Constructive safety-climate can increase safe presentation moreover through rewards/recognition or through values of communal conversation (Zohar, 2000; Clarke, 2006b) and that safety-climate strength meanderingly touch safety behavior through some interference variables (Griffin and Neal, 2000; Zohar and Luria, 2003) cited in (Xinxia Liu. Et.al., 2015). The Brown and Holmes encompassed

the three factors in their final tool for defining safety-climate, that represent safety-climate as: (a) employee vision of management's involvement with their concern ; (b) approach of employee that how fast the management was resolving these concerns ; and (c) how employees observed current corporeal risk. cited in (Gillen et al. 2001).

J. Ajslev et al. referred study of Kines et al., 2011 on reliability of NOSACQ-50 tool for determining the safety-climate and useful for predicting the safety in future , noted down the individual safety level. J. Ajslev et al. (2017) used five questions to determine safety-climate as following (1) "Management confirms that everyone obtains the essential facts on safety", (2) "It boosts employees to effort in peacefull environment with proper safety plans – even when highly work agenda is fitted", (3) "Management includes employees in decisions regarding safety", (4) "every employee help each other while working and teach each other that how to work and built safe enviroment ", (5) "people working there considers unfortune incidents as a usual part of our everyday work".

A current analysis of 56 Fifty-six studies of safety-climate and its connection with safety related pointers such as ill healthiness and grievances in the building industry states that "safety-climate measurements can be used to proactively assess an organization's effectiveness in identifying and remediating work- related hazards, thereby reducing or preventing work-related ill health and injury" Schwatka et.al., cited in (S.A. Kvalheim et al. 2016).

In another study carried out by B. Bronkhorst (2015) evaluating the correlation between job demands, safety-climate, job resources and safety behavior amid employees occupied in healthcare. By integrating safety-climate concept in the JD-R model, it was apparent that, job resources, safety-climate and job demands play a character in operative physical and psychosocial safety-behavior. However, Huang H.Y., et.al., (2016) used key factors of employees', engagement, satisfaction level and rate of

turnover to highlight the important and valuable effects of safety-climate apart from safety results. According to them Safety-climate, it is a scope of the standard to which safety is an important factor for them to work in a place where the safety of employees given high significance in their organisation. Working safety-climate is made to use measure of the risk of uncertain events and injuries at workplace. J. Ajslev et al. (2017) examined the factors that are connected to the safety-climate and uncertain events at workplace. Many safety-climate hitches are increasingly related with amplified odds for undergoing accidents. The more safety problems are faced by the new and young employees that are unaware of the safety environment and thus are involved in accidents. Mainly the transport area and construction area's workers are Particularly manufacturing, transport, service workers and construction are more probable to involvement safety-climate problems.

2.2.4 Dimensions

2.2.4.1 Management priority, commitment, and competence:

Managerial commitment is defined as “engaging in and maintaining behaviors that help others to achieve goals” top performance corporations direct high pledge to safety by evolving process in which workers can participate and which is applied and checked so both organizational leaders and staff can receive response. The companies which have behavior safety process applied high level of management commitment, delegate authorities to workforce, resources are required to attain organizational goals. Dominic cooper (2006). Zohar stresses on the understanding of safety-climate must be known to be having several dimensions and facade specific notion, showing the safety status by investigating management and workers' pledge and attitudes for safety. J. Ajslev et al. (2016). Safety awareness and conduct are developed not certainly but only because of the actual arrangement of numerous actions. Consequently, it is essential to appraise

the outcome, that include the question of asking what are the important aspects that constitute the organization, "a mechanism for continuously improving safety" and has substantial monotonous happenings for ornamental safety. The start point for ensuing the Safety-culture is improving continuously which is the central/key aspect that plays a leading role in the management of an organization experiences "cognitive transformation" Shi. G., & Shiichiro. I., (2012). Multiple studies voices that a 'positive' "safety-climate" is connected with advanced levels of work-place safety over enhancement of employees' safety inspiration and involvement (Neal and Griffin, 2006), cited in J. Ajslev et al. 2016.

A constructive safety-climate will consequently rise the occurrence of safety performance amongst workforces exposed to physical or psychosocial stress. It can happen once top management demonstrates their commitment by furnishing applicable resources. Spending on employee with regards to health and safety is reflection to the organizations primacies relating to worker well-being (Mearns, Hope, Ford, & Tetrick, 2010). K.J. Nielsen (2014) in his case study proved that safety culture can be upgraded through better health & Safety-climate in his research he observes low safety commitment, low safety priority with worker, unsafe behavior & management obligation as indicated by meetings and survey data. This echoed the overall attitudes to safety of organization and workers, little was spent with regards to safety and external advisors were not welcomed for any inputs. Situation got better once top management get involved in safety related matters, as top organizational leaders commitment is a key/critical aspect for generating transformation.

It is reasoned that the methodology deployed for communication that is considered to be connected with transformational-leadership work-method that offers a appropriate model for increasing both confidence and work-related safety (Zacharatos., et al., 2005). The Transformational leaders intellectually inspire, rouse and are individually

understanding of employees (Bass & Avolio, 1994). Employees are encouraged to keep a side personal expansion and attain at a mutual understanding & collective goalmouths (Bass & Avolio, 1994), that rationally is baised to the acceptance of safety-culture.

Leadership is an continuing demonstration of the oth taken for the safety, neglecting the fact at what level of management role one's play, the safety duties must be performed continuesly and prove their commitment to safety and health principles daily. OSHA (2009) stated 7 principles of employee involvement in participation guide.

Principle #1: It is important that a climate of mutal trust must be there between workers and manager with respect. The people must be trusted by their leaders/managers.

The Leaders/managers must have trust on the system that has sustained talented employees and empower them for decision making. The other part of relation is that peoples must have trust on their leaders/managers only to ensure a safe work place. This mutal trust is the key, if the key trust is missing then the real success does not exist.

Principle #2: The work party at all levels must be aware of the larger picture. The organizational goals, objectives, targets, pirorities etc must be known at all levels as this will help generate great ideas to achive the set targets and ownership of employee will move to next level. This all will generate a positive climate.

Principle #3: Miscellany must be respected, open forums collacting multiple taughts will be better than single source of input, further this also facilitates the concept of team work. The practice of collating this taughts must be effectively and openly welcomed. The decision making must be based on collected inputs. These inputs must be soltion oriented. These methods not only help collect pragmatic solutions but also strenghted the team work approach /culture/climate.

Principle #4: Leaders / Managers must not keep the control within same level.

It is important that the employees are not micro managed but are given required competencies by mentoring of the manager. They should be given the power to take decision on safety & health matters in their area of expertise. The manager should empower them and ensure they are communicating with the team leaders/ managers to ensure the work is progressing in a safe direction. The people must not have the feeling that they are being controlled and do not have the free will for safety. Further the manager /leaders must continue to coach the team mates. The team mates must raise red flags when they encounter any concern.

Principle #5: Employees must be empowered and has no Fear to get involved.

The workers / employees must be comfortable highlighting /raising red flags for concerns over safety and health, this should be done without any fear at all regarding consequential punishment / retaliation or reprisal. This dictates that the leaders/managers must be open to hear out the concerns raised by the team. The approach to these concerns must be taken with optimism that is to emphasis on the root cause / causal factors rather than the human behind the scene.

Principle #6: Open / uninfluenced communication environment.

All the stakeholders must be open to obtain/receive feedback at all times. Leaders/manager must demonstrate openness for exchanging information, sharing available information and also listening. The ability to listen does not limit to capacity/capability of coming across good news, without "shooting the messenger. ". Employees/work team should be enthusiastic to reach out to managers/leaders, where they are provided with constructive suggestions.

Principle #7: Environment of sharing positive Reinforcement.

The environment of encouragement from the leads is important, at the time when safety & health and issue are raised. The observing work team will get confidence on the

processes and will encourage them to encourage them to raise voice and generate an open reporting system.

2.2.4.2 Management safety Empowerment:

To empower anyone is to make the individuals able to take actions confidently (Breeding, 1996). The ability to take decisions, the workers' contributions towards the organisation and to make managers trust workers' is called the true allocation of empowerment (Kines et al, 2011). Managers can show their trust by sanctioning the organisation workers'. Enablement would reinforce public connections, and in those circumstances where the safety of employees is very important for an organization would boosts the reinforce and reciprocation safety behavior (Kines et al, 2011) cited in safe work Australia report (2016). Likewise, taking more part in managerial issues enhances the information and make easily to take decisions which results in high rated productivity. Lately, the transformation of the workplaces has been characterized as the word high-performance working systems. Which includes the commitment of employees, it also includes the competitive environment, the hard work of employees and human practices. (Zacharatos et al. 2005). As far as the safe work is concerned Australia report on Observed stages of management Health & safety empowerment and equality among employers of Australia "Employers generally perceived that management safety empowerment was performed frequently in their businesses. In terms of consultation, 90% of employers indicated that their business considers workers' proposals regarding safety most of the time or always, and 88% of employers showed that their business encourages workers to join in decisions which affect their safety. Most employers also indicated that their businesses worked to foster a safe environment by scheming useful systems of work (82%) and ensuring that workers have a high level of competence regarding safety (89%) most of the time or always". Safe

work Australia report (2016). Communication is the best way to develop trust among them to achieve a good high-performance system. However, it is important to set a good example by listening and understanding the employee's problems which may provide them satisfactory and try to resolve their problems by taking serious managerial actions. Mitchell. J (2008). Treating workers with respect and as intelligent individuals they become more responsible and more dedicated towards their workplace and this will also help the organisation in high performance. As far as High-performance is concerned the workers are main source for the work systems and working in a competitive environment also results in improvement. This may be achieved by encouraging them and providing them good quality training classes and by sharing information and experience with each. (Zacharatos et al. 2005). Whitener et al. (1998) proposed that five features inspiring employee's observations of managerial dependability. These include behavioral steadiness, information passed on, behavioral integrity and allocation of control, a demo of concern for the well-being of others and open communication.

2.2.4.3 Management safety justice

The employees making intentional deviation and impacting the culture lead to create a unjust treatment for the ones that are make a honest deviation (Kinas et all, 2011). The NOSACQ fifty-50 shoulders that the employee responsibility towards safety & behavior could be certainly influenced positively by procedures developed by management and the interface safety justice, such plans / work instruction and fair treatment while dealing with near miss or incidents (Kinas et all, 2011) cited in Safe work Australia report 2016. There are ample dissimilarities in different organizations, creating undesired restrictions between individuals may affects performance and leaves harmful motivation. DeJoy (1994) said that in mangemental safety where placing blame for unwanted events is so inherent, there may be a bias for conclusions about the causes of

injury. It is aligned with attributional theory, it is supposed to be in top management's policy to blame the innocent workers for the sake of safety of other top managers'. In comparison, workers should hold the responsibility of injuries at workplaces. Cited in Zacharatos et al. 2005). Commonly the Employers shows more responsibility and safety equality if they are working with young workers or new trainees. For example, all the employers while working with trainees (97%) showed themselves more responsible and they tend to report the health, security and safety management on time (safe work Australia report 2016). Gillen, Baltz, Gassel, Kirch, and Vaccaro (2002) stated that union among the workers are more probable to observe their seniors as caring about their safety as compared to other nonunion workers. (Zacharatos et al. 2005). In a high-performance work system, everybody feels like they can give their best in order to increase the organisational output. Measuring the safety-climate allows them to find out how other workers work, other safety affairs that can be managed by the manager should be known to everyone, and the behaviour of employees and coworkers towards the safety, etc (Kouabenan et.al., 2015) Studies summarize that the dramatic change of leadership for safety is somehow helpful. Yule (2003; cited by Mitchell. J (2008) in his study said that the dramatic change in leadership in the UK energy sector, led the organizational units surprisingly lower rate of injuries. Yule found out several employee's attitude which includes open talks about the safety issues, main staff in concluding and being unbiased while dealing with such safety problems.

2.2.4.4 Workers' Safety Commitment

Commitment is known as the level of trustworthiness to which some organisation connects with other's organisation the relation is worth spending time and money for establishment and promotion. Two dimensions of commitment are continuance commitment, which is defined as the mean line of behavior, and affective commitment, is known as emotional introduction. (Paine 2003)

Managers in administrations are tackled with challenging priorities & may consequently make interchange by raising their obligation to firm aspects of the business whereas ignoring others. To well understand the relation of management commitment to the safety affects employee results, Employer awards extra pay, good training, social and emotional support to those employees who gives their best and show more responsibility towards their work and hence results in high performance outcomes or production, this type of theory is known as new social exchange theory. (Michae et.al., 2005) the workers' job satisfaction is related to the meaningful and other organizational responsibilities, standards and the practical work at the workplace. The work perfection and safety-climate are the main expected part to increase the workers' satisfaction level. In effect, the anticipated level of structural support, the organizational and other social organizational are closely related to the safety and are important factors for the safety environment. (Gyekye A.S 2005)

The assurance of employees is the main fact that failure happens to use the safety precautions that are provided at workplaces, still 40% of work accidents happens there. Many efforts have been done but the statistic remains same for more than 20 years. (Zohar and Gil , 2003, p. 567 (781) Other safety-climate researchers also identified / found similar sort of findings supportive to the positive association among safety-climate and employees' commitment (e.g., Dejoy et al., 2010), which additional provisions the communal conversational argument in that employees/staff/workerrrs incline to be more committed to the organization, only if they detect organizational apprehension for their individual safety & well-being. Employees that are enthusiastic, are more inspired, committed and energized to carryout their job/work, consequently resulting in raised levels of rendezvous at work (Dejoy et al., 2010). Organizational pledge to safety is a broader notion than job fulfillment since it encicile attitudes to the organization than of individual's job. Commitment are classed into three sects: (a)

“affective commitment,” (b), normative commitment and (c) continuance commitment. Normative commitment is the feeling that employees have for their organisation, while continuance commitment refers to a person's belief that there is some cost related with leaving the organization) or that there are few alternatives to their current job. Affective commitment, which reflects a person's wish to remain with their employer. This is desirable for the organization because high levels of affective promise have been correlated with higher relative individual productivity. (Michaie et.al., 2005)

2.2.4.5 Workers' safety priority and risk non-acceptance

The environment of an organisation has been known for the important alarm for the organizational outcomes as employees' approach of the state of these cases in place where they work have concerned their views regarding safety and behaviour of the work. A research reported that the organisational climate contributed much to affect the involvement among workers structure their positive responses to the work climate. (Michaie et.al., 2005). It is confirmed that there is a correlation between performance related to safety and safety environment. Silva et al. (2004) he said there are more evidences that positive thinking of safety and low uncertain incidents are highly related with each other, while Cooper and Phillips (2004), and then Seo (2005), According to him the positive safety observations and safety behaviours among workers is linked. Cited in Kouabenan et al. 2015). For the low injury rates and maintaining a safe place to work in it is important to sustain a high safety environment. It is important to keep measuring the Safety-climate it provides a clear picture of the culture of safety. as they it can be seen in the workers viewpoints about how the management is dealing with these situations on daily. However, research indicates that the safety in work places may be ignored by the workers during night shifts. There are several evidences which proves that the safety may be ignored by the workers working in night shifts. The major accidents that took place like Three Mile Island, Chernobyl and Exxon Valdez, all of

them happens during night shifts. Employees who have not suffered from any accident have the higher safety-climate as compared to those workers who have gone through these dangerous situations during work. (Bergh et.al., 2013) in 2014 Australian organisations workers were more irresponsible and careless as compared to workers in other professions. Workers of small or medium organisations are more involved in avoiding the safety precautions just to finish their work and the workers of large working organisations agree with this statement. According to these results and researches the work places of these little organisations are more likely in accepting the risk in work places. These workplaces need to give more attention on the factors by which the working environment is more involved in risk taking and breaking rules.

