AN ANALYSIS OF WORK RELATED STRESS FACTOR IN SELECTED INDUSTRIES IN KERALA, INDIA

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By

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Ph.D Thesis

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Certificate

This is to certify that the thesis entitled " **AN ANALYSIS OF WORK RELATED STRESS FACTOR IN SELECTED INDUSTRIES IN KERALA, INDIA"** is an authentic original work done by **SATHEESH KUMAR.K** under my supervision and guidance in School of Engineering, Cochin University of Science and Technology. No part of this thesis has been presented for any other degree from any other institution.

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DECLARATION

I hereby declare that the work presented in the thesis entitled **"AN ANALYSIS OF WORK RELATED STRESS FACTOR IN SELECTED INDUSTRIES IN KERALA, INDIA"** is based on the original work done by me under the supervision of Prof.(Dr.) G. MADHU, Division of Safety and Fire Engineering, School of Engineering, Cochin University of Science and Technology. No part of this thesis has been presented for any other degree from any other institution.

Kochi-22 **SATHEESH KUMAR.K**

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Dedicated to

My Parents

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ABSTRACT

Occupational stress is becoming a major issue in both corporate and social agenda .In industrialized countries, there have been quite dramatic changes in the conditions at work, during the last decade ,caused by economic, social and technical development. As a consequence, the people today at work are exposed to high quantitative and qualitative demands as well as hard competition caused by global economy. A recent report says that ailments due to work related stress is likely to cost India's exchequer around ₹72000 crores between 2009 and 2015. Though India is a fast developing country, it is yet to create facilities to mitigate the adverse effects of work stress, more over only little efforts have been made to assess the work related stress.

In the absence of well defined standards to assess the work related stress in India, an attempt is made in this direction to develop the factors for the evaluation of work stress. Accordingly, with the help of existing literature and in consultation with the safety experts, seven factors for the evaluation of work stress is developed. An instrument (Questionnaire) was developed using these seven factors for the evaluation of work stress .The validity , and unidimensionality of the questionnaire was ensured by confirmatory factor analysis. The reliability of the questionnaire was ensured before administration. While analyzing the relation ship between the variables, it is noted that no relationship exists between them, and hence the above factors are treated as independent factors/ variables for the purpose of research .

Initially five profit making manufacturing industries, under public sector in the state of Kerala, were selected for the study. The influence of factors responsible for work stress is analyzed in these industries. These industries were classified in to two types, namely chemical and heavy engineering ,based on the product manufactured and work environment and the analysis is further carried out for these two categories.

The variation of work stress with different age , designation and experience of the employees are analyzed by means of one-way ANOVA. Further three different type of modelling of work stress, namely factor modelling, structural equation modelling and multinomial logistic regression modelling was done to analyze the association of factors responsible for work stress. All these models are found equally good in predicting the work stress.

The present study indicates that work stress exists among the employees in public sector industries in Kerala. Employees belonging to age group 40-45yrs and experience groups 15-20yrs had relatively higher work demand ,low job control, and low support at work. Low job control was noted among lower designation levels, particularly at the worker level in these industries. Hence the instrument developed using the seven factors namely demand, control, manager support, peer support, relationship, role and change can be effectively used for the evaluation of work stress in industries.

Key words : Work Stress, Confirmatory Factor Analysis, Factor Modelling, Structural Equation Modelling, Multinomial Logistic regression Modelling

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LIST OF ABBREVIATIONS

AGFI	Adjusted Goodness of Fit Index
CFA	Confirmatory Factor Analysis
CFI	Comparative Fit Index
GFI	Goodness of Fit Index
NFI	Normed Fit Index
RMR	Root Mean Square Residual
RMSEA	Root Mean Square Error of Approximation
SRMR	Standardised Root Mean Square Residual
TLI	Tucker Lewis Index

Chapter - 1

INTRODUCTION

CONTENTS

1.1 Work related stress – An overview

Occupational stress is gaining significance in both corporate and social agenda. The business environment has become grown more complex today. The organizations are now experiencing a new culture of increasing speed, efficiency and competition. In industrialized countries, considerable changes in the conditions of work and changing complexions of the work place , is found during the last decade, due to the social and technical development (NIOSH, 2002). Today as a consequence, people at work are

exposed to high quantitative and qualitative demands at workplace. In multinational companies , lean production and downsizing resulted in fewer employees to produce more and which inurn raised the level of work stress due to over stimulation (Conti et al.,2006; Roed and Feveng, 2007; Vahtera et al., 2004).

Over a last decade, the escalating costs associated with workplace stress indicate an international trend among industrialized countries. A study of mental health policies and programs for workers in Finland, Germany, Poland, United Kingdom and United States (ILO, 2000) shows an increasing incidence of mental health problems, with almost one in ten workers subjected to stress, depression, anxiety or burnout, leading to consequences of unemployment and hospitalization. The study of work stress in member states of European Union (EU), points out that on an average 22% of the working Europeans experience work stress. In 2002, the annual economic cost of work related stress in the EU-15 was estimated at € 20,000 million. (EASHAW,2005). The stress related absenteeism in the United states is four times higher than that resulting from work place accidents and occupational diseases .Study in Canada shows that 38.8% of Canadians between the age group of 15 and 75 are stressed (Brun and Lamarche, 2006). In Japan, the sheer magnitude of working hours has been one of the suggested causes for death due to over work or 'Karoshi'(Shimizu et al.,1997). A survey conducted by the industry body Assocham has revealed that stress levels among the Indian employees are raising (The Economic times, 2009) and is likely to cost India's exchequer around ₹72000 crores during 2009-15.

1.2 Definition of Stress

The Health and Safety Executive (HSE-UK) (Palmer et al., 2004) defines stress as "the adverse reaction people have to excessive pressure or other types of demand placed upon them".