2.2.4.6 Safety communication, learning, and trust in co-worker's safety competence

It is true that trust is a worldwide accepted concept. Multi-level: it results in the form of interactions that space the workers, group and inter-organizational facilities. (Paine 2003) in (2000) Hale created the name 'creative mistrust' who disputed that workers should ask more questions to avoid the unwanted events and these incidents are because of trusting the technologies blindly. Trusting organisations may increase the people to accept the agreement or 'group decisions' and helps to reduce the self-sufficiency among them. (Reason, 1997). By developing the habit of questioning each other workers are more likely to understand each other's intentions and way of working. In this way, workers can easily understand the safer ways of working in an organisation. The area where human mistakes are common the 'creative mistrust' term is beneficial for organisation. Many would say 'Yes' under certain situations the most efficient employee can make a mistake. In a particular environment the checks would be placed in order to identify errors. For example, taking the process of breaking down the apparatus there may be mistakes in different levels under certain conditions (doing in

this condition many different checks can be made to reduce the errors. According to study conducted by Vaccaro et.al. 255 construction workers/labours that encountered nonfatal falls, their opinion / perceptions of the safety-climate of the worksite to the work location that caused them injury, and their perceptions of job demands, decision autonomy, and coworker sustenance were discovered as possible instrumental factors to the severity of their injuries. (Gillen et al. 2001, p. 35). The direct / indirect costs of safe committed behavior, including a steady pace, additional determination, or personal uneasiness, are given reasonable consideration than low-probability intimidations, resulting in a situation where the probable value of un-safe behavior surpasses that of defined safe performance such variation is reinforced by the fact that required safe/compliant behaviors consequences are of non-failures, whereas unsafe / non-compliant conduct result to impacts, subsequent in strengthening culture preferring safe behavior patterns. Thus, safe conduct departments decision-making challenges. (Zohar and Gil, 2003). It has been noticed that employees demonstrate compliant conduct when the senior encourage and support safety improvements, and where the co-workers are also demonstrating similar behaviors (Tucker et al., 2008). Workforces are trending to highlight more and more Safety issues to their seniors when they are influenced through effective of prevention programs (Kuenen et al. 2015)

2.2.4.7 Trust in the efficacy of safety systems

A broader-used description of belief was planned by Mayer, Davis & Schoorman (1995; p.712) as “the willingness of a party to be vulnerable to the actions of another party based on the expectation that the other will perform a particular action important to the trustor, irrespective of the ability to monitor or control that other party” Mitchell. J (2008). According to the Australian Transport Safety Bureau (2012) safety environment is a measure reticence of organizational injuries and managerial failure, which

includes the major reasons of these incidents there should be a control limit to ensure the security of the workers. The laws and regulations must be applied to both the high-risk companies as well as the low rate risk companies. it is important to explain that the perception of safety is a veritable starting point in decision making and in improving the workplace health and safety system, which offers information the about hazardous situations and conducts of risk that workers face in the performance of their work activities. Therefore, evaluating the perception of workers about the workplace health and safety system is important for assessing the level of compliance with the components of the health and safety system that have been established in the institution, in addition to the ownership and responsibility of each worker towards their own safety. (Macedonio et.al., 2016). The main reasons of breach of laws is higher in faith relationships. For example, if any employee acknowledged to have a close-hit to a trustable employee then they may not be threatened. Where as if an employee share any information with whome he does not belief then the threatened rate increases. They become more vulnerable if the trust was violated by the person they belief and hence it may cause behavioural changes in employeyes. (Mitchell. J (2008) a lot of researches concluded that trust plays a vital role in maintaining the safety environment with in an organisation. As, it is contended that the trust with ion organizational open talks and sharing habits among the employees helps in reducing the rate of errors. (Bonacich & Schneider, 1992).

As it is mind set of many peoples that management has the force of safety-climate and realated behaviours. (Conchie & Donald, 2006). That's why trust is an important for the workplace commitment and making true organizational decisions. Dirks & Ferrin, 2001). as management has least meetings with the employees so they lack trust and thus have less information and less shared experiences with them. The main safety messages are often conveyed by using the different technologies such as posters, videos etc. but

the employees who trust their management has more strong safety behaviours likewise, the message delivered from the management is related with safety. So, to develop the trust among the managers and employees it is important to find out the methods in which communication develops to make safety behaviors better. cited in Mitchell. J (2008)

CHAPTER 3

3. Research Methodology

Assessing safety-climate is multifaceted, time consuming, complex, effort requiring and adaptation of triangulated methods. No entirely satisfactory methodology has been developed yet for evaluating safety-climate. For obtaining better results both quantitative and qualitative approaches must be utilized when reviewing a safety-climate.

3.1 Site Selection:

Based on current scenarios and situation, Pakistan is now focusing on fulfilling energy needs, for that several power plants are in installation phase and many are operating. As a master student power sector was chosen in Punjab region for determining safety-climate of Power industry. For that different power plants were selected with operating baggas based fuel. After site selection meeting was arranged with management of plants to explain the rationale and significance of study and asked for support in filling the forms. Management agreed to give data with following condition.

1. Collected data will be solely used for research purpose without disclosing the name of sites.
2. To share the safety-climate results with management

Permission of site visit and interviewing the employees was also in the agenda at the time of meeting with management where they allowed for conducting interviews but with restriction to not to take any documents out of site premises.

3.2 Selection of questionnaire:

A literature review was completed in the start of the project to acquire more about safety culture, safety-climate and the approaches for evaluating safety-climate. After

literature review the questioner was chosen for the survey that is originally developed by NOSACQ 50. There were many questioners available in literature which were used with aim to determine safety-climate having different dimensions. Main reason for choosing NOSACQ 50 questioned from literature for

1. Constructing and developing questioner will take time.
2. Evaluation of validity and reliability of newly constructed questioner is a big challenge and time consuming.
 1. The questioner should be detailed to determine safety-climate
 2. The questioner must confirm reliability and validity.
 3. The questioner must cover all possible aspects of Management & workers.

3.3 The Nordic Safety-climate Questionnaire (NOSACQ-50)

The Nordic Occupational Safety-climate Questionnaire (NOSACQ-50) is an analytic and interference tool which can be utilized for the assessment the current status and development of safety-climate in an organization. It can be opt for benchmarking tool at a group/regional, organizational, sectoral, national and international level. (NOSACQ-50 database, 2010) the Nordic Safety-climate Questionnaire (NOSACQ-50) was developed by a Nordic team of occupational safety scholars. Based on theories and practice of what characterizes safety-climate, seven dimensions were drawn up to form the basis of the 50 questions in the questionnaire and is based on organizational theory, safety-climate philosophy, psychosomatic theory, previous research, results assimilated through studies and the incessant development process of the questionnaire. The seven dimensions' deal with:

- Respondents' perceptions of how their leaders deal with safety – dimensions 1, 2 & 3 (items 1-22), and

- Respondents' perceptions of how their co-workers deal with safety – dimensions 4, 5, & 6, as well as their perceptions of the formal safety system – dimension 7 (items 23-50)

The questionnaire consists of direct and reverse questions: details are as below; the questionnaire is organized in 7 dimensions with between 6-9 items each. The items can be classed into 02-two sets – those asked in a positive way and those items asked in a reversed (negated) way.

Table 3.1
The seven dimensions of safety climate and Question numbers

Dimensions	Positively formulated items	Reversed formulated items
Dimension 1- management safety priority and ability (9 items/questions):	A1, A2, A4, A6, A7	A3, A5, A8, A9
Dimension 2 – management safety empowerment (7 items):	A10, A11, A12, A14, A16	A13, A15
Dimension 3 – management safety justice (6 items):	A17, A19, A20, A22	A18, A21
Dimension 4 – workers' safety commitment (6 items):	A23, A24, A27	A25, A26, A28
Dimension 5 - workers' safety priority and risk non-acceptance (7 items):	A33	A29, A30, A31, A32, A34, A35
Dimension 6 – Peer safety communication learning, and trust in safety ability (8 items):	A36, A37, A38, A39, A40, A42, A43	A41
Dimension 7 – workers' trust in efficacy of safety systems (7 items/questions):	A44, A46, A48, A50	A45, A47, A49



Figure 3.1 The seven dimensions of safety climate

The questionnaire contains 50 questions with answer categories ranging from “Strongly disagree”, “Disagree”, “Agree” to “Strongly agree” (See table 1). In the analyses the answers are translated to a number on a scale from 1 (1 indicates a poor safety-climate) to 4 (4 indicate a healthy safety-climate). Depending on whether the question is positively or reverse worded, 4 points are given to either “Strongly agree” or “Strongly disagree”, respectively. If it is a positive question like e.g. “Management takes care of workers’ safety”, the answer “Strongly disagree” will score 1 points. On the other hand, if it is a reverse question like e.g. “Management never considers workers’ suggestions regarding safety”, the answer “Strongly disagree” will score 4 points., while “Strongly disagree” in this case only scores 1 point. All the substances in the questionnaire are answered in the same way (Lichert scale 1-4), but must be scored reliant on of the invention of the enquiry:

Table 3.2
Answer categories (Lichert scale 1-4)

	Strongly disagree	Disagree	Agree	Strongly agree
Score for positive items	1	2	3	4
Score for reversed items	4	3	2	1

The safety-climate is defined through seven Dimensions; the seven safety-climate dimensions are described below.

Dimension 1 – Management safety priority, commitment and competence:

Demonstrated management commitment to active safety Support, Protection and lead the way to salvation - prepared under time pressure. There is enough information on the risks and the workers believe in this direction has the knowledge and ability to handle security. Follow-up and execution: participation in the Management of salvation declared killed in action, i.e. more than just talking to salvation. Necessary precautions assignments and mental reactions to unsafe behavior

Dimension 2 - Management safety empowerment: The management initiates activities that support and encourage participation in safety.

Dimension 3 - Management safety justice: Justice i.e. no guilt: Workers who are involved in an accident are treated fairly. All circumstances are examined and there is a focus on preventing the reoccurrence of accidents.

Dimension 4 – Workers’ safety commitment: This dimension deals with issues where respondents estimate their co-workers – and indirectly their own – commitment to safety:

- a) Commitment to safety: The group of workers judge that safety work is a common responsibility, and that they support and initiate safety work.
- b) Safety follow-up and implementation: Participation in safety is expressed in continuous action by taking precautions and reacting to risky behavior.
- c) Co-operation on safety within the group: To take a common responsibility for safety.

Dimension 5 – Workers’ safety priority and risk non-acceptance:

This part discusses how worker’s priority security compared to production goals, e.g. If security is downgraded during the period of pressure. Knowledge of safety in dangerous work points to the fact that many workers accept that there are risks associated with their work. they see them as a problem at all, because it is an integrated part of their work duties. In some places, it may not be generally accepted to show fear of some tasks to work, because that is considered a "coward" and thus loose social standing. Workers also asked about their lack of fear and resignation when it comes to dealing with the risk.

Dimension 6 - Safety communication, learning and trust in co-worker safety competence:

This dimension deals with perceptions of the processes that support continuous learning about safety. There is an open and free communication on safety and risks at work. There are continuous improvements, i.e. are workers’ ideas of improvement of safety are taken seriously and used as a basis for safety improvements. Learning is also about the ability to analyses accidents and find causes, i.e. not just consider them to be” no-fault accidents” or due to “bad luck”. Furthermore, this dimension is about trust

between co-workers, which is very important when it comes to safety-climate. Trust concerns whether you can trust your co-workers to work safely and to follow safety rules. Trust also concerns whether commitment to safety work gives respect and social status.

Dimension 7 – Workers’ trust in the efficacy of safety systems:

This dimension deals with the workers’ perception of the efficacy of the formal safety systems like safety organizations, safety goals and objectives, planning (risk evaluation), safety inspections, safety training and the effectiveness of the persons responsible for safety, safety stewards and the safety committee.

3.6 The Procedure

The questionnaires were developed on google forms as per connivance of majority of the management of selected sites and online links were sent out via email to management who further disseminated forms to staff, each plant had configuration of general shift while operations staff comes in day and night shifts. Questionnaires were also provided in the central control rooms for those in-shift workers who did not work at the time of the delivery. Questioner was kept fully anonymously and volunteer keeping in view the Pakistan as developing country where workers are reluctant to raise their voices without any fear of retaliation and it was also stated in the questionnaire that the results would be presented in a way which assured that no individual and site would be identified. Site name was also kept confidential as it was decided during site selection meeting with management that collected data will be solely used for research purpose without disclosing the name of sites. English version of the questionnaire was used and for receiving the forms different mechanisms were used that were online submission of google forms, returned via the mail, the regular mail (advanced postage) or by handing the questionnaire directly to the author of this master’s thesis. The time for answering the questionnaire was altogether 6 months for collecting the feedback

from 200 workers, engineers and management from 2 different plants. From 2 plants 1 site choose to fill and submit online survey and 1 requested for hard copies which were sent through courier services and collected by hand.

For field workers who do not have approach to emails and computers hard forms were printed and shared with workers in person and few forms were printed in local language and explained to workers to obtain correct information.

After collection of all survey forms, interview and site visit was also conducted to validate the results of filled form.

3.7 Selection of interview questions

Basic reason to conduct interviews and site visits was to validate the collected data, as these forms were filled by workers with different educational background, stages, perception and understanding. We assumed that movement of workers is usually common and employees coming from smaller industrial structure have different understanding about safety-climate. Interview was not only focused the workers but also the management as 3 dimensions were related to management.

Interview questions were open ended and related to dimensions which mentioned in questioner and asked in very friendly way during site visits and understanding the process and major existing hazards at site. Site visit was focused on implementation, availability of procedure, communications, and understanding of workers. E.g. incident reporting, retaliation, procedures, investigation and corrective actions implementation status.

3.8 Data Analysis:

Only questionnaires returned with a filled information were included in the compilation of the results. The data collected through the interviews, site visits and the 50 items of

NOSACQ-50 were analyzed by using mini tab (version 17) and Microsoft Office Excel (2003 and 2007). The raw data from the items were used to calculate mean scores for each dimension and individual. Only answered items were used in the calculations. Forms were circulated among many plants but only those sites were included in analysis who responded with more than 20 forms to draw results based on larger samples. All answers for a dimension were excluded from the calculation if less than 70% of the items in that dimension were answered. The reason for this is that a mean score based on less than 70% of the items cannot be considered reliable. The mean scores for each dimension and individual were then used to calculate mean scores for each dimension and group. The minimum size of the studied groups was 200 individuals. The mean scores for the seven dimensions are displayed in radar charts in the results chapter. A radar chart is a 2-dimensional chart which can be used to present difference between averages of leaders and workers and comparison with bench mark.

For calculating variance dimension wise box charts were plotted to analyse each dimension.

3.9 Research Model:

Research Question:

What is the state of safety-climate in recently developed power plants in Pakistan.

- Is the level Management Safety priority, Commitment and Competence in Power Plants high or low?
- Is the level of Management Safety Empowerment in Power Plants High or Low?
- Is the level of Management Safety justice in Power Plants high or low?
- Is the level of Workers' Safety Commitment in Power Plants high or low?