The definition clearly states that stress is the result of excessive demands or pressures. A certain amount of pressure is inevitable in any job. Dealing successfully with pressure can give people a sense of achievement and can motivate people.

Work related stress is a negative and unpleasant condition which may be experienced when a person perceives that they are unable to meet the demands and pressures that are placed upon them and which may be associated with a range of ill health effects, both physiological and psychological (Cox,1993).

The National Institute of Occupational Safety and Health (NIOSH - USA) (NIOSH ,1999) defines stress as "the harmful physical and emotional responses that occur when the requirements of the job do not match the capabilities, resources, and needs of the worker."

According to NIOSH, working conditions play a primary role in causing work stress. However role of individual factors is not ignored. NIOSH is of the view that exposure to stressful working conditions (called job stressors) can have direct influence on worker safety and heath and says that individual and organizational factors may intensity the effects of stressful working conditions (NIOSH ,2002).

1.3 Types of stressors

The common type of stressors found at the work place are environmental stressors and occupational stressors (Vischer, 2007; Mc Coy and Evans, 2005). Environmental stressors are those which arise from extremes of temperatures and humidity, inadequate ventilation, excessive noise and vibration and presence of airborne contaminants such as dusts ,fumes and gases .Occupational stressors are associated with too much or too little work, work relationships, decision latitude, role, support and changes at the work (HSE, 2006). It is observed that the presence of any one of the above or both can induce work stress.

1.4 The effect of stressors

Work stress results in loss of control at work due to the imbalance between the pressures being exerted and the resources of the individual. When the pressure/demand becomes too high, individual thinking, feeling and behavior get altered. As a result, changes in psychological functions occur which, if unresolved can lead to health problems. However, people tend to perform better when under a moderate amount of pressure.

In Fig. 1.1 both A&B represent high performing individuals .However A is working comfortably with in the optimum zone , while B is working in high risk zone, which leads to the development of adverse reactions. Working at peak performance (highest point on the graph) is acceptable for short periods, but the risk of remaining at the peak for long period is likely hood of additional events adding to the pressure and pushing the individual into over load zone. Once an individual have moved

past in to the over load zone, the performance of the individual drastically decreases (IPIECA, 2006). With out intervention this can result in illness.

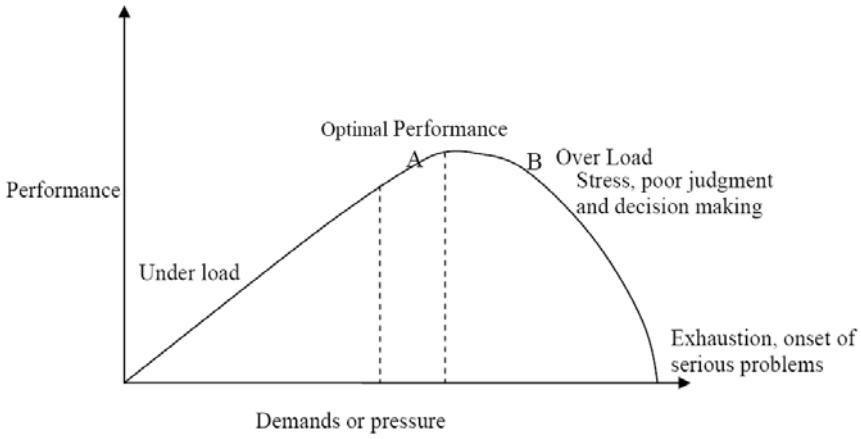

Figure 1.1 : Performance curve

1.5 Common causes of Stress in industry

It is accepted that any job can cause stress and also that it is not just about over work. Boredom and monotony can also be stressful. Some of the activities which can lead to occupational stress (NIOSH, 2002; Levi, 2000) at the work place are

- dealing with clients or the public
- cuts, reorganizations and lack of job security
- poor working conditions
- threats of violence, harassment and bullying
- lack of flexibility
- lack of control over work
- too demanding a job or too high a work load
- monotonous or boring work
- lack of training

- excessive hours and shift work
- working in isolation
- working relationship

1.6 Impacts of Work Stress

Stress affects the physical and mental health of the workers who are exposed to it. The research conducted in Europe highlights that work related stress is the second most common cause of illness after musculoskeletal disorders (Teasdale, 2006). The commonly found short and long term symptoms of work stress are listed below.

1.6.1 Short Term effects

The short term symptoms which arise from the hormonal changes include (EASHAW, 2009; Jex and Crossley, 2005; NIOSH , 2002)

- Headaches
- Indigestion
- Raised blood pressure
- Disturbed sleep
- Skin rashes
- Muscle fatigue
- Anxiety
- Irritability
- Forgetfulness
- Drop in performance
- Increased accidents
- Increased use of alcohols, tobacco, drugs

1.6.2 Long term effects

In the long term the range of symptoms can be linked to a variety of illness.(Jex and Crossley, 2005; NIOSH , 2002).

- **Heart and circulatory system**

  Hypertension

  Heart diseases

  Strokes

  Heart attacks

- **Digestive system disorders**

  Chronic inflammation

  Peptic ulcers

  Diarrhea

- **Immune system**

  Reduced resistance to infection

  Chronic asthma

  Possible increased cancer risk

- **Reproductive system disorders**

  Infertility

  Increased risk of miscarriage

  Increase risk of low birth weight babies

- **Mental health**

  Chronic anxiety

  Depression

  Mental breakdown

  Suicide

  Alcohol/substance abuse

  Social isolation

  The effect of the above is well documented in literature

1.7 Recognizing and understanding the symptoms of work stress

Recognizing and understanding the common symptoms of work stress can help management to take corrective actions before serious problems emerge. The following list identifies some of the common observable symptoms of stress. Since no two people are alike, not everyone will have all symptoms or particular type of symptom. Some people are more prone to angry outbursts, aggressive behaviors, and even violence when stressed out, others tend to withdraw and become depressed.(Leka etal., 2003; NIOSH ,2002).

- **Emotional symptoms are**

  Chronic anxiety, nervousness and worrying

  Reduced frustration tolerance

  Emotional outbursts

  Depression

  Physical symptoms

  Decreased energy level

  Uncharacteristic clumsiness

- **Mental symptoms are :**

  Difficulty in concentrating

  Forgetfulness

  Difficulty in thinking clearly

  Paranoia, defensiveness and irrational fears

1.8 Work stress and safety

According to safety experts, unsafe behaviour are the leading contributor to accidents and injuries in the work place. Research shows that unsafe behaviour have significant role in work place accidents and injuries than do unsafe environmental factors such as wet floors, unsafe equipments etc. Experts estimate that unsafe behaviour amount for 80% of the work place accidents and injuries (Caruso et al., 2004; Kathryn and Harie, 1998).Therefore focusing solely on physical environment will solve only 20% of the problem. One of the leading causes of unsafe behaviour is stress. Since stress negatively affects how people think, act and react, it makes employees more vulnerable to accidents and injuries.

By reducing employee stress, companies can significantly reduce the behavioral problems that lead to safety issues (HSE, 2006). By reducing stress, they can also reduce other stress related costs such as absenteeism, turnover, reduced productivity grievances, and litigation.

1.9 The Legal Frame Work

Under the health and safety at work Act 1974,the employers in UK have the duty under the law to ensure the health and safety of the employees at work (HSE, 2009; Cousins et al., 2004). There is also legal frame work through the manner in which the courts and employment tribunals have adjudicated in stress cases. In addition to this The management of health and safety at work Regulations, 1999 require employers to assess health and safety risk, and to introduce prevention and control measures based on the risk assessment.

The occupational safety and health Act 1970 was created by both National Institute of Occupational Safety and Health (NIOSH) and the Occupational Safety and Health Administration (OSHA). OSHA is part of the US Department of Labor and is responsible for developing and enforcing workplace safety and health regulations. NIOSH is an agency established to help assure safe and healthful working conditions for working men and women by providing research, information, education and training in the occupational safety and health.

In India the Factories act, 1948 is enacted for occupational safety and health and welfare of the workers at the workplaces. The provisions of the act relate to i) Health ii) Safety iii) Welfare facilities iv) Working hours.

On 5th Feb 2009, the Union cabinet of India has approved the national policy on Safety, Health and Environment at work place to address the issues of securing health and safety of workers in the country.

The Department of Factories and Boilers, Government of Kerala has formed various rules, known as Kerala Factory rules 1951, Under Factories act 1948 for ensuring safety, health and welfare of the workers.

National Safety Council (NSC) was set up by Ministry of Labour, Government of India (GOI) on 4th March 1966 to generate, develop and sustain voluntary movement on safety, health and environment at the national level. The various activities of NSC include organizing and conducting specialized training courses, conferences, seminars and workshops, conducting consultancy studies such as safety audits, hazard evaluation, risk assessment, designing and developing HSE promotional materials etc.

1.10 Measurement of work stress in Industries

The most common method of evaluation of work stress in industries is in terms of periodic stress surveys and assessment and such a process is called psychological risk assessment (Hicks and Caroline, 2006; Stranks, 2005). Such surveys and audits are tailored to specific individuals and organizations in which they work. This can provide a baseline measure from which subsequent intervention can be evaluated. Normally line mangers play the lead role for the survey or audit and provides feedback between employer and employee. Such surveys or audits are normally carried out internally by the human resource department.

Qualitative data from the individual employees who expresses work stress are collected through interviews (Hicks and Caroline, 2006) .The employees keep a stress diary prior to the interview. Such type of data can be collected from the focus groups or work groups.

Quantitative data collection is a very popular method of data collection now a days. (Murphy and Schoenborn, 2008; Stranks, 2005) .This can be done by means of self completed questionnaires .The validity and reliability of such questionnaires has to be ascertained before the administration.

1.11 The need for the present work

Most of the studies on work related stress have been done in developed countries. India being a large country with high population and quite a large number of people employed in the industrial sector, only little efforts have been found in assessing the work stress. Therefore it is worth while to investigate and analyze the factors responsible for work stress.

A recent survey conducted in India among employees found 57% rise in work related stress in India, due to global recession compared to last two years, which inurn affected their performance (The Economic times, 2009) . It is also reported that the intensity of work stress varies with type of industry and occupation (Shimizu et al., 1997). Investigations carried out in developed countries reveal that work stress varies with age, designation, educational qualification, gender difference, language etc. (Shields, 2006). Therefore there is a wide scope for analyzing the factors responsible for work stress among the employees in the Indian industries by using reliable and valid instruments.

Many earlier research findings projected the influence of work environment on work stress (Thayer et al., 2009; Jennings, 2008). It is worth while in analyzing the factors responsible for work stress in different type of industries in India.

The modelling of work stress by factor analysis leaves enough scope for analyzing the work stress under the influence of different factors. The structural equation modelling of work stress where the complex relationship of work stress with different factors responsible for it can be modelled and tested, which is not possible by other multi variable techniques (Kaiser and Coffery, 1965).

The multinomial logistic regression modelling (Mala et al., 2010; DeMaris et al., 2003) is another potential area of research, where the odds of improvement in work stress for unit increase in the factors responsible for it can be evaluated . Little research is done so far in the modelling of work stress by this method.