- Is the level of Workers' Safety Priority and Risk non-acceptance in Power Plants high or low?
- Is the level of Safety Communication, Learning and trust in co-worker Safety Competence in Power Plants high or low?
- To Assess the level of Trust and Efficacy of Safety system in Power Plants high or low?

Limitations

- 1- The Feedback form Workers is moderately influential as the research questioner is floted to them through the organziational management.
- 2- The feedback is also impacted due to te level of EHS competency of leaders/workers.
- 3- The feedback is expected to be influenced as the research questioner is not in local language, the used questioneer was in english.

CHAPTER FOUR

4.0 Analysis: Result and Discussion:

For this study two organizations were taken into consideration that are power generating facilities using solid fuel i.e. Mainly bagasse but with a provision of Coal to be used, if required.

The Solid fuel-based cogeneration power plant with a gross capacity of around 50 - 60 MW. This plant consists of boilers and generators. The Fuel is burnt in the boiler from which steam is generated that is used to generate power with the installed turbines. For the management of smooth operations technical team members are hired, the organizational structure constitutes of 500 + Manpower where around 350 are laborer's handling fuel. The remaining 150 includes Management, Operations and Maintenance Team members.

The exercise was carried out to determine and analyses Safety-climate of power generating facilities, in this chapter we will see the safety-climate outcome of organizations as whole, safety-climate of workers and of leaders. Further comparisons will be generated for the workers and leaders for the analytical part, Along with this an overall researcher evaluation of the organizational Safety-climate. Only for this thesis a signs system is developed to represent organizational HSE gaps and recommendations to overcome those gaps.

Before we go in detailed results and discussion, below information is important to understand and for the validation of results, the source of the below remains that same and is NOSACQ.

As mentioned in the methodology section that a Survey will be carried out and mean value is calculated for each aspect, where the mean value will range between 1-4, where 1 is lowest level and 4 is highest level.

The scale mean: The mathematical mean for the scale 1-2-3-4 is 2.5. So, in principle results over 2.5 are positive (but there is usually room for improvement).

A rule of thumb for interpreting the results of each dimension:

- A score of more than 3.30 indicates a good level allowing for maintaining and continuing developments
- A score of 3.00 to 3.30 points to a fairly good level with slight need of improvement
- A score of 2.70 to 2.99 shows a fairly low level with need of improvement

Table 4.1

Safety Climate Ranges, Rating and Level of Action Required

Result Range	Sign	Means	Action Required
>3.30	★	Good Level	Maintain
3.00 to 3.30	✔	Fairly Good Level	Slight Need of Improvement
2.70 to 2.99	⚠	Fairly low Level	Need Improvement
<2.7	✘	low level	Great Need of improvement

- A score below 2.70 indicates a low level with great need of improvement

This scale along with signs are used for marking results of the safe climate determined through the defined methodology. As an overall evaluation of safety-climate was carried out including questioner survey, multiple site visits and interviews at all levels.

The determination of safety-climate is done using the seven dimensions:

“Dim1 - Management safety priority and ability

Dim2 - Management safety empowerment

Dim3 - Management safety justice

Dim4 - Worker safety commitment

Dim5 - Workers' safety priority and risk non-acceptance

Dim6 - Peer safety communication, learning, and trust in safety ability

Dim7 - Workers' trust in the efficacy of safety system”

4.1 Organization 1

The Solid fuel-based cogeneration power plant with a gross capacity of around 50 - 60 MW. This plant consists of boilers and generators. The Fuel is burnt in the boiler from which steam is generated that is used to generate power with the installed turbines. For the management of smooth operations technical team members are hired, the organizational structure constitutes of 500 + Manpower where around 350 are laborer’s handing fuel. The remaining 150 includes Management, Operations and Maintenance Team members.

Firstly, to just have flavor of what we are trying to determine and how the practice makes a difference when analysis is done separately for workers and leaders, to start with below is an overall safety-climate of the organizations; where six out of seven dimensions are at fairly good level and above.

Table 4.2
Over all Safety Climate of the organization 1

#	Category	Criteria	Overall	Worker Mean	Worker Median	Worker Benchmark	Leader Mean	Leader Median	Leader Benchmark
1	Management	Priority & Ability	3.05	2.9	2.78	3.09	3.22	3.28	3.32
2		Empowerment	3.03	2.95	3	3.01	3.11	3	3.22
3		Justice	3.04	2.97	2.83	3.02	3.12	3.17	3.28
4	Worker	Commitment	3.21	3.19	3.17	3.12	3.23	3	3.33
5		Priority & non Risk Acceptance	2.92	2.79	2.71	3.00	3.09	2.93	3.27
6	Co-Workers	Communication Learning & trust	3.17	3.1	3	3.13	3.23	3	3.31
7	Worker	Trust	3.36	3.27	3.14	3.22	3.46	3.36	3.34

Result Range	Sign	Means
>3.30	★	Good Level
3.00 to 3.30	🟢	Fairly Good Level
2.70 to 2.99	🟡	Fairly low Level
<2.7	🔴	low level

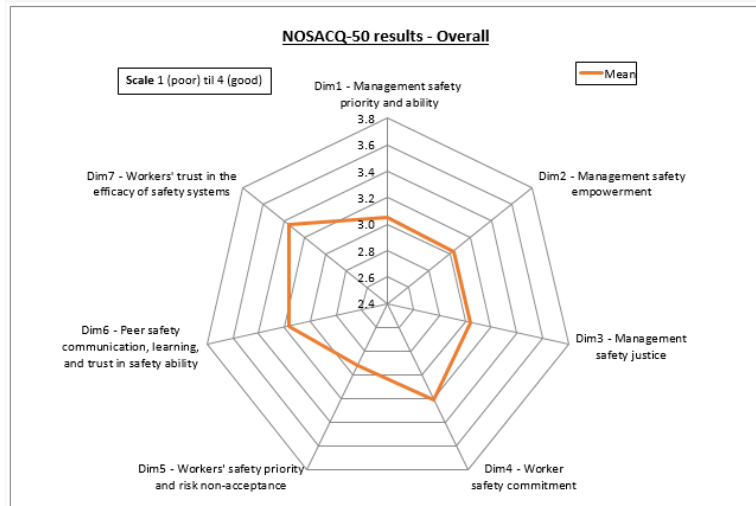


Figure 4.1 Comparison of Safety Climate for Overall Organization

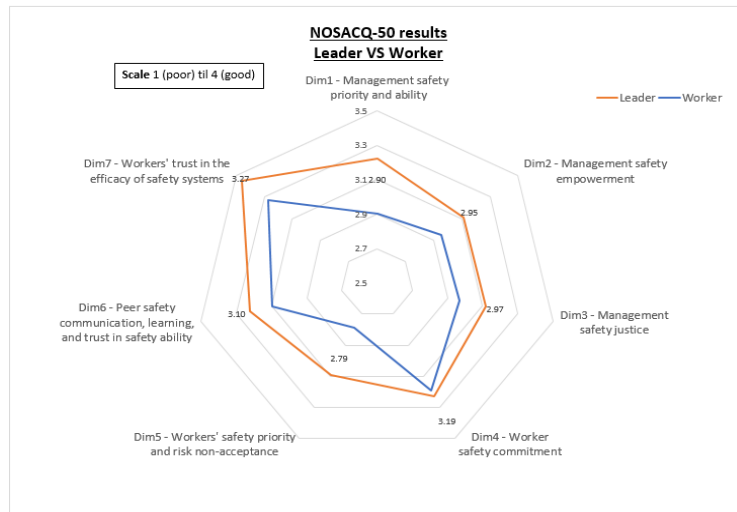


Figure 4.2 Comparison Safety Climate for Worker Verses Leaders

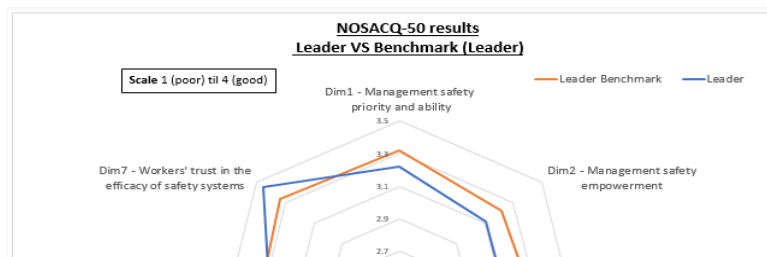


Figure 4.3 Comparison of Safety Climate for Leader Verses Leader Benchmark

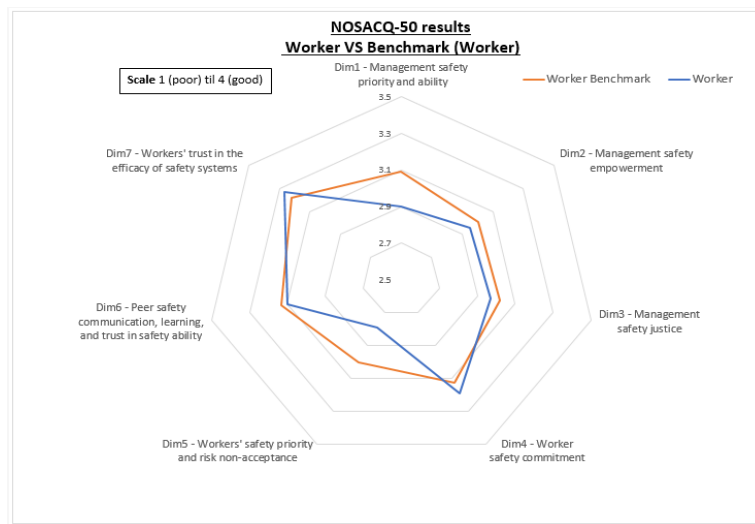


Figure 4.4 Comparison of Safety Climate for Workers Verses Worker Benchmark

4.2.1 Results:

4.2.1.1 Overall Safety-climate of the organization 1

Let's start off by reviewing the overall site safety-climate that includes Workers and Leader's as cumulative. The evaluation of the overall safety-climate for the Site indicates that it is Good and requires slight improvement. As per the methodology a safety-climate mean score over 2.5 is considered as a positive result and the overall results shows that most of the dimension range from 3.00 to 3.30, which means the site needs slight improvement.

4.1.1.2 Comparison Worker VS Leader for Organization 1:

The Safety-climate results of Worker and Leader shows strong correlation relation (Pearson Correlation: 0.83). The comparison graph illustrates; the Leaders of the organization rate the safety-climate at “Fairly Good” level and perceives that low level of improvements are required in the EHS management system. Whereas the worker’s rated Safety-climate shows that most of the dimensions are rated as “Fairly low” and worker consider that reasonable level of improves are required in the EHS system.

This comparison gives a better picture of the safety management system of the organization, as the overall safety-climate was rated as “Fairly Good” but this comparison shows that the overall organizational climate was impacted by the leader’s perception. The worker level of Safety-climate is rated fairly low, that actually relates more to the site observations and interview outcomes.

4.2.1.3 Comparison Leader Vs Leader Benchmark Organization 1:

Further the Leader Safety-climate was compared to the available benchmark rating of safety-climate for energy sector, the benchmark data was collected from 2785 Leaders. Upon comparison, the slight different in safety-climate perception was observed. For a deep dive T test was applied and the results are as below.

Table 4.3
One-Sample Statistics on DIM1 for Org.1

N	30
Mean	3.2220
Std.Deviation	0.40191
Std.Error Mean	0.07338

$$H_0 : m = 3.32$$

$$H_1 : m \neq 3.32$$

Table 4.4
One-Sample test on DIM 1 Org.1

t	DF	Sig.(2-tailed)	Mean Difference	95%Confidence Interval of the Difference	
-1.336	29	0.192	-0.09800	Lower -0.2481	Upper 0.0521

Since the sig. value is greater than 0.05 so H_0 accepted and H_1 rejected.

Table 4.5
One-Sample Statistics on DIM2 for Org.1

N	30
Mean	3.1100
Std.Deviation	0.33352
Std.Error Mean	0.06089

$$H_0 : m = 3.32$$

$$H_1 : m \neq 3.32$$

Table 4.6
One-Sample test on DIM 2 Org.1

T	DF	Sig.(2-tailed)	Mean Difference	95%Confidence Interval of the Difference	
-1.86	29	0.081	-0.11000	Lower -0.2345	Upper 0.0145

Since the sig. value is greater than 0.05 so H_0 accepted and H_1 rejected.

Table 4.7

One-Sample Statistics on DIM3 for Org.1

N	30
Mean	3.1167
Std.Deviation	0.52783
Std.Error Mean	0.09637

$$H_0 : \mu = 3.28$$

$$H_1 : \mu \neq 3.28$$

Table 4.8

One-Sample Statistics on DIM3 for Org.1

t	DF	Sig.(2-tailed)	Mean Difference	95% Confidence Interval of the Difference	
-1.695	29	0.101	-0.16333	Lower -0.3604	Upper 0.0338

Since the sig. value is greater than 0.05 so H_0 accepted and H_1 rejected.

Table 4.9

One-Sample Statistics on DIM4 for Org.1

N	30
Mean	3.2277
Std.Deviation	0.39725
Std.Error Mean	0.07253

$$H_0 : \mu = 3.33$$

$$H_1 : \mu \neq 3.33$$

Table 4.10

One-Sample test on DIM 4 Org.1

t	DF	Sig.(2-tailed)	Mean Difference	95% Confidence Interval of the Difference	
-1.411	29	0.169	-0.10233	Lower -0.2507	Upper 0.0460

Since the sig. value is greater than 0.05 so H_0 accepted and H_1 rejected.

Table 4.11 One-Sample Statistics on DIM 5 for Org.1

N	30
Mean	3.0930
Std.Deviation	0.42522
Std.Error Mean	0.07763

$$H_0 : \mu = 3.27$$

$$H_1 : \mu \neq 3.27$$

Table 4.12
One-Sample Statistics on DIM 5 for Org.1

t	DF	Sig.(2-tailed)	Mean Difference	95%Confidence Interval of the Difference	
-2.280	29	0.030	-0.1770	Lower -0.3358	Upper 0.0182

Since the sig. value is less than 0.05 so H_0 rejected and H_1 accepted.

Table 4.13
One-Sample Statistics on DIM 6 for Org.1

N	30
Mean	3.2277
Std.Deviation	0.37491
Std.Error Mean	0.06845

$$H_0 : \mu = 3.31$$

$$H_1 : \mu \neq 3.31$$

Table 4.14
One-Sample Statistics on DIM 6 for Org.1

t	DF	Sig.(2-tailed)	Mean Difference	95%Confidence Interval of the Difference	
-1.203	29	0.239	-0.08233	Lower -0.2223	Upper 0.0577

Since the sig. value is greater than 0.05 so H_0 accepted and H_1 rejected.

Table 4.15
One-Sample Statistics on DIM 7 for Org.1

N	30
Mean	3.4557
Std.Deviation	0.43279
Std.Error Mean	0.07902

$$H_0 : \mu = 3.34$$

$$H_1 : \mu \neq 3.34$$

Table 4.16
One-Sample Statistics on DIM 7 for Org.1

t	DF	Sig.(2-tailed)	Mean Difference	95% Confidence Interval of the Difference	
-1.464	29	0.154	0.11567	Lower -0.0459	Upper 0.2773

Since the sig. value is greater than 0.05 so H_0 accepted and H_1 rejected.