1.12 Research objectives

The major objectives of the study are

- To identify the factors responsible for work stress
- To develop a valid and reliable instrument for the evaluation of work stress by using the factors identified
- To analyze the influence of these factors among the employees of different age groups , designation levels and experience levels in manufacturing industries
- To develop models for the prediction of work stress by using the above factors

1.13 Research methodology

In the absence of well defined standards to assess the work stress in India, an attempt is made in this direction to identify and develop the factors responsible for it .Accordingly with the help of existing literature, and in consultation with the safety experts, seven factors were developed for the evaluation of work stress. Initially draft questionnaire containing fifty two items, covering the above factors were prepared. This was subsequently fine tuned to 35 item questionnaire after conducting preliminary survey and discussion with the safety professionals and management experts. Five large scale profit making manufacturing industries were selected for the study by random sampling. All the industries were profit making out of which three are chemical industries and two are heavy engineering industries .The participants for the study

consists of engineers ,supervisors and workers. Responses to items were solicited in five point Likert scale from Always to Never. Ten demographic questions were also included in the questionnaire for various analyses. The response rate was 81.3% .

1.14 Organization of the thesis

The thesis is presented in six chapters, Chapter-1, gives an introduction about the work. In chapter-2, a review of literature in which different approaches for the study of work stress is presented. This is followed by a review of factors influencing the stress with respect to the context and content of work is made. A review of modelling of work stress by using different factors in developed countries is discussed. Observation from the literature review and motivation for the present study are also discussed there.

The factors developed for the evaluation of work stress are identified and discussed in chapter-3. This is followed by a discussion on the development of an instrument for measuring work related stress. Validation and reliability of data collected through a questionnaire based survey in five manufacturing industries in Kerala is presented. The relationship between the different factors is also analyzed in this chapter.

The influence of various factors responsible for work stress in the selected five industries is analyzed in chapter–4. The analysis was done for different age groups, designation levels and employees having different experience in these industries .This was done by means of one-way ANOVA. A cross comparative study of each factor is made at the end of each analysis. The analysis was further extended to chemical and heavy engineering industries.

In chapter-5, modelling of work stress is discussed. The development of different type of models, namely factor models and structural equation models and multinomial logistic regression model is presented.

In chapter-6, summary and conclusions of the research, and scope for further research are presented.

Chapter - 2

LITERATURE SURVEY

CONTENTS

2.1 Different approaches for the study of work stress

Over the past 30-35 years, the knowledge base on occupational stress has increased substantially and it has been noticed that occupational stress is rapidly becoming the single greatest cause of occupational disease (Noblet and La Montagne, 2006). This calls for a systematic assessment of factors responsible for work stress. Stress audit is a proactive approach to the management of stress at work. It helps to assess organizational and individual strengths and weaknesses and acquire the information necessary to focus on desired response. When the information provided by an audit is appropriately acted upon, there tends to be subsequent reduction in absenteeism and increased levels of commitment and productivity (Leontaridi and Ward, 2002). It has been concluded in several different reviews of scientific literature on stress that there are essentially three different, but overlapping approaches to the study of work stress (Cox, 1993). The first approach namely 'Engineering Approach' treats stress as a stimulus characteristics of the person's environment, usually conceived in terms of load or level of demand placed on the individual (Cox,1990). In

this approach occupational stress is treated as a property of work environment, and usually as an objectively measurable aspect of that environment. According to the approach, stress was said to produce a strain reaction which although often reversible, but in many occasions proves to be irreversible (Sutherland and Cooper, 1990).

The second approach known as 'Physiological Approach' received its initial impetus from the work of Selye (1950) which defines stress "as a state manifested by a specific syndrome, which consists all the non specific changes with in the biologic system". It treats stress as a dependent variable of a particular physiological response to a threatening or damaging environment.

The third approach, namely 'Psychological' approach, conceptualizes work stress in terms of the dynamic interaction between the person and their work environment. The development of psychological models has been to some extent, an attempt to over come the criticisms leveled at the earlier approaches. Psychological approaches to the definition of stress are largely consistent with the definition of psychosocial hazards of international labour office (ILO, 1986) and with the definition of well being recommended by the World Health Organization (WHO, 1986).

2.2 Research work on work stress in the context of work

The following literature review points out psychological hazards, in the context of work. The potential stressors for these hazards are organizational culture and function, role in the organization, career development, decision latitude and control, inter personal relationship at work, work-home interface and change (Mackay et al .,2004).

2.2.1 Organizational culture and function

One of the main source of stress is organization itself. French and Caplan (1970) found that people with greater opportunities for participation in decision making reported greater job satisfaction. Michie and Williams (2002) points out that non participation in decision making at work is one of the significant predictor of work related ill health.

Most of the workers in Europe feel that there exists restrictions in individual freedom, autonomy and identity at their work (Whetten and Camareron, 2007). Studies on the employees perceptions and descriptions of their organizations, suggest three distinct aspects of organizational function and culture - organization as a task environment, as a problem solving environment and as a development environment (Cox and Leiter, 1992;Cox and Hawarth,1990). The available evidence suggests that the organizations perceived to be poor in respect to these environments, will likely to be associated with higher stress. Landy (1992) pointed out that improper management behavior and supervisory style are mainly responsible for the work stress. Meanwhile Leka et al.2003) notes that factors like poor communication, poor leadership, and lack of clarity about the organizational objectives and structure of the organization may lead to work stress.

Mansor and Tayid (2010) found a strong correlation among organizational culture, employee job stress and job satisfaction among the employees of Malaysia in direct tax administration. The effect of stressors in organizational context of IT employees were analyzed by Kim and Wright (2007) and found that stressors like resources, participation and feedback leads to work exhaustion and accelerate turn over intensions.

2.2.2 Role in the organization

Another major source of stress is associated with persons role at work. A great deal of research is done on role ambiguity and role conflict. Role ambiguity is the result of employees uncertainties, lack of information about the job role, expectation and responsibilities (Cox et al., 2000). Colligan and Higgins (2005) points out that role conflict and role ambiguity are instrumental in developing physiological disorders and says that the above factors can also lead to organizational dysfunction and decreased productivity. Deterioration of job performance due to lack of role clarity was noted by Fried et al. (2003).

Rizzo et al. (1970), defines the role conflict as the incompatibility of requirements and expectations from the role, where compatibility is judged based on the set of conditions that impact the role performance .The effect of role stressors namely role ambiguity and role conflict among the employees was studied by Tang and Chang (2010), who concluded that these role stressors affect the employees creativity. Stellman (1998) points out that role conflict and role ambiguity can be minimized by improving the interaction and communication between the supervisors and workers.

2.2.3 Career development

Lack of expected career growth is one of main source of work stress. The factors connected with this are poor promotion polices, job insecurity and poor pay in the organization (Sverke and Hellgren, 2002). Bosma et al. (1998) reveals that poor promotion prospects and blocked career may lead to work related stress hazard like coronary heart disease (CHD).

The study among twenty private and public organizations by Rehman (2008) shows positive correlations between job stress and job insecurity, but Witte et al. (2003) points out that job security is associated with reduction in job satisfaction and organizational commitment among the employees. Studies conducted among construction workers by Loosemore and Waters (2004) notes that poor pay increases the levels of work stress.

2.2.4 Decision latitude and control

Decision latitude and control are important aspects of work stress. They represent the extent to which the employees are participating in the decision making process, and also shows the freedom given to the employees for choosing their work. Park (2007) indicates that individuals with highest income group is most likely to have low strain due to greater job control. He further states that white collar workers have higher levels of decision latitude.

Based on studies conducted in a private sector organization in London by Bond and Bunce (2005) reveals that job control is the one of the important mediator for improving the mental health, commitment and absenteeism. Lack of control combined with too many job demands increase the likely hood of early retirement (Turcotte and Schellenberg, 2005).

Shields (2006) points out that work stress leads to depression among employees. The study further says that high psychological demands and low decision latitude leads to more work stress among women. Aras et al.(2001) found musculoskeletal problem like shoulder pain among the workers due to low job control and less possibility to discuss the problem with superiors.

Schaubroeck et al.(2000) suggests that higher job control will improve the coping ability of the employees at times of high job demand but Searle et al.(1999) noticed low job performance due to low job control. de Croon et al.(2004) suggests that improvement of working conditions like better job control can reduce the turnover tendency of workers.

The work stress factors like high work demand and low job control were analyzed among industrial workers of different age and sex by Kivimaki et al. (2002), and found that workers having high work demand and low job control had a higher cardio vascular risk compared to those who had lower stress. Similar results were found in the studies of Kuper and Marmot (2003), but the incidence of coronary heart disease (CHD) was noted more among the younger workers. The research works of Heraclides et al. (2009) reveal that, exposure to long term stresses resulting from low job control and high work demand leads to increase in the risk of type-2 diabetes.

2.2.5 Interpersonal relationship at work

A number of research investigations point out, the need for good relationship with superiors, support from the superiors, support from the colleagues at work for the elimination of work related stress hazards (Spielberger et al., 2003). Ben (2007) says that the real source of problems connected with work stress is not located in the work environment, but is person-based, and the most effective way to reduce stress is to change the person based factors. Accordingly a questionnaire was developed by Ben (2007) and circulated among the check out assistants in the age group 18 to 56yrs, who belonged to both sex. The study revealed that higher level of job demand and low level of support at work can cause job stress.

Bacquer et al. (2005) developed a questionnaire for the study of work stress among the middle age men and women working in large scale industries in Belgium and found that supportive work environment by coworkers and supervisors are required for the minimization of work related stress hazards like CHD. The effect of supervisor support at times of high work demand among the correctional officers in a high risk industry in Australia was studied by Brough and Williams (2007). The study pointed out that low supervisor support was one of the major reason for work stress.

Burt et al. (2008) studied the influence of co-worker support and supervisor support on work stress among the workers in a construction industry and found that the presence of the above factors could improve the group cohesion and team safety. The reliability of the questionnaire developed for the analysis was ensured before the administration.

Kjellberg and Wadman (2007) in his study among assembly workers at Sweden found musculoskeletal complaints among the employees and argued that low work support and work demand were more responsible for work stress rather than control.

Paschol and Tamayo (2004) developed a work stress scale for the evaluation of occupational stress, which can be used in different work environments and variety of occupations. The scale initially had 31 items and the scale was validated by means of factor analysis and the final version had 23 items.

2.2.6 Home – Work Interface

Many research studies points out the work related stress hazards due to work-family conflict. Yang et al.(2000) states that work-family conflict is a form of inter role conflict ,in which the role pressures from the work and family domains are mutually non compatible in same respect. Jansen et al. (2006) examined the effect of work - family conflict among male and female workers and observed that work- family conflict leads to greater sickness-absence in men and women and this was more pronounced in women. Studies of Frone (2000) about the work- family conflict reveals that work family conflict leads to one set of psychiatric disorders.

2.2.7 Change

Change is one of the most commonly found stressor in the context of work. Conner and Douglas(2005) points out that changes in the modern work environment as result of technological advances, organizational restructuring and various redesign options can elevate the work stress. Shegemi et al.(1997) states that rapid changes along with poor relationship can lead to one set of work related stress hazards.

Launis and Pihlaja (2007) points out nine type of changes in the work place, which are creeping change, new managers with new vision, lunching of new data systems, weakening of individual position, service concept disputes, employment under threat, Changes as a coercion from outside , change as a starting point of new activity, change due to the new idea brought into the local work unit due to the arrival of new project. Most of the times such dynamics of transformations are not well understood by the employees. Such recurrent changes are found instrumental in inducing the work stress.