The One-Sample T-Test applied on the Worker response in reference to the benchmark values shows that Dimension 5 (Worker Safety priority & Risk Non-Acceptance) is the only dimension that is low / not equal to the benchmark value. This result is not very consistent to the mean comparison calculated. The results means the organization has strong safety-climate that is equivalent to benchmark.

4.2.1.4 Comparison Worker VS worker Benchmark Organization 1:

The comparison of Worker Safety-climate of the organization with the benchmark shows strong correlation. The benchmark safety-climate of energy sector collected from 5152 workers was used and compared, that shows variation in dimension 01 and 05. This indicates that the safety priority and ability of Management is low that might lead to workers accept risk while working.

Table 4.17
One-Sample Statistics on DIM 3 for Org.1

N	33
Mean	2.9694
Std.Deviation	0.32454
Std.Error Mean	0.05849

$$H_0 : \mu = 3.02$$

$$H_1 : \mu \neq 3.02$$

Table 4.18
One-Sample Statistics on DIM 3 for Org.1

t	DF	Sig.(2-tailed)	Mean Difference	95% Confidence Interval of the Difference	
-0.896	32	0.377	-0.05061	Lower -0.1657	Upper 0.0645

Since the sig. value is greater than 0.05 so H_0 accepted and H_1 rejected

Table 4.19
One-Sample Statistics on DIM 4 for Org.1

N	33
Mean	3.1912
Std.Deviation	0.34617
Std.Error Mean	0.06026

$$H_0 : \mu = 3.12$$

$$H_1 : \mu \neq 3.12$$

Table 4.20
One-Sample Statistics on DIM 4 for Org.1

T	DF	Sig.(2-tailed)	Mean Difference	95% Confidence Interval of the Difference	
1.182	32	.246	.07121	Lower -.0515	Upper .1940

Since the sig. value is greater than 0.05 so H_0 accepted and H_1 rejected.

Table 4.21 One-Sample Statistics on DIM 5 for Org.1

N	33
Mean	2.7858
Std.Deviation	0.35450
Std.Error Mean	0.05345

$$H_0 : \mu = 3.12$$

$$H_1 : \mu \neq 3.12$$

Table 4.22
One-Sample Statistics on DIM 5 for Org.1

T	DF	Sig.(2-tailed)	Mean Difference	95% Confidence Interval of the Difference	
-3.367	32	0.002	0.21424	Lower	Upper
				-0.3435	-0.0850

Since the sig. value is less than 0.05 so H_0 rejected and H_1 accepted.

Table 4.23
One-Sample Statistics on DIM 6 for Org.1

N	33
Mean	3.1012
Std.Deviation	0.26670
Std.Error Mean	0.04643

$$H_0 : \mu = 3.13$$

$$H_1 : \mu \neq 3.13$$

Table 4.24
One-Sample Statistics on DIM 6 for Org.1

T	DF	Sig.(2-tailed)	Mean Difference	95% Confidence Interval of the Difference	
-0.620	32	0.540	-0.02879	Lower	Upper
				-0.1234	0.0658

Since the sig. value is greater than 0.05 so H_0 accepted and H_1 rejected.

Table 4.25
One-Sample Statistics on DIM 7 for Org.1

N	33
Mean	3.2676
Std.Deviation	0.35657
Std.Error Mean	0.06207

$$H_0 : m = 3.22$$

$$H_1 : m \neq 3.22$$

Table 4.26
One-Sample Statistics on DIM 7 for Org.1

T	DF	Sig.(2-tailed)	Mean Difference	95% Confidence Interval of the Difference	
0.766	32	0.449	0.04758	Lower -0.0786	Upper 0.1740

Since the sig. value is greater than 0.05 so H_0 accepted and H_1 rejected.

The One-Sample T-Test applied on the Worker response in reference to the benchmark values shows that dimension 1 (Management Safety Priority & Competence) and Dimension 5 (Worker Safety priority & Risk Non-Acceptance) are the only that are low to the benchmark value. This result is not very consistent to the mean comparison calculated.

4.2.2 Discussion:

For a deep dive to analyses safety-climate site visits and employee interviews were conducted, based on the cumulative analysis it was concluded that the EHS management system of the organization is Fairly low and requires Improvements.

The overall climate is the collective representation of workers and leader's perception of the Safety Management system. To have a better picture the worker and Leader

safety-climate is evaluate and compared separately. This is to be considered while analyzing the results that the survey was spread in the organizations through the management and as per the local culture of the country open reporting / open feedback is not strength. This is to be considered that the feedback to survey will have a certain level of influence.

As Whole based on the site visit, interviews and second-hand information, it can be stated that the overall organizational safety-climate is fairly low and need improvement, knowing this upon detailed review of the organizational considering multiple factors, I would say the below related safety-climate is high than the actual organizational safety-climate standing. Among many influencing factor a key factor is the employee's safety Awareness level, as many of the interviewed employees were unable to recognize obvious risks. The observations during site walk downs again validate the point that the employee awareness level is low and certain level of risk are left unattended.

4.2.2.2 Comparison Worker VS Leader for Organization 1:

The interview and observation show that the Workers and Management are committed to work safely, but the Management / organizational commitment is not practiced on ground, the workers believes that management lacks to demonstrate their priority in Safety. As management wants workers to be safe but on ground resource allocation does not support what is said, gap of workers and management is observed as well.

The organization does not authorize/empower workers to practice Stop work authority and due to operational pressures, the workers are exposed to situations with uncontrolled risk. These situations are known and allowed by management.

Further the workers/ leaders have responded low levels of trust on Incident Investigation and it was shared several significant incidents occurred but were not

reported at all. In case a report was generated the records were not readily available. Few incident investigations were carried out by non-technical and untrained personnel and Root cause was not identified and the corrective actions defined and taken including termination of employees.

The triangulation - survey results, interview and on-site observations also shows that the worker and few leaders do not have true understanding of EHS management system / Safety-climate, this low awareness level has caused the higher rating.

4.2.2.3 Comparison Leader Vs Leader Benchmark Organization 1:

As mentioned earlier the safety-climate rated in the organization was much higher than the actual and on-ground condition of safety Management system.

4.2.2.4 Comparison Worker VS worker Benchmark Organization 1:

The figure above shows that, although the workers are committed to Safety but due to the EHS Management system the worker are prone to take risk at workplace to meet operational needs. As from the radar chart the workers trust on management commitment and subsequently worker's self-commitment is also low that shows workers commitment is directly impact by from the organizational / managements safety Commitment. Similarly, workers don't feel empowered enough to stop work. For Dimension 03, The variation in worker's safety-climate to the benchmark is quite low that should mean workers are confident to stop work that is not safe but that is not on ground practiced. All the point of discussion relates back to the worker's safety awareness and experience. As we move forward and review every dimension in detail we come across further variation in the safety-climate of aspect wise.

4.2 Dimension Wise Safety-climate Analysis:

To review Safety-climate in detail dimension wise review is generated:

4.3.1 Dimension 01: Management Safety Priority & Competence for Organization 1

Dimension one deal with the management commitment, to analyses question wise mean was calculated and a radar graph was generated, along with question wise Box plot in comparison with worker to leader;



Figure 4.5 Question wise Box Plot Comparison of Safety Climate for Worker Verses Leader for Dimension 1

Results:

As mentioned earlier that dimension 01 comprises of 09 questions, the variation in perception for Dimension one is illustrated in above figures, Question 05. “Management

accepts employees here taking risks when the work schedule is tight” is a reverse question, where the median value of manager and worker shows difference in perception for EHS management system, implemented at site. Workers show agreement to this aspect and Leaders show high level of disagreement that reflects management is either not aware of employee’s exposure to uncontrolled risk or they don’t consider risk taking as a concern. This can also mean that management’s perception to risk to quite low and risk taking is considered as an acceptable practice at site. The difference in mean for the question/item 5 between Worker and leader is >0.5 , this is the highest difference in mean from all the questions in dimension 01.

Discussion:

Relating the survey outcomes with the site visit and interviews it can be stated with sheer confidence that Management and worker’s EHS awareness and appreciation of the risk is low, in some cases this is due to the industrial background and EHS expertise level of employees.

Question / item # 9 of Dimension 01, “Management lacks the ability to deal with safety properly” was also responded with notable statistical difference where the difference in Mean is 0.4, 25 % of the worker population clearly agrees to the questions statement. The leaders of the organization complete disagree to the question statement. As 25 % of the worker population has shown concern in management ability to manage safety at site seem to be a reasonable number. As these surveys are shared upon approval from & by Site management, the openness of workers at certain aspect of the questioner can reflect the safety-climate of the organization.

4.3.2 Dimension 02: Management Safety Empowerment for Organization 1

Dimension two relates to management empowerment to employees, to analyses question wise mean was calculated and a radar graph was generated, along with question wise Box plot in comparison with worker to leader;



Figure 4.6 Question wise Box Plot Comparison of Safety Climate for Worker Verses Leader for Dimension 2

Results:

Dimension 02 of the survey comprises of 7 Questions / item's that relates to Management Safety Empowerment, the variation observed is in Question/ Item 16, "Management involves employees in decisions regarding safety". Where 25 % of the worker population has shown disagreement that shows lower level of worker involvement in safety decision making.

Discussion:

The onsite interview with worker and leaders shows reasonable communication gap and low level of worker safety ownership. The communication is not adequate and channels seem not be clear. The employee showed no confidence in stopping work that is/was unsafe, as per the workers the management priority is production focus. Where leaders believe that if a situation poses significant safety risk that will be reported and such

works should be stopped by worker. If the organization can improve communication channels and concept of open reporting, the safety-climate can be improved.

4.3.3 Dimension 03: Management Safety Justice for Organization 1

Dimension three deal with the management deployment of Safety Justice in organization, to analyses question wise mean was calculated and a radar graph was generated, along with question wise Box plot in comparison with worker to leader;



Figure 4.7 Question wise Box Plot Comparison of Safety Climate for Worker Verses Leader for Dimension 3

Results:

Dimension 03 relates to Management safety justice, the variation in safety-climate in worker and leader is observed in question/ item number 17 & 20. Where question 17 refers to the accuracy of the collected information for incident investigation the difference on mean is 0.5 and quartile 01 shows disagreement of workers, where as the leader are firm with regards to the information collected for investigation is correct and satisfactory. Question / item no 20 refers to blame game in event of an incident, 25 % of the leadership has agreed that in incident investigation the organization looks for the

guilty person not the causes. This was interesting observation as workers have shown satisfaction and the leaders were in disagreement.

Discussion:

On interviewing workers and leaders, the situation was clear as the organization has encountered a few significant incidents and they have resulted in termination of leaders not workers. The overall organization safety justice is evaluated as low, as the organization does not have a document process to manage incident Investigation, this has led to non-reporting of events and blame termination of leaders.

The organization need to define an incident investigation process that is focused on Root cause analysis & fact finding instead of fault finding, determining corrective actions and preventive actions.

4.3.4 Dimension 04: Worker Safety Commitment for Organization 1

Dimension four relates to worker’s personal commitment to Safety, to analyses question wise mean was calculated and a radar graph was generated, along with question wise Box plot in comparison with worker to leader;

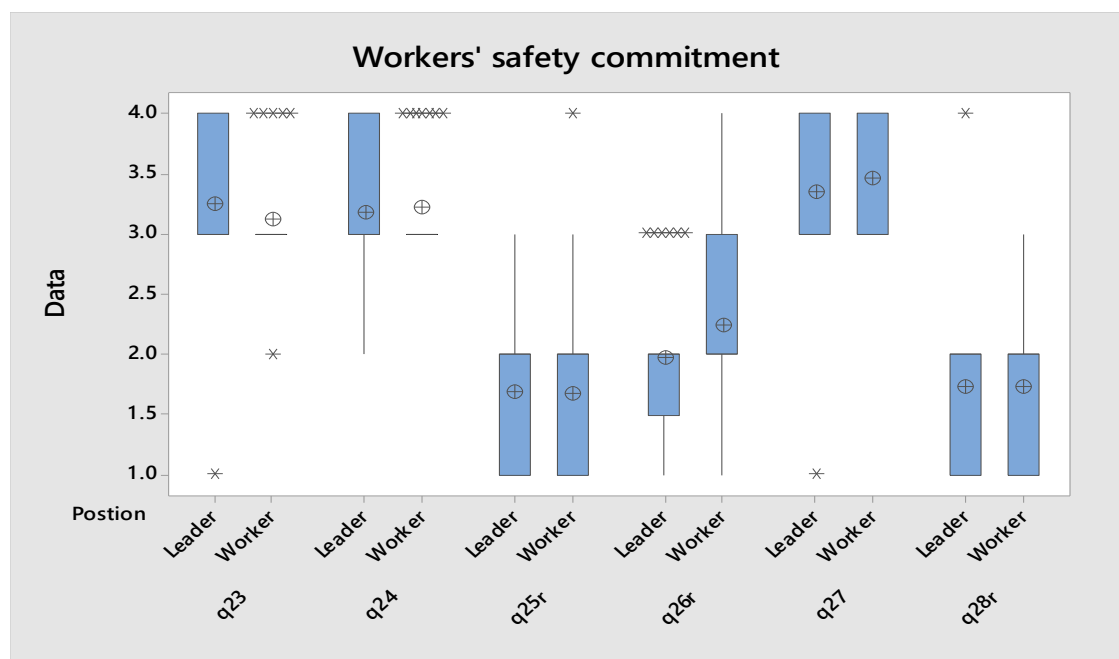


Figure 4.8 Question wise Box Plot Comparison of Safety Climate for Worker Verses Leader for Dimension 4

Results:

Dimension 04 relates to Worker Safety Commitment, at this aspect of the safety-climate the leaders and workers are aligned and the only variation observed in on question/item 26, that related to worker exposing themselves to know risks. 25 % of the worker population responded that they do require to take risk and expose themselves to situations of uncontrolled risk. This is consistent to earlier discussed variations.

4.3.5 Dimension5: Worker Safety priority & Risk Non-Acceptance for Organization 1

Dimension five talks about how worker’s priorities safety and what is risk non-acceptance level, to analyses question wise mean was calculated and a radar graph was generated, along with question wise Box plot in comparison with worker to leader;

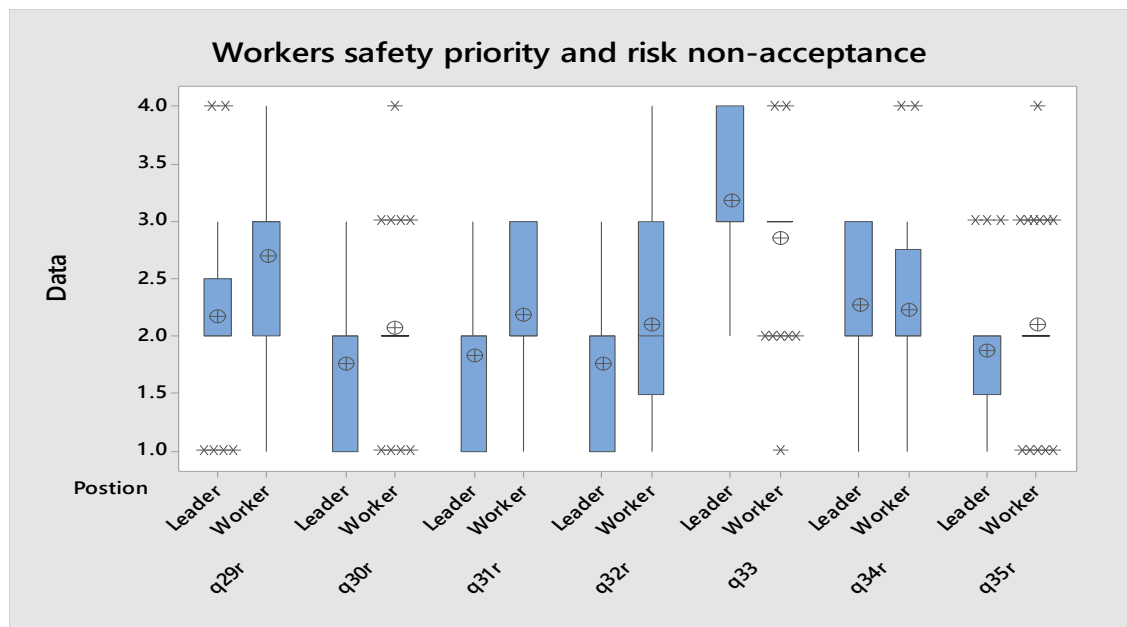


Figure 4.9 Question wise Box Plot Comparison of Safety Climate for Worker Verses Leader for Dimension 5

Results:

Dimension five of safety culture related to Worker Safety Priority and Risk non-acceptance, the variation is observed in three items, these items relate to acceptance of

risk & violating safety rules to meet targets. This is again constant to previous gaps where workers show agreement to reverse questions i.e. risk acceptance. The repetition of similar aspects of safety-climate identifies the focus area for the organization.