2.3 Research work on work stress in the content of work

Like context of work, content of work also leads to work stress. The following literature cited below discuss the research findings on the factors which lead to work stress and related hazards in the content of work .These factors arise due to improper design of the task , work load and work pace ,and work schedule (Mackay et al.,2004 ; Cox et al., 2000).

2.3.1 Task design

There are several aspects of job content which are found hazardous and these include low value of work, low use of skills, repetitive work, uncertainty, lack of opportunity to learn, high attention demand, conflicting demand and insufficient resources (Cox et al., 2000).The research work shows that work related stress hazards arise due to meaning less task and lack of variety etc. It is also noted that most stressful type of works are those which have excessive demand and pressures ,that do not match with the worker's knowledge and abilities (WHO, 2007).

Many earlier studies point out that jobs with low degrees of autonomy and skill generally have 'low need satisfying value' for the individual and this results in low self confidence and affects the mental health (Handy, 1995). The studies conducted by Society of Human Resources Management UK among women and workers of age below 35 in 2005 showed that low value of work leads to low job satisfaction (WFC, 2006). But Chandola et al. (2006) points out that lower level of physical activity in the work often leads to work stress, meanwhile Leka (2003) notes that monotonous, under stimulating and meaning less tasks, unpleasant tasks, and aversive tasks are stress raising factors.

Bond and Bunce (2005) points out that repetitive work and task cycle time are responsible for work stress .A study of the effect of repetitive work was carried out by Lundberg et al. (1989) among assembly line workers and found that stress due to repetitive work leads to cardiovascular problems among workers.

2.3.2 Work load and work pace

Work load or work demand is one of the most important factors responsible for work stress. There are two different type of work load – qualitative and quantitative .Quantitative work load refers to the amount of work to be done ,while qualitative work load refers to the difficulty in that work (Cox et al.,2000). Melchior et al. (2007) studied the effect of work stress among men and women working groups in USA and found that high psychological work demands like excessive work load and time pressures lead to work stress and cause depression and anxiety among young working adults, but Levi (2000), noticed work related stress hazards like depressive disorders and abdominal fat among workers with high work demands. A higher correlation between work stress and coronary heart disease (CHD) was noted by Chandola et al. (2008) in his study among male and female employees of different age groups .It is noted that more association of CHD was found among the age group above 50years.

Bosma et al.(1998) investigated the association between two alternative job stress models- the effort reward imbalance model and job strain model and the risk of coronary heart diseases among male and female British civil servants and found that imbalance between personal efforts (competitiveness, work related over commitment and hostility) and the

rewards (poor promotion prospects, and blocked career) was associated with coronary heart disease. Job strain and job demand are not related to heart disease. But Vrijkotte et al. (2000) suggested that work related stress due to high effort and low reward lead to increased heart beat and blood pressure. They also found that self reported chronic stress can be an independent stress risk factor for cardiovascular disease in middle aged men (Ohlin et al.,2004; Siegrist et al., 2002).

Wilkins et al. (1998) in their study notes that work stress is more among service and blue collar employees. The analysis of stress and strain among men and women revealed that among men job stress is significantly associated with migraine and psychological distress. Among women job strain was significantly associated with work injury.

Park et al. (2007) in their study among the Canadian employees of different age groups finds that younger work groups of age 15-24yrs always prefer to be in active jobs. The study reveals that 40-54yrs age group had higher perceived job stress than the younger work groups. But the studies among the north Italian employees by Cesana et al. (2003) on the age groups 25-54 yrs by using a questionnaire derived from the demand – control model of Karasek (1998) report that increased blood pressure among the employees while moving from low to high strain jobs. Mc Clenahan et al. (2007) conducted a study using demand – control / support model of Karasek and Theorell(1990) among academics and suggests that more number of variables are required for analyzing the work stress for a particular occupation.

Cavanaugh et al. (2000) conducted a study among US managers ,by considering two types of work stress. The fist one is challenge-related

stress, which is due to time pressure, high levels of responsibility, job over load etc and this leads to job satisfaction and the second one - hindrance-related stress ,which is due to organizational politics, red tape and concerns about job security will leads to turn over.

A study of work stress among young workers of New Zealand done by Melchior et al. (2007) shows that high physical demands had a two fold risk of major depression and anxiety compared to those with low demand. For this study data was collected from the participants through interview method.

Work stress is found to vary with different places;de Smet et al.(2005) studied the occupational stress among men and women working in two different work centers namely middle European work centers and Swedish work centers and observed that , men in middle European work centers perceived marginally less work demand compared to women ,where as a reverse trend was observed in Swedish work centers. But Leontaridi and Ward (2002) is of the view that physical demands of job involving risk and hard work play a larger role in increasing the job stress levels.

The association of work stress with monotonous work, perceived high work load and pressure were studied by Szabo and King (2000). They also pointed out that the above factors can lead to work stress, which in turn could lead to injury and musculoskeletal problems for the workers.

2.3.3 Work schedule

Two major factors responsible for work stress due to improper work schedule are shift work and long working hours .The studies conducted in Italy by Conway et al. (2008), among the shift workers observed that shift work leads to poor sleep and health related problems. The work stress was evaluated by means of effort- reward imbalance questionnaire, derived from Siergrist stress (1996) model. The reliability of the questionnaire was found satisfactory.

Shields (2006) observed higher job strain among shift workers than those people with regular hours of working. They have higher levels of psychological demands and lower job control and less job satisfaction. It has been also found that physically demanding work is one of the important factors for work absence among men and women (Park, 2007).

The study among fire fighters during night shift work shows that shift schedules, particularly night shift work often develops fatigue and induces heart rate variability (Takeyama et al., 2005).

Hirose (2005) studied the effect of work stress among women workers in dish factory in shifts. He points out that shift work often leads to sleep disturbances and causing fatigue. Higher level of blood pressure was observed among employees working in night shifts.

Yang et al. (2006) points out that long working hours develop work stress leading to hypertension among the employees. The study was conducted in California, among working population by interview survey method and found that on individual working 40 hours per week were 14% more likely to report hyper tension and those who worked between 41 to 50

hours per week are over 17% more likely to report hypertension and those who worked ≥51 hours per week were 29% more likely to report hypertension.

Dewa et al. (2007) points the link between psychiatric disorders and stress. The study conducted in Canada among working professionals of different age and occupation levels shows that chronic work stress amplifies the effects of psychiatric disorders which leads to physical disability. Stressful working conditions like long working hours is found responsible for musculoskeletal problems and work injury (Dempsay and Filiaggi, 2006 ; Daraiseh et al., 2003). A similar study was made by Rinder et al. (2008), by means of epidemiological appraisal instrument.

Krantz et al. (2005) conducted a study among white collar workers in Sweden, and found that work stress is associated with men subjected to long working hours (75 hours/week) and it often leads to wide range of ill health in men and women.

Caruso et al. (2004) analyzed the effects of overtime and employee health among Japanese workers. The study shows that overtime work is associated with the risk of myocardial infarction, increased blood pressure, increased injury rates, unhealthy weight gain and increased alcohol consumption. The study also indicates that working twelve hours or more hours per shift was associated with increased risk of back disorders and gastro intestinal complaints.

Hung and Jiang (2009) developed a fatigue questionnaire to evaluate physiological fatigue due to long term web browsing and found that long working hours lead to fatigue.

2.4 Work stress and modelling

Several models have been proposed to explain the causes of work related stress. Frankenhaeuser(1986) and colleagues have described a model where stress is defined in terms of imbalance between the perceived demands from the environment and individuals perceived resources to meet those demands .This imbalance can be caused by quantitative (A very high work pace, too much work to do etc…) or qualitative (too much responsibility, problems too complex to solve, conflicts ,overload etc…). However, an interesting feature of this model is the postulate that stress may be caused by an imbalance caused by under stimulation .This situation can be found in monotonous and repetitive work, such as traditional assembly line work and in data entry work at video display units , and among people who are underemployed.

A well known model describing work stress or strain is the demand control model proposed by Karasek and Theorell (Karasek and Theorell, 1990) and developed and expanded by others. According to this model, the combination of high demands and lack of control at work results high job strain. High demand combined with a high degree of control, which characterizes many high strain jobs , are described as an active work situation and are not associated with enhanced health risks.

The demand control model has been tested in numerous studies, which in general , shows that occupations characterized by high job strain are associated with elevated health risks compared with low strain jobs. Although most studies are cross sectional, thus excluding the possibility of making casual interferences, the few prospective studies that have been performed reports similar findings. In recent years, a third dimension

'social support' has been added to demand – control model. High job strain combined with low social support at work contributes to even more elevated health risks. Social support is generally considered to be protection against stress at work or it serves as a buffer against health risks under stressful conditions.

Johannas Siergrist (Siegrist et al ., 2004; Siegrist,1996) proposed a new model for stress at work called the effort-reward imbalance model. According to this model, lack of adequate reward in response to the individual's achievement is considered to contribute to high stress levels and elevated health risks .Reward could be in terms of economic benefits, such as higher income.

Work stress models have been proposed by a number of researchers earlier to explain the causes of work stress and many such causes are explained in sections 2.2 and 2.3 .The main objective of developing the model is to find out the relationship between the variables responsible for work stress.

Factor analysis is the basic model and has received a lot of attention in the field for many years (Lee, 2007) and it is used to develop the relationship between a set of variables (Thurstone , 1945; Spearman, 1904).

Mackay et al. (2004), conducted a factor analysis for the management standards developed for the risk assessment and many researchers used the indices like Tucker-Lewis Index (TLI), Normed Fit Index (NFI), Comparative Fit Index (CFI) and Root Mean Square Error of Approximation (RMSEA) for the analysis of fit for the structural equation modelling (Harrington, 2009).

Chan (2005) developed structural equation model for work stress .In this, association between different variables- namely stress, health, work, family and finance were analyzed by means of this model. The structural equation modelling was done by means of confirmatory factor analysis.

Forgarty et al.(1999) indicates that age and gender are important conditions influencing work stress. The study employed a path analysis to examine how occupational stressors, coping resources of the individual and characteristics of the individual-negative affectivity and positive-affectivity predict occupational strain. Further structural equation modelling was done linking negative-affectivity, positive-affectivity, coping resources of the individual and job satisfaction.

Kouvonen et al.(2005) developed multinomial logistic regression model, for examining the association between work stress and smoking intensity among Finnish public sector employees and found strong association between smoking and job stress.

Lindblom et al.(2006) examined the relationship between psychosocial work stress factors like work content ,work load and social support and job burn-out, by means of multinomial logistic regression, which is capable of handling more than one outcome.

2.5 Observations from literature review

The literature review shows that work related stress is common among the employees through out the world. It has been found that quantitative work demands which are considered to be an important source of stress, are concurrently affected by two reverse trends : a positive one- shorter working hours which would likely to reduce stress, and a negative one- greater work intensity, which generates higher stress levels.

Low job control is recognized as another important source of stress and many other research studies show that low support from superiors and colleagues are the main source of stress. Large number of studies indicates that strained relationship at work, role ambiguity, role conflict, inability to adjust with the changes in the production system result in work stress. Another sources of stress is harassment, where large number of workers report that they are subjected to work place harassment and bullying.