Discussion:

As multiple times, it is highlighted that the workers are exposed to situations of uncontrolled risk and they do this for meeting targets and as whole the organization has acceptability to take risks, considering no accident will happen. This was informed during interviews of leaders and workers that significant accidents have happened recently and organization had not taken known those in account. The workers based on the situation has been constantly been exposed to the risk and they have started to consider it as routine. It is concluded that routine exposures to unsafe situations over the period impact workers in a way that they began to consider risk taking as routine.

4.3.6 Dimension 6: Safety Communication & trust in Coworker Competence for Organization 1

Dimension six deals with communication and trust with / on co-workers based on their safety competence, to analyses question wise mean was calculated and a radar graph was generated, along with question wise Box plot in comparison with worker to leader;

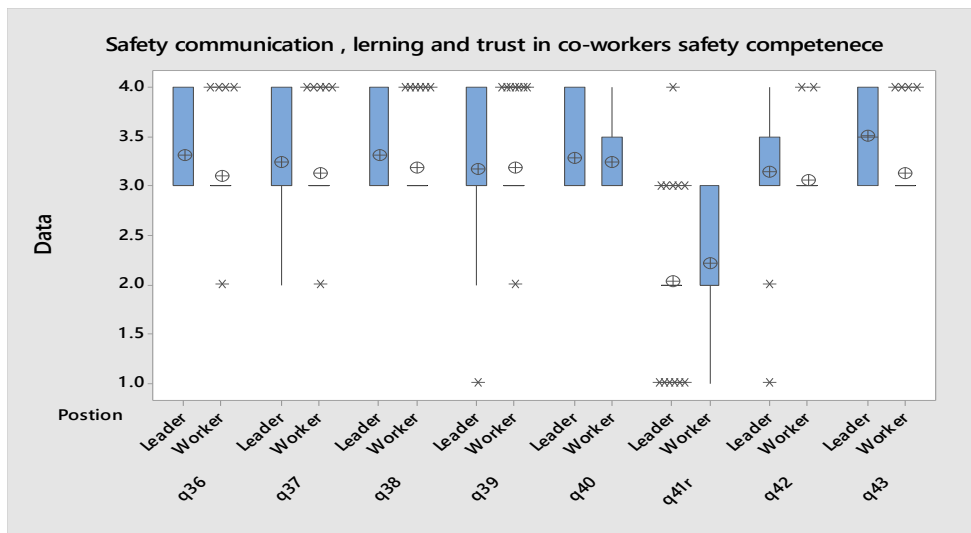


Figure 4.10 Question wise Box Plot Comparison of Safety Climate for Worker Verses Leader for Dimension 6

Results:

Dimension 6 relates to the safety communication, learning & trust in Coworker Safety Competence, the key variation observed here is communication part of the safety-climate, were 25 % of the worker population seldom talks on safety.

Discussion:

This again represents variation in employee awareness and safety experience, resulting in variation in the agreement. The 25 % worker’s safety-climate reflects that talking about safety is not something they do or feel confident to perform such actions.

4.3.7 Dimension 7: Trust in the Efficacy of Safety System for Organization 1

Dimension seven is about how much leaders and worker trust in the efficacy of the safety system that is deployed at site, to analyses question wise mean was calculated and a radar graph was generated, along with question wise Box plot in comparison with worker to leader;



Figure 4.11 Question wise Box Plot Comparison of Safety Climate for Worker Verses Leader for Dimension 7

Result & Discussion:

Dimension 7 relates to employee trust in the efficacy of safety system, variation is not much in workers and leaders. The overall rating shows that workers and leaders have high trust level in the EHS system but based on interview and provided information the organization does not have a complete and efficient management system.

4.2 Results and Discussion for Organization 2

4.2.1 Introduction of Organization 2:

The second organizations taken into consideration that is a power generating facilities using solid fuel i.e. mainly bagasse but with a provision of Coal to be used, if required.

The Solid fuel-based cogeneration power plant with a gross capacity of around 50 - 60 MW. This plant consists of boilers and generators. The Fuel is burnt in the boiler from which steam is generated that is used to generate power with the installed turbines. For the management of smooth operations technical team members are hired, the organizational structure constitutes of 500 + Manpower where around 350 are laborer's handling fuel. The remaining 150 includes Management, Operations and Maintenance Team members.

The exercise was carried out to determine and analyses Safety-climate of power generating facilities, in this chapter we will see the safety-climate outcome of organizations as whole, safety-climate of workers and of leaders. Further comparisons will be generated for the workers and leaders for the analytical part, Along with this an overall researcher evaluation of the organizational Safety-climate. Only for this thesis a signs system is developed to represent organizational HSE gaps and recommendations to overcome those gaps.

Table 4.27

Detailed overview of the determined Safety-climate of Organization 02

#	Category	Criteria	Overall	Worker Mean	Worker Median	Worker Benchmark	Leader Mean	Leader Median	Leader Benchmark
1	Management	Priority & Ability	3.08	3.03	3	3.09	3.16	3.11	3.32
2		Empowerment	3.01	3	3	3.01	2.97	3	3.22
3		Justice	3.02	3.05	3	3.02	2.97	3	3.28
4	Worker	Commitment	3.18	3.28	3.3	3.12	3.08	3	3.33
5		Priority & non Risk Acceptance	2.99	3.01	2.9	3.00	3.01	3	3.27
6	Co-Workers	Communication Learning & trust	3.01	2.99	2.94	3.13	3	3	3.31
7	Worker	Trust	3.19	3.23	3.28	3.22	3.17	3	3.34

Table 4.28

Legend

Result Range	Sign	Means
>3.30	★	Good Level
3.00 to 3.30	🟢	Fairly Good Level
2.70 to 2.99	🟡	Fairly low Level
<2.7	🔴	low level

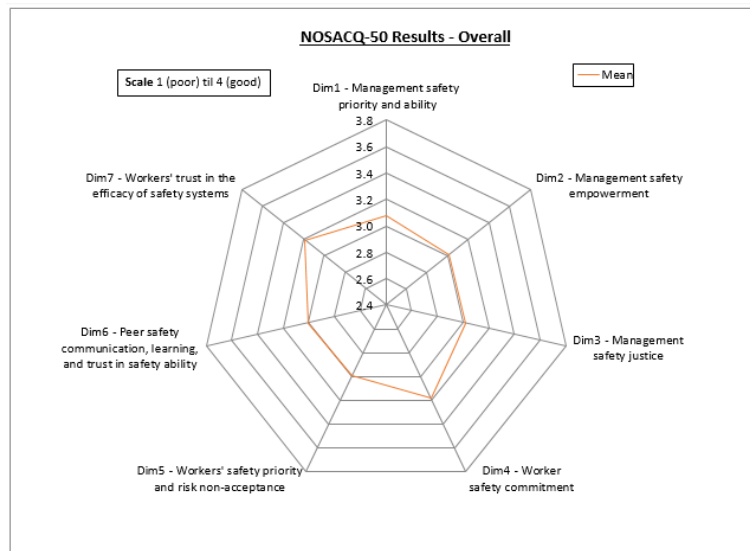


Figure 4.12 Overall Safety Climate of organization

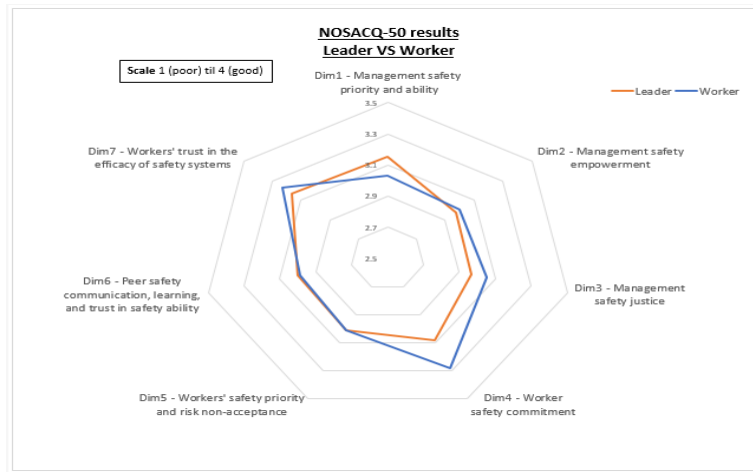


Figure 4.13 Comparison Safety Climate for Worker Verses Leaders

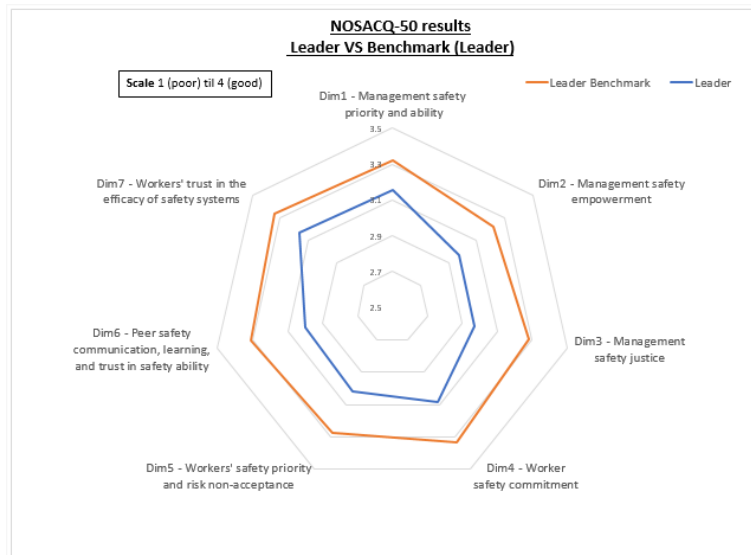


Figure 4.14 Comparison of Safety Climate for Leader Verses Leader Benchmark

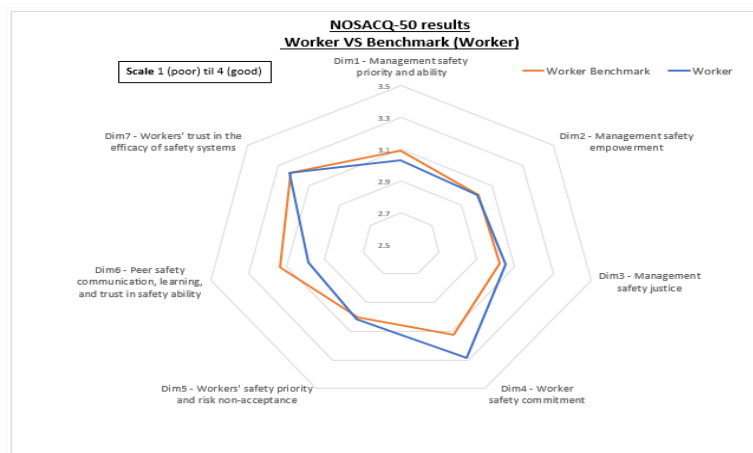


Figure 4.15 Comparison of Safety Climate for Workers Verses Worker Benchmark

4.2.1 Results:

4.4.2.1 Over all Safety-climate of the organization 2

In overall review of organization 2 where cumulative safety-climate of Workers and Leaders were evaluated. In this mean score was above 2.5 that is good & required slight improvement. As per the methodology a safety-climate mean score over 2.5 is considered as a positive result and the overall results shows that most of the dimension range from 3.00 to 3.30, which means the site needs slight improvement.

4.4.2.2 Comparison Worker VS Leader for Organization 2:

The Safety-climate results of Worker and Leader shows most commonality, the perception of workers and leaders are not much different and rated safety-climate as Fairly good. This comparison gives a better picture of the safety management system of the organization, as the overall safety-climate was rated as “Fairly Good”

4.4.2.3 Comparison Leader Vs Leader Benchmark Organization 2:

Further the Leader Safety-climate was compared to the available benchmark rating of safety-climate for energy sector, the benchmark data was collected from 2785 Leaders. Upon comparison, difference was observed in each dimension. Sample organization leader gave fairly good to each dimension and require improving the safety-climate.

Table 4.29
One-Sample Statistics on DIM 1 for Org.2

N	10
Mean	3.1540
Std.Deviation	0.22122
Std.Error Mean	0.06996

$$H_0 : \mu = 3.32$$

$$H_1 : \mu \neq 3.32$$

Table 4.30
One-Sample Statistics on DIM1 for Org.2

T	DF	Sig.(2-tailed)	Mean Difference	95% Confidence Interval of the Difference	
				Lower	Upper
-2.373	9	0.042	-0.16600	-0.3243	-0.0077

Since the sig. value is less than 0.05 so H_0 rejected and H_1 accepted.

Table 4.31
One-Sample Statistics on DIM 2 for Org.2

N	10
Mean	2.9720
Std.Deviation	0.22120
Std.Error Mean	0.06996

$$H_0 : \mu = 3.32$$

$$H_1 : \mu \neq 3.32$$

Table 4.32
One-Sample Statistics on DIM2 for Org.2

T	DF	Sig.(2-tailed)	Mean Difference	95% Confidence Interval of the Difference	
				Lower	Upper
-3.545	9	0.006	-.24800	-0.4062	-0.0898

Since the sig. value is less than 0.05 so H_0 rejected and H_1 accepted.

Table 4.33 One-Sample Statistics on DIM 3 for Org.2

N	10
Mean	2.9670
Std.Deviation	0.17366
Std.Error Mean	0.05492

$$H_0 : \mu = 3.38$$

$$H_1 : \mu \neq 3.38$$

Table 4.34
One-Sample Statistics on DIM3 for Org.2

T	DF	Sig.(2-tailed)	Mean Difference	95% Confidence Interval of the Difference	
				Lower	Upper
-5.700	9	.000	-.31300	-0.4372	-0.1888

Since the sig. value is less than 0.05 so H_0 rejected and H_1 accepted.

Table 4.35
One-Sample Statistics on DIM 4 for Org.2

N	10
Mean	3.0830
Std.Deviation	0.22445
Std.Error Mean	0.07098

$$H_0 : \mu = 3.33$$

$$H_1 : \mu \neq 3.33$$

Table 4.36
One-Sample Statistics for DIM 4 Org.2

T	DF	Sig.(2-tailed)	Mean Difference	95% Confidence Interval of the Difference	
				Lower	Upper
-3.480	9	.007	-.24700	-.4076	-.0864

Since the sig. value is less than 0.05 so H_0 rejected and H_1 accepted.

Table 4.37
One-Sample Statistics for DIM 5 Org.2

N	10
Mean	3.0140
Std.Deviation	0.36598
Std.Error Mean	0.11573

$$H_0 : \mu = 3.27$$

$$H_1 : \mu \neq 3.27$$

Table 4.38

One-Sample Statistics for DIM 5 Org.2

T	DF	Sig.(2-tailed)	Mean Difference	95% Confidence Interval of the Difference	
-2.212	9	.054	-.25600	Lower -.5178	Upper .0058

Since the sig. value is greater than 0.05 so H_0 accepted and H_1 rejected.

Table 4.39

One-Sample Statistics for DIM 6 Org.2

N	10
Mean	3.0030
Std.Deviation	0.17601
Std.Error Mean	0.05566

$$H_0 : \mu = 3.31$$

$$H_1 : \mu \neq 3.31$$

Table 4.40

One-Sample Statistics for DIM 6 Org.2

T	DF	Sig.(2-tailed)	Mean Difference	95% Confidence Interval of the Difference	
-5.516	9	.000	-.30700	Lower -.4329	Upper -.1811

Since the sig. value is less than 0.05 so H_0 rejected and H_1 accepted.

Table 4.41 *One-Sample Statistics for DIM 7 Org.2*

N	10
Mean	3.1680
Std.Deviation	2.9999
Std.Error Mean	0.09487

$$H_0 : \mu = 3.34$$

$$H_1 : \mu \neq 3.34$$

Table 4.42
One-Sample Statistics for DIM 7 Org.2

T	DF	Sig.(2-tailed)	Mean Difference	95% Confidence Interval of the Difference	
-1.813	9	.103	-.17200	Lower -.3866	Upper .0426

Since the sig. value is greater than 0.05 so H_0 accepted and H_1 rejected.

The One-Sample T-Test applied on the Worker response in reference to the benchmark values shows that dimension 1 (Management Safety Priority & Competence), 2 (Management safety empowerment) 4 (Worker safety commitment), and Dimension 6 (Peer safety communication, learning, and trust in safety ability) are the only that are not equal to the benchmark value. This result is not very consistent to the mean comparison calculated.

4.4.2.4 Comparison Worker VS worker Benchmark Organization 2

The benchmark safety-climate of energy sector collected from 5152 workers was used and compared, that shows variation in dimension 04 and 06. This indicates that the safety worker commitment and peer safety communication, Learning & trust inn safety ability.

Table 4.43
One-Sample Statistics for DIM 1 Org.2

N	10
Mean	3.0330
Std.Deviation	.20117
Std.Error Mean	0.06361

$$H_0 : \mu = 3.09$$

$$H_1 : \mu \neq 3.09$$

Table 4.44

One-Sample Statistics for DIM 1 Org.2

T	DF	Sig.(2-tailed)	Mean Difference	95% Confidence Interval of the Difference	
-.896	9	.394	-.05700	Lower -.2009	Upper .0869

Since the sig. value is greater than 0.05 so H_0 accepted and H_1 rejected.

Table 4.45

One-Sample Statistics for DIM 2 Org.2

N	10
Mean	3.0000
Std.Deviation	0.16553
Std.Error Mean	0.05235

$$H_0 : \mu = 3.01$$

$$H_1 : \mu \neq 3.01$$

Table 4.46

One-Sample Statistics for DIM 2 Org.2

T	DF	Sig.(2-tailed)	Mean Difference	95% Confidence Interval of the Difference	
-.191	9	.853	-.01000	Lower -.2009	Upper .0869

Since the sig. value is greater than 0.05 so H_0 accepted and H_1 rejected

Table 4.47

One-Sample Statistics for DIM 3 Org.2

N	10
Mean	3.0500
Std.Deviation	0.30379
Std.Error Mean	0.09607

$$H_0 : \mu = 3.33$$

$$H_1 : \mu \neq 3.33$$

Table 4.48

One-Sample Statistics for DIM 3 Org.2

T	DF	Sig.(2-tailed)	Mean Difference	95% Confidence Interval of the Difference	
.312	9	.762	.03000	Lower -.1873	Upper .2473

Since the sig. value is greater than 0.05 so H_0 accepted and H_1 rejected.

Table 4.49

One-Sample Statistics for DIM 4 Org.2

N	10
Mean	3.2830
Std.Deviation	0.34503
Std.Error Mean	0.10911

$$H_0 : \mu = 3.12$$

$$H_1 : \mu \neq 3.12$$

Table 4.50

One-Sample Statistics for DIM 4 Org.2

T	DF	Sig.(2-tailed)	Mean Difference	95% Confidence Interval of the Difference	
1.494	9	.169	.16300	Lower -.0838	Upper .4098

Since the sig. value is greater than 0.05 so H_0 accepted and H_1 rejected.

Table 4.51 *One-Sample Statistics for DIM 5 Org.2*

N	10
Mean	3.0150
Std.Deviation	0.28072
Std.Error Mean	0.08877

$$H_0 : \mu = 3.00$$

$$H_1 : \mu \neq 3.00$$

Table 4.52

One-Sample Statistics for DIM 5 Org.2

T	DF	Sig.(2-tailed)	Mean Difference	95% Confidence Interval of the Difference	
.169	9	.870	.01500	Lower -.1858	Upper .2158

Since the sig. value is greater than 0.05 so H_0 accepted and H_1 rejected.

Table 4.53

One-Sample Statistics for DIM 6 Org.2

N	10
Mean	2.9910
Std.Deviation	0.21538
Std.Error Mean	0.06811

$H_0 : \mu = 3.13$

$H_1 : \mu \neq 3.13$

Table 4.54

One-Sample Statistics for DIM 6 Org.2

T	DF	Sig.(2-tailed)	Mean Difference	95% Confidence Interval of the Difference	
-2.041	9	.072	-.13900	Lower -.2931	Upper .0151

Since the sig. value is greater than 0.05 so H_0 accepted and H_1 rejected.

Table 4.55

One-Sample Statistics for DIM 7 Org.2

N	10
Mean	3.2300
Std.Deviation	0.37642
Std.Error Mean	0.11903

$H_0 : \mu = 3.22$

$H_1 : \mu \neq 3.22$

Table 4.56

One-Sample Statistics for DIM 7 Org.2

T	DF	Sig.(2-tailed)	Mean Difference	95% Confidence Interval of the Difference	
.084	9	.935	.01000	Lower -.2593	Upper .2793

Since the sig. value is greater than 0.05 so H_0 accepted

The One-Sample T-Test applied on the Worker response in reference to the benchmark values shows that results of all the dimensions are equal to the benchmark value. This result is not very consistent to the mean comparison calculated.

4.4.3 Discussion:

Overall site response including Leaders and workers rated the site EHS culture as fairly good. As this response was collective representation of workers and leaders, later the responses from workers and leaders were observed separately and comparison was also drawn to see the clear perception from each group.

4.4.3.1 Comparison Worker VS Leader for Organization 2:

According to workers and leader's minor improvement are required to improve the safety-climate, however in worker's commitment direction leaders think that more should be done as compared to workers. Here leaders are required to give clearer message to workers for organization commitment and their required level of engagement.

Workers scored the management safety priority & ability as fairly low which is in contrast to management empowerment & management safety justice. I would say that might be workers didn't understand questions related to the management safety priority or as per enlisted questions management gave the rights to workers for decision but not emphasis to keep safety on priority. In later discussion, each question will be discussed in detail.

4.4.3.2 Comparison Leader Vs Leader Benchmark Organization 2:

Leaders response in each dimension was lower than the benchmark that means leaders think that improvements are required in current safety culture.

4.4.3.3 Comparison Worker VS worker Benchmark Organization 2:

Workers vs workers benchmark comparison was drawn and results showed that workers think their safety commitment is much higher as compared to leader’s safety priority. This shows workers thinks that they care about safety however leaders are not. But leaders have scored in this contrast as per them workers commitment is low and required improvement. There must be sessions between leaders and workers to listen each priorities and progress. As we will move forward and review every dimension in detail we come across further variation in the safety-climate of aspect wise.

4.2 Dimension Wise Safety-climate Analysis:

To review Safety-climate in detail dimension wise review is generated:

4.5.1 Dimension 01: Management Safety Priority & Competence for Organization 2

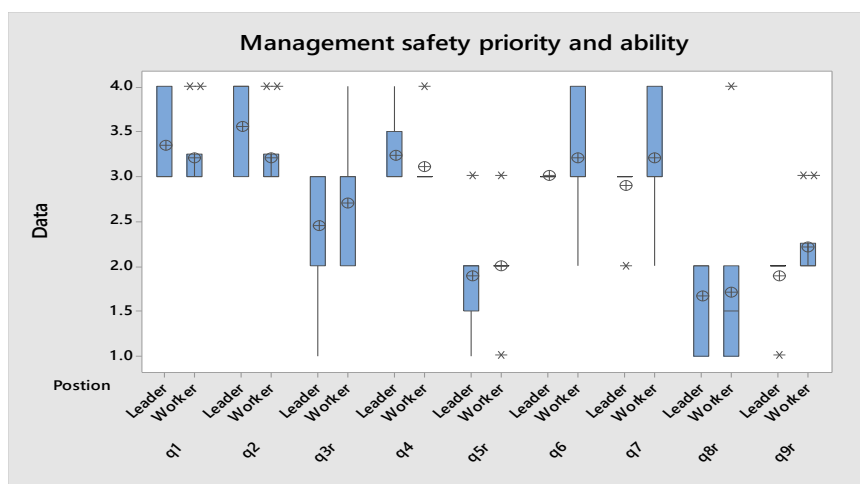


Figure 4.16 Question wise Box Plot Comparison of Safety Climate for Worker Verses Leader for Dimension 1

Results:

Dimension 1 is related to safety priority and ability of management that contains total 9 questions in which 4 are reverse questions, in this dimension variation can be observed

in 1 & 2nd question where workers scored low on level of provided information related to safety. Similarly, in question 9 workers scored the reverse question with agree that management has lack of ability to handle safety properly.

Discussion:

Relating the survey outcomes with the site visit and interviews it can be stated with sheer confidence that Management and worker's EHS awareness and appreciation of the risk is low, in some cases this is due to the industrial background and EHS expertise level of employees.

Question / item # 9 of Dimension 01, "Management lacks the ability to deal with safety properly" was also responded with notable statistical difference where the difference in Mean is high, most of the worker population clearly agrees to the questions statement. The leaders of the organization complete disagree to the question statement. As most of the worker population has shown concern in management ability to manage safety at site seem to be a reasonable number.

4.5.2 Dimension 02: Management Safety Empowerment for Organization 2

Dimension two relates to management empowerment to employees, to analyses question wise mean was calculated and a radar graph was generated, along with question wise Box plot in comparison with worker to leader.

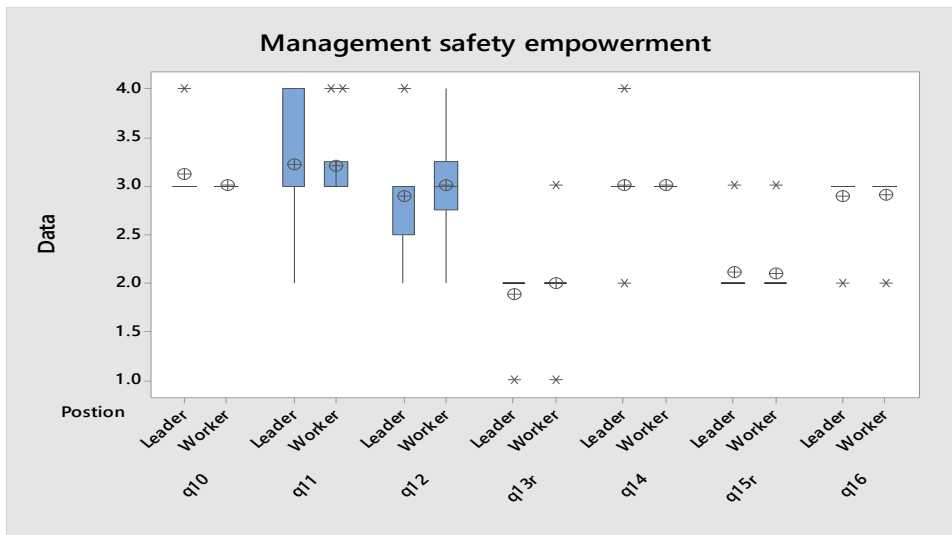


Figure 4.17 Question wise Box Plot Comparison of Safety Climate for Worker Verses Leader for Dimension 2

Results:

No notable variation in this response in all question.

Discussion:

Both mean are positive and minor improvements are required. However, on ground reality is different where there is no stop work culture and practicing.

The employee showed no confidence in stopping work that is/was unsafe, as per the workers the management priority is production focus. Where leaders believe that if a situation poses significant safety risk that will be reported and such works should be stopped by worker. If the organization can improve communication channels and concept of open reporting, the safety-climate can be improved.

4.5.3 Dimension 03: Management Safety Justice for Organization 2

Dimension three deal with the management deployment of Safety Justice in organization, to analyses question wise mean was calculated and a radar graph was generated, along with question wise Box plot in comparison with worker to leader;



Figure 4.18 Question wise Box Plot Comparison of Safety Climate for Worker Verses Leader for Dimension 3

Results:

Dimension 03 relates to Management safety justice, there is no significant variation was observed. However slightly different response was observed in question 18 that was reverse question. Where question 18 refers to discouraging of reporting due to fear of sanction. Workers scored it in disagreement. This was interesting observation as workers have shown satisfaction and the leaders were in disagreement.

Discussion:

The overall organization safety justice is evaluated as fairly good.

The organization need to define an incident investigation process that requires to be focus on determining the Root cause rather than blaming to promote incident reporting culture.

4.5.4 Dimension 04: Worker Safety Commitment for Organization 2

Dimension four relates to worker's personal commitment to Safety, to analyses question wise mean was calculated and a radar graph was generated, along with question wise Box plot in comparison with worker to leader;

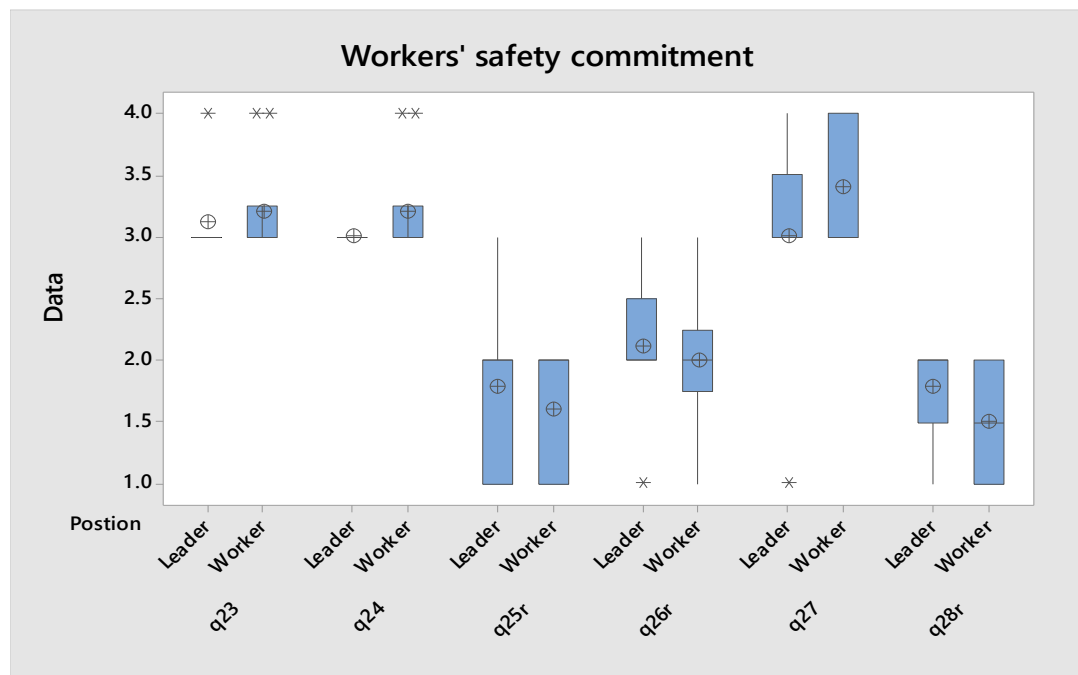


Figure 4.19 Question wise Box Plot Comparison of Safety Climate for Worker Verses Leader for Dimension 4

Results:

Dimension 04 relates to Worker Safety Commitment, in question 26 which is reverse question related to avoid tacking risks if discovered during work in which few leader's response that need improvement while according to worker this is positive and no improvement is require.