Many studies show the variation of work stress intensities among different age groups, but irrespective of age, employees report that work stress affects their health. Work stress is found in all sectors like, health, agriculture, forestry, manufacture and service. Studies show that work stress exists among employees in private and public sector. Works stress is prevalent in both white and blue collar employees. Well being scores for the self employed workers were found lower than employed workers. Among employed workers, the type of employment contract affects the stress related indices. Among the four contract types-permanent contract, fixed term contract, temporary contract and apprenticeship, workers with permanent contracts displayed higher stress levels.

From the literature review presented above, it is evident that studies on work related stress leaves scope for further research. Most of the studies in work related stress are carried out in developed countries, where researchers used either already existing standards or developed new factors for the evaluation of works stress. But in developing countries like India, well defined standards are not currently available for the evaluation of work stress.

Literature review reveals further that the factors used for the evaluation of work stress are different in different countries. Most of the studies are identical in nature. Therefore proper identification and development of factors for the evaluation of work stress are essential, which can be applied to Indian Industrial environment.

Although most of the reported research works are conducted according to well accepted methodology of scientific research, little consensus has been reached in certain aspects commonly associated with work stress. The researchers have used different questionnaires, resulting in different factor structures. The questionnaires that have been used were naturally influenced by authors' perception about the 'relative importance' of the questions.

While developing questionnaires by using different standards for the evaluation of work stress, very few researchers have attempted to support their claim by reporting an indication of its construct validity, unidimensionality or predictive validity. Most of the efforts have not progressed beyond the stage of face validity.

It is found that "risk assessment" has emerged as the principal factor in many studies. Since this assessment contains various factors developed by different researchers, identification of deficiencies in each standard has become difficult from their studies.

The modelling of work stress was done by several researchers using factor modelling, structural equation modelling and multinomial logistic regression modelling on different stress factors. As these standards are totally influenced by the work environment and work culture, general conclusions cannot be drawn from this.

2.6 Motivation for present research

Considerable research has been done on work related stress in developed countries like USA, European Union, Australia, Canada etc. But little research is done in India so far in this area. The review of the literature shows that various factors/risk assessment parameters developed so far can be effectively used for the work stress. But in India, where the work environment and work culture are different from the rest of the world the research work in this area is found to be meager. Hence it is worth while to develop factors/risk assessment parameters for the evaluation of work stress.

Empirical investigation of relationship between the factors responsible for work stress and the determinants are necessary for decision makers to give evidence and scientific explanations to support their decisions. The literature review reveals that enough such studies have not been reported not only from India, but also from developed countries.

Most of the scientific research in this area clearly shows that the factors responsible for work stress changes with age, designation, and experience. But little research has been done among people of different designation levels and experience in the same organization. Therefore it will be useful to analyze these factors in industries. As factors differ in different work environment, it is advisable to extend the analysis of factors among chemical and heavy engineering industries.

Apart from studying the parameters influencing work stress in industry, it is important to compare the effect of these factors in other similar organizations by cross comparison. Such type of study is not reported from India as well as developed countries.

The factor modelling of work stress by alpha factor analysis is seldom found in literature. Such type of modelling by using the factors developed for the study will help in establishing relationship of the factors with work stress, which can be used in Indian industries for prediction of work stress.

Most of the structural equation models on work stress reported from developed countries show the relationship between the various factors and work stress. Since the factors are totally dependent on the work environment and culture, it is worth while to develop such a model suiting the Indian work environment.

Multinomial logistic regression models for work stress has been done only in developed countries. Most of the analysis is based on either age or gender. But studies on improvement in work stress due to unit increase in these factors among different designation and experience groups is not found in literature. Hence it is important to carry out such studies to predict relative increase in work stress among different groups over the reference group.

Chapter - 3

FACTORS IDENTIFIED FOR THE EVALUATION OF WORK STRESS

CONTENTS

The seriousness of the problem of work place stress and resultant costs to the individuals and organizations (Palmer et al.,2004), calls for identification of factors responsible for work stress. An assessment method based on the above factors is essential for the investigation of work stress. Such an empirical study demands a rigorous research methodology, with reliable and valid instruments (Ahire et al ., 1996). This can be achieved only by measuring the perceptions of the employees in

the industries. A survey using questionnaire is most cost effective especially suitable for studies involving large samples (Kultar sigh,2007) The study using such instrument is non-biased and easy to analyze by using computer soft wares.

3.1 Factors Responsible For Work Stress

The following seven factors are identified from literature survey and through discussion with safety professionals and safety mangers in various industrial units in Kerala. These factors are

1. Demand
2. Control
3. Manager support
4. Peer support
5. Relationship
6. Role
7. Change

These factors can be treated as independent variables influencing the work stress in an organization. A detailed discussion about these factors is given below

3.1.1 Demand

This includes issues such as work load, work patterns and work environment. Work load is one of the first aspects of work to receive attention. It has been found that both work overload and work under load can be problematic (Cox et al., 2000). There are two types of work load - qualitative and quantitative and both are associated with work stress.(Edwards and Rothbord, 2005 ; Cox et al., 2000). There is a strong

evidence that they pose a threat to both physical and psychological health (Teasdale et al., 2006; Handi et al.,1995). Some of the other researchers have extended this line of argument by suggesting work load as a function of quality, quantity and time (Cox et al., 2000 ; Handy et al.,1995). Stress related illness were more reported with "working deadlines" and having "too much of work" than general working population. It is also to be noted that unrealistic expectations from the employees, particularly during the time of reorganizations can lead to unhealthy and unreasonable pressure on the employees (Cox et al., 2000).

The two main issues that relate to the effects of work scheduling on health are shift working and long working hours. Research work shows that shift work often develops fatigue among workers and increases the risk of cardiovascular disease (