Discussion:

To tackle risks if identified during work, workers required training for Risk interpretation, consequences & solutions, risk assessment training are required. The

response from workers was disagree that might be due to workers perception about risk evaluation and lack of training.

4.5.5 Dimension5: Worker Safety priority & Risk Non-Acceptance for Organization 2

Dimension five talks about how worker’s priorities safety and what is risk non-acceptance level, to analyses question wise mean was calculated and a radar graph was generated, along with question wise Box plot in comparison with worker to leader;

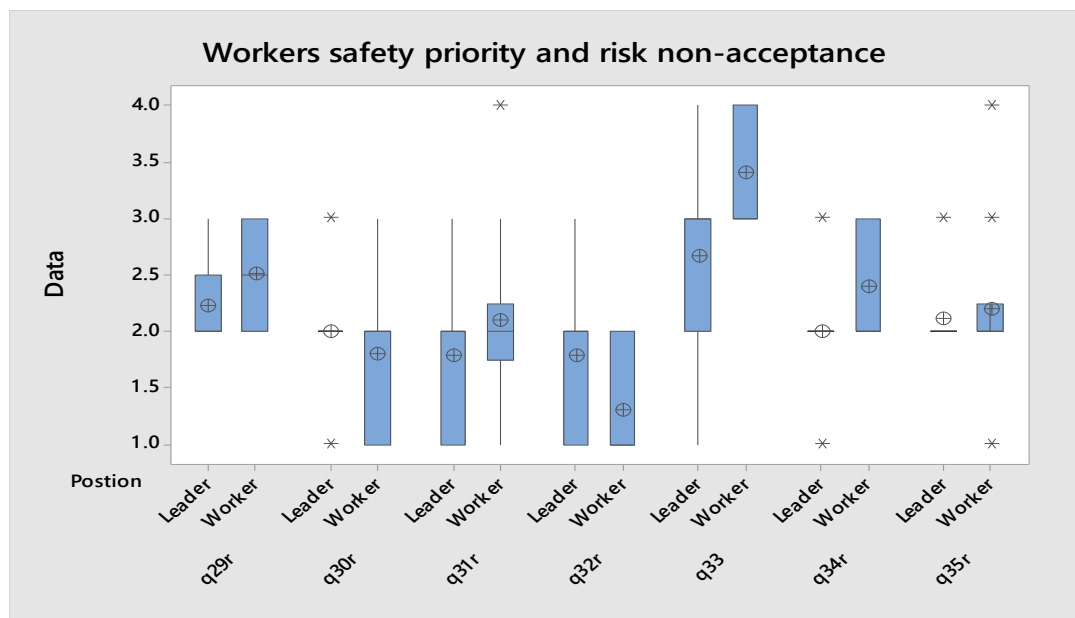


Figure 4.20 Question wise Box Plot Comparison of Safety Climate for Worker Verses Leader for Dimension 5

Results:

Dimension five of safety culture related to Worker Safety Priority and Risk non-acceptance, the variation is observed in two items, one was related to reverse question 34 and one was with positive question 33. In question 33 workers showed highly positive response as compared to leaders and in question 34 workers response varied from disagree to agree on the other hand leaders showed disagreement.

Discussion:

Workers are highly confident that they don't take risks even if it comes to tight schedule to meet the targets as in previous dimensions workers feel empowered to take decisions but as per leader's little work is still require strengthening this response.

As per analysis of the question 34 that is related that workers think their work is not suitable for cowards. The workers here are prone to take risks and thinks taking risks is a bravery. This culture needs to be discourage. It is concluded that routine exposures to unsafe situations over the period impact workers in a way that they began to consider risk taking as routine.

4.5.6 Dimension 6: Safety Communication & trust in Coworker Competence for Organization 2

Dimension six deals with communication and trust with / on co-workers based on their safety competence, to analyses question wise mean was calculated and a radar graph was generated, along with question wise Box plot in comparison with worker to leader;



Figure 4.21 Question wise Box Plot Comparison of Safety Climate for Worker Verses Leader for Dimension 6

Results:

Dimension 6 relates to the safety communication, learning & trust in Coworker Safety. No variation was observed in workers and leader’s response.

Discussion:

This dimension was related to safety communication which comprised of 8 questions related to employee communication, solution findings, working together, helping each other and regard the opinions & suggestion. This dimension showed positive safety culture in organization.

4.5.7 Dimension 7: Trust in the Efficacy of Safety System for Organization 2

Dimension seven is about how much leaders and worker trust in the efficacy of the safety system that is deployed at site, to analyses question wise mean was calculated and a radar graph was generated, along with question wise Box plot in comparison with worker to leader;



Figure 4.22 Question wise Box Plot Comparison of Safety Climate for Worker Verses Leader for Dimension 7

Result:

Dimension 7 relates to employee trust in the efficacy of safety system, variation is not much in workers and leaders except question 49 that is reverse question.

Discussion:

Workers have less trust however leader have high trust in peers and colleagues when it comes to safety. This reverse question was related to pre-planning. Where workers scored pre-planning as meaningless that prompt organization to work on Pre-planning stage as it is not very strong. Few workers just planned and work immediately rather than assessing the risks. this org is a new power plant were people are developing their process to get it mature.

4.3 Results and Discussion Overall Organization:

Table 4.57

Combined Overview of the Safety Climate for Organizations (01 & 02)

#	Category	Criteria	Overall	Worker Mean	Worker Median	Worker Benchmark	Leader Mean	Leader Median	Leader Benchmark
1	Management	Priority & Ability	✓	🟡	🟡	✓	✓	✓	★
			3.15	2.93	2.88	3.09	3.19	3.16	3.32
			2	Empowerment	✓	🟡	✓	✓	✓
3.04	2.96	3	3.01		3.08	3	3.22		
3	Justice	✓	✓	✓	✓	✓	✓	✓	
3.08		2.99	3	3.02	3.08	3.16	3.28		
4	Worker	Commitment	✓	★	✓	✓	✓	✓	★
3.19			3.21	3.17	3.12	3.19	3	3.33	
5	Co-Workers	Priority & non Risk Acceptance	✓	🟡	🟡	✓	✓	✓	✓
2.9			2.84	2.85	3.00	3.06	3	3.27	
6	Co-Workers	Communication Learning & trust	✓	✓	✓	✓	✓	✓	★
3.07			3.07	3	3.13	3.17	3	3.31	
7	Worker	Trust	★	✓	✓	✓	★	✓	★
			3.33	3.25	3.14	3.22	3.3	3.2	3.34

Table 4.58

Detailed overview of the determined Safety Climate of Organization 01

#	Category	Criteria	Overall	Worker Mean	Worker Median	Worker Benchmark	Leader Mean	Leader Median	Leader Benchmark
1	Management	Priority & Ability	✓	✓	✓	✓	✓	✓	★
			3.08	3.03	3	3.09	3.16	3.11	3.32
			2	Empowerment	✓	✓	✓	✓	🟡
3.01	3	3	3.01		2.97	3	3.22		
3	Justice	✓	✓	✓	✓	🟡	✓	✓	
3.02		3.05	3	3.02	2.97	3	3.28		
4	Worker	Commitment	✓	✓	★	✓	✓	✓	★
3.18			3.28	3.3	3.12	3.08	3	3.33	
5	Co-Workers	Priority & non Risk Acceptance	✓	✓	🟡	✓	✓	✓	✓
2.99			3.01	2.9	3.00	3.01	3	3.27	
6	Co-Workers	Communication Learning & trust	✓	✓	🟡	✓	✓	✓	★
3.01			2.99	2.94	3.13	3	3	3.31	
7	Worker	Trust	✓	✓	✓	✓	✓	✓	★
			3.19	3.23	3.28	3.22	3.17	3	3.34

Table 4.59

Detailed overview of the determined Safety Climate of Organization 02

#	Category	Criteria	Overall	Worker Mean	Worker Median	Worker Benchmark	Leader Mean	Leader Median	Leader Benchmark
1	Management	Priority & Ability	3.05	2.9	2.78	3.09	3.22	3.28	3.32
2		Empowerment	3.03	2.95	3	3.01	3.11	3	3.22
3		Justice	3.04	2.97	2.83	3.02	3.12	3.17	3.28
4	Worker	Commitment	3.21	3.19	3.17	3.12	3.23	3	3.33
5		Priority & non Risk Acceptance	2.92	2.79	2.71	3.00	3.09	2.93	3.27
6	Co-Workers	Communication Learning & trust	3.17	3.1	3	3.13	3.23	3	3.31
7	Worker	Trust	3.36	3.27	3.14	3.22	3.46	3.36	3.34

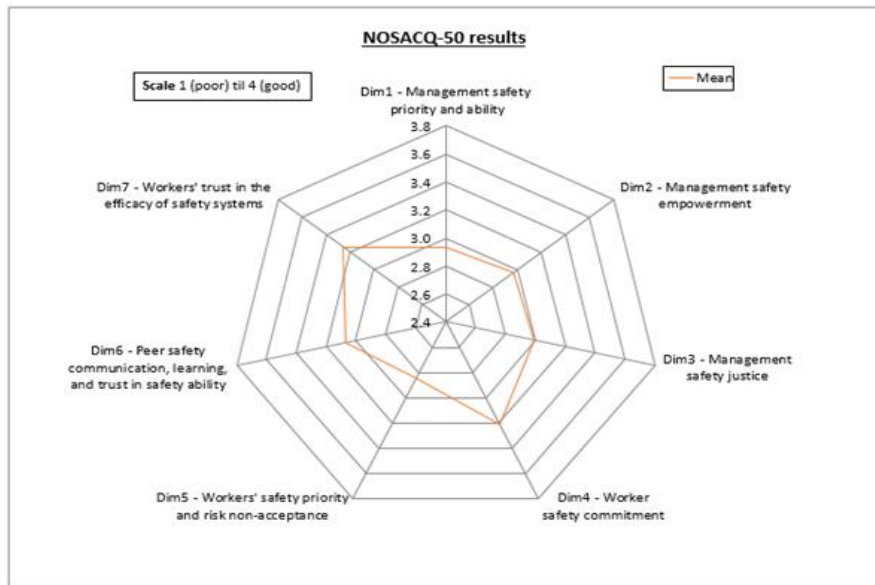


Figure 4.23 Overall Safety Climate of organization

Organization 1 and 2(Workers vs Workers)

$$H_0 : m_1 = m_2$$

$$H_1 : m_1 \neq m_2$$

Table 4.60

Independent Samples Test Org 1 & 2 (Workers vs Workers)

		Levene's Test for Equality of Variances		t-test for Equality of Means			
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference
DIM1	Equal variances assumed	2.470	.124	-1.011	41	.318	-.12997
	Equal variances not assumed			-1.399	30.063	.172	-.12997
DIM2	Equal variances assumed	1.459	.234	-.538	41	.594	-.04727
	Equal variances not assumed			-.682	23.905	.502	-.04727
DIM3	Equal variances assumed	.011	.919	-.698	41	.489	-.08061
	Equal variances not assumed			-.723	15.771	.480	-.08061
DIM4	Equal variances assumed	.086	.770	-.735	41	.466	-.09179
	Equal variances not assumed			-.736	14.937	.473	-.09179
DIM5	Equal variances assumed	.334	.566	-1.826	41	.075	-.22924

	Equal variances not assumed			-2.101	19.140	.049	-.22924
DIM6	Equal variances assumed	.317	.576	1.191	41	.240	.11021
	Equal variances not assumed			1.337	18.202	.198	.11021
DIM7	Equal variances assumed	.006	.938	.288	41	.775	.03758
	Equal variances not assumed			.280	14.263	.784	.03758

Since all the sig. values are greater than 0.05 so H_0 accepted and H_1 rejected. It means org1 and org2 means are equal for all Dim's.

The One-Sample T-Test applied on the Worker of Organization 1 in reference to organization 2 values shows that the overall climate of workers of organization 1 is equal to the climate of workers for organization 2. This result is not consistent to the mean comparison calculated.

Organization 1 and 2(Leaders vs Leader)

$$H_0 : m_1 = m_2$$

$$H_1 : m \neq m_2$$

Table 4.61

Independent Samples Test Org 1 & 2 (Leader vs Leader)

	Levene's Test for Equality of Variances		t-test for Equality of Means			
	F	Sig.	t	df	Sig. (2-tailed)	Mean Difference

DIM1	Equal variances assumed	2.470	.124	-1.011	41	.318	-.12997
	Equal variances not assumed			-1.399	30.063	.172	-.12997
DIM2	Equal variances assumed	1.459	.234	-.538	41	.594	-.04727
	Equal variances not assumed			-.682	23.905	.502	-.04727
DIM3	Equal variances assumed	.011	.919	-.698	41	.489	-.08061
	Equal variances not assumed			-.723	15.771	.480	-.08061
DIM4	Equal variances assumed	.086	.770	-.735	41	.466	-.09179
	Equal variances not assumed			-.736	14.937	.473	-.09179
DIM5	Equal variances assumed	.334	.566	-1.826	41	.075	-.22924
	Equal variances not assumed			-2.101	19.140	.049	-.22924
DIM6	Equal variances assumed	.317	.576	1.191	41	.240	.11021
	Equal variances not assumed			1.337	18.202	.198	.11021

DIM7	Equal variances assumed	.006	.938	.288	41	.775	.03758
	Equal variances not assumed			.280	14.263	.784	.03758

Since all the sig. values are greater than 0.05 so H_0 accepted and H_1 rejected. It means org1 and org2 means are equal for all Dim's.

The One-Sample T-Test applied on the Worker of Organization 1 in reference to organization 2 values shows that the overall climate of Leaders of organization 1 is equal to the climate of Leaders for organization 2. This result is not consistent to the mean comparison calculated.

If we see the cumulative of both organizations there is no much variation in responses in workers & leader's perception as well the both organization. As per Table 4.23 Workers & leader's perception differ in 1st, 2nd & 5th Dimension. If we describe the results in terms of Hypothesis for dimension 1 null hypothesis has been proved as management perception about their safety priority & ability is high however as per workers its scored as low. If we see this through on ground interviews its proved that management require to work on taking safety as priority.

For Dimension 2: Management involves workers in decision making process has been proved although according to workers this area need improvement and more empowerment is required to be given to worker. During interviews, it was observed that management do involve the employees in decision making process and respect their decision when it comes to safety. Might be in workers response few have taken social decision making as well in this perspective.

For Dimension 3: Null hypothesis has been proved. There is contradiction in facts and on ground results. As per table 4.5 H3 hypothesis has been proved but during site visit & inspection & theory of triangulation, Individual responses didn't show confidence on justice and transparency in incident investigation. Our research has one limitation that some of the workers responses are influential that is impacting overall results.

For Dimension 4: Workers thought their commitment is high and it required to be sustained, but leader thinks their commitment should be high. There must be clear communication from leader to workers about their expectations. In actual workers risk evaluation perception is low and need training to improve perception. This perception results are in between and need further improvements both at leaders & workers end.

For Dimension 5. This dimension related to workers safety priority & non-risk acceptance, following the discussion made in dimension 4 workers are prone to take risks and bold decisions based on their low level of risk evaluation, training & understanding. As in dimension 1 workers thinks that their leaders have don't keep safety as priority this perception also impacted to worker behavior and they take risks to meet their targets. One might possible reason for risk acceptance is they may think if they will raise the voice it will impact their job and they do the influential decisions.

For Dimension 6: "Co-workers are competent on safety & have effective communication: hypothesis has been proved. But still the trainings are required to sustain & improve this dimension.

Dimension 7:

The workers & leaders gave fairly good scoring to this dimension and if we relate outcomes of safety justice, risk non-acceptance & Management safety priority & ability this trust need to improve on systems & evaluation.

4.4 Conclusion & Recommendation:

The overall organizational safety-climate of organizations were fairly good perceived strength of Safety management system by leaders was higher than the workers. Although the safety-climate perceived by both is much higher than the actual situation on ground, this is due to the education level of leader and workers with regards to safety. Three of the dimension including management safety ability & priority, Safety justice and workers commitment & risk non-acceptance need little improvement to strengthen the overall safety culture.

The organization needs to start with setting up HSE management system, as of the time to audit the organization only had an unapproved copy of HSE plan, firstly the organizational Management need to define HSE Policy.

Next the organization needs to carryout risk assessment and identify all high-Risk activities and based on that define the framework of the HSE management system.

Upon complete development and approval of the procedures, a detailed Trainings plan should be developed to communicate all the procedures to all employees and contractors. The process of trainings must include the process of validation of the training carried out.

Further with immediate effect the implementation of procedures should be monitored, the monitoring must have Management Audits / inspections to validate the compliance, that should be supported by positive encouragement or / & Disciplinary actions.

The organization needs to give Special focus on the implementation and training of incident investigation; the organization should get employees of all levels to be trained on defined methods of Root Cause Analysis (RCA). After trainings on specialized RCA

and procedural awareness, management needs to drive reporting. Over the period system will grow and improve.

The reporting system need to be strengthened through the promotion of Open Reporting and setting targets at personal level from senior most leaders to sub-contractors. The more proactive reporting that will have a direct impact on reducing the lagging reporting.

The setting up EHS management system from policy, plans, procedures etc, will define the organizational HSE framework, the communication of structured framework and compliance validation will show workers the management commitment, the management involvement in the day to day process will strength safety-climate and employee trust. As the management, will use a defined process for incident investigation engaging teams will also strength the worker confidence on safety justice. As the involvement of team member from all levels will be method of that will show organizational commitment.

This will build & strength the HSE management system but over the period will reduce the occurrence of significant incidents, promote open reporting, demonstrate Management Commitment to employees / workers, drive continuous improvements, improve safety at work place and community etc, these are will strength the safety-climate of organization (worker / Leaders). The safety-climate that will be determined after completing the recommendation will be actual safety-climate, that safety-climate could be ever lower from the one determined now that is due to low HSE awareness.

The utilization of the recommendation will support the organization improve the safety-climate of the organization.

Further as a conclusion of the research, would define the safety Climate as “The perceived / anticipated strength/weakness of a deployed EHS management system of an organization and beyond, by the employees/people that are exposed to / or are part of the running system”

Where Safety culture is a combination of safety climate, in relation with the statical standing (# of leading /lagging indicator) and on ground actuality.

As part of the research a sign based tool is generated that can be used to generate safety-climate reports, the tool with graphics is given in appendix.

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Appendix 1

	Sign Indication	Critical EHS Procedures Missing / Require Attention
	Suggestion/Action	<ol style="list-style-type: none"> 1. Organization should have EHS policy specific to the organization process/impacts. 2. Ensure organization as HSE procedures for all significant\High risk operation activities and provides clear requirement guidelines for industry specific risk management. <ol style="list-style-type: none"> 2 (a) Development/Review of procedures should be carried out by subject expert, sector specialist, personals with knowledge of applicable law. 2 (b) Risk management process defined in procedure should be specific to the industry type and provide comprehensive guidelines for all potential situation i.e., routine operation, abnormal & emergency situations. 3. Communication of developed/updated policy, procedures & plans with all affected employees, contractors and other stakeholders. 4. Carry out frequent reviews of the developed policy, procedures & plans involving management & employees/contractors. <p>Note: *Risk and legal register should be in place to identify structured need of HSE/management procedures.</p>
	Sign Indication	Low Legal Compliance or Requirements Not known
	Suggestion/Action	<ol style="list-style-type: none"> 1. Identify competent legal expert, internal or/& External, to identify all applicable legislation, laws, rules etc. <ol style="list-style-type: none"> 1(a) Organization to define internal or/& external mechanism to remain updated on the changes of the applicable legal requirements. 2. Formally communicate legal requirements to all affected employees through <ol style="list-style-type: none"> 2 (a) Formal trainings & awareness.

		<p>2(a) adding/ referring in HSE procedure.</p> <ol style="list-style-type: none"> 3. Develop a legal complinace team comprsing of managemst , staff, workers and contractors to drive awarness and on ground legal compliance. 4. Carry out self-assessments (inspection\audits) to validate , implement corrective actions for findings and Maintain Records. 5. Communicaction of legal requirments with all relevent persons.
	Sign Indication	Weak Workers HSE Competence
	Suggestion/Action	<ol style="list-style-type: none"> 1. Training Program-Craft specific HSE training to be conducted/annual refresher. 2. Extended Trainings/Awarness session on site HSE procedures. 3. Hiring process should involve HSE competence evaluation process for all position i.e management, worker & contractors. 4. Management Audits / inspections to validate HSE awarness/competece/ compliance. 5. Perform assessment, to idenfiy competence gaps and areas of improvement for each employee (employee self assessment, line manager assessment).
	Sign Indication	Low level of Management HSE Competence &/or Involvement
	Suggestion/Action	<ol style="list-style-type: none"> 1. Develop/ update & implement HSE Trainings Program, ensure every member of management undergo and qualify through training program. 2. Management enrolment in EHS activities as a leader/driver. 3. Corporate level HSE programs to engage / educate top Management. 4. Management to involve site/national/international level HSE forums or sessions 5. Management annaul appraisal should be structured to ensure that atleast 25% based on HSE.

		<ul style="list-style-type: none"> 6. Corporate/External HSE audits to validate HSE compliance. 7. Management to demonstrate HSE ownership through “Lead by Example”.
	Sign Indication	Weak Emergency Response
	Suggestion/Action	<ul style="list-style-type: none"> 1. Identify potential Emergencies, through Risk assessment 2. Develop procedures / plans for all identified potential Emergencies. 3. Train Employees (trainings / Drills) on site emergency procedures and response techniques. 4. Ensure site is well equiped with all emergency response equipments. 5. Periodic inspections/audits to validate readiness of the deployed equipments. 6. Develop competent Emergency Response team internaly. 7. Conduct Periodic Drills involng internal & external agencies and team. 8. Liaison with External/Local Agencies for readiness.
	Sign Indication	HSE Reward & Disciplinary System Missing / Weak
	Suggestion/Action	<ul style="list-style-type: none"> 1. Develop disciplinary and incentive programs. 2. Implementation should be a management priority. 3. Communicate to employees, through demonstration of reward/discipline. 4. Implement the process and actions 5. Review and imporve programs.
	Sign Indication	Management Commitment Requires Improvement

	Suggestion/Action	<ol style="list-style-type: none"> 1. Corporate Program to ensure Management demonstrate HSE Leadership. 2. Every leader participating in at least 06 HSE activates every month. 3. HSE committee to have 50 % leadership attendance. 4. Deploy and Lead Behaviors base cultural change programs. 5. Carry out one to one/group HSE discussion with workers. 6. Communicate HSE goals & objectives/ expectations to workers & contractors. 7. Carry ou active community services through environmental stewardship.
	Sign Indication	Worker Commitment Requires Improvement
	Suggestion/Action	<ol style="list-style-type: none"> 1. Ensure every worker is qualified on craft specific Trainings, further behaviour based training program should be incorporated. 2. Deploy disciplinary procedures & incentive plans. 3. Management to drive/ensure that workers understand HSE empowerment. 4. Develop culture of team work through employee involvment program. 5. Management to support\recognize the employees that practice Stop Work authority. 6. Management to reseolve workers HSE compliants in practical timelines. 7. Every workers requires to involve in atleast 3 HSE activities.
	Sign Indication	Communication Gap within the Organization
	Suggestion/Action	<ol style="list-style-type: none"> 1. Define Clear chanel of commuicntion (worker / contractor etc) 2. Effectiveness of communcntion to be Validted through audits/inspecciton 3. Look to deploy new and effective methodologies


	Sign Indication	Incident Investigation and Justice
	Suggestion/Action	<ol style="list-style-type: none"> 1. Develop a incident investigation procedure, with clear process and engaging specialized investigation methodologies. 2. Communicate and Train employee & contractors on the procedures 3. Conduct specialized training for Investigators 4. Promote opening reporting through involvement 5. Involve workers and contractor on the process to develop trust.

Table: Safety Icons system, highlighting key Gaps in HSE system and Recommendation to Overcome the Gap(s).

Appendix 2

- Management encourages employees here to participate in decisions which affect their safety
- Management strives for everybody at the worksite to have high competence concerning safety and risks
- Management involves employees in decisions regarding safety
- Management never considers employees' suggestions regarding safety
- Management never asks employees for their options before making decisions regarding safety

3. Management safety justice

- Managers collect accurate information in accident investigations
- Management listens carefully to all who have been involved in an accident event
- Management looks for causes, not guilty persons, when an accident occurs
- Management treats employees involved in an accident fairly
- Fear of sanctions (negative consequences) from management discourages employees here from reporting near-miss accidents
- Management always blames employees for accidents

4. Workers' safety commitment

- We who work here try hard together to achieve a high level of safety
- We who work here take joint responsibility to ensure that the workplace is always kept tidy

- We who work here help each other to work safely
- We who work here do not care about each other's safety
- We who work here avoid tackling risks that are discovered
- We who work here take no responsibility for each other's safety

5. Workers' safety priority and risk non-acceptance

- We who work here never accept risk-taking even if the work schedule is tight
- We who work here regard risks as unavoidable
- We who work here consider minor accidents as a normal part of our daily work
- We who work here accepts dangerous behaviour as long as there are no accidents
- We who work here break safety rules in order to complete work on time
- We who work here consider that our work is unsuitable for cowards
- We who work here accept risk-taking at work

6. Safety communication, learning, and trust in co-worker safety competence

- We who work here try to find a solution if someone points out a safety problem
- We who work here feel safe when working together
- We who work here have great trust in each others' ability to ensure safety
- We who work here learn from our experiences to prevent accidents
- We who work here take each others' opinions and suggestions concerning safety seriously
- We who work here always discuss safety issues when such issues come up

- We who work here can talk freely and openly about safety

- We who work here seldom talk about safety

7. Trust in the efficacy of safety systems

- We who work here consider that a good safety representative plays an important role in preventing accidents

- We who work here consider that safety training is good for preventing accidents

- We who work here consider that safety rounds/evaluations help find serious hazards

- We who work here consider that it is important that there are clear-cut goals for safety

- We who work here consider that safety rounds/evaluations have no effect on safety

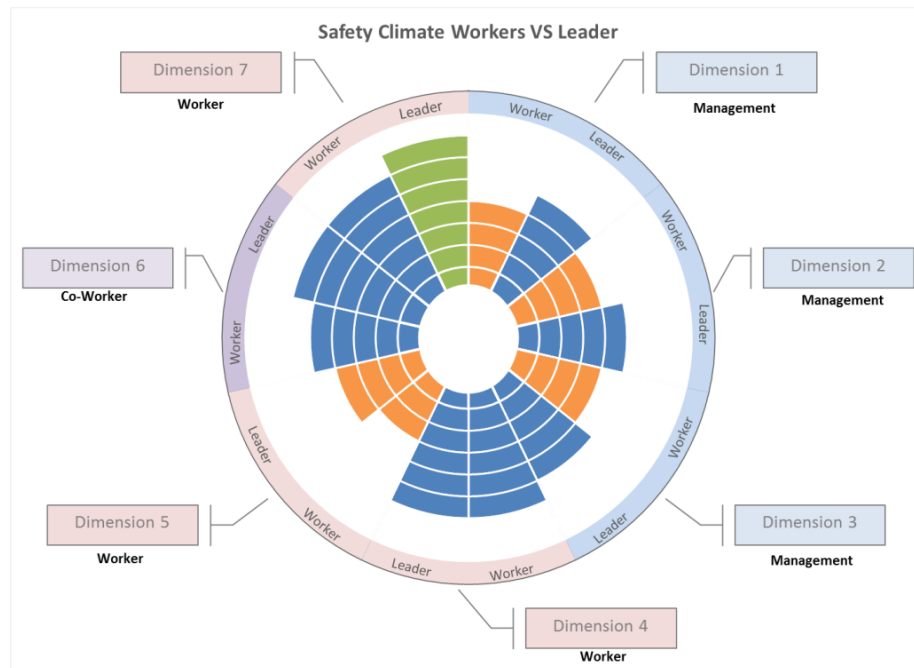
- We who work here consider early planning for safety as meaningless

- We who work here consider that safety training is meaningless

Appendix 3 – Showing Results of organization 1 deploying the formulated symbolic tool

By deploying the suggested methodology one page detailed report that will be generated is as below;

Dimension	Comparisen Worker VS Leader													
#	1		2		3		4		5		6		7	
Category	Management						Worker				Co-Workers		Worker	
Criteria	Priority & Ability		Empowerment		Justice		Commitment		Priority & non Risk Acceptance		Communication Learning & trust		Trust	
Worker	⚠ 2.84 ▶	⚠ 2.91 ▶	⚠ 2.93 ▶	✅ 3.17 ▶	⚠ 2.7 ▶	✅ 3.07 ▶	✅ 3.21 ▶	✅ 3.19 ▶	✅ 3.06 ▶	✅ 3.18 ▶	✅ 3.21 ▶	✅ 3.21 ▶	✅ 3.21 ▶	
Leader	✅ 3.19 ▶	✅ 3.06 ▶	✅ 3.08 ▶	✅ 3.19 ▶	✅ 3.06 ▶	✅ 3.18 ▶	★ 3.44 ▶	✅ 3.19 ▶	✅ 3.06 ▶	✅ 3.18 ▶	✅ 3.18 ▶	★ 3.44 ▶	★ 3.44 ▶	



Gaps and Recommendations

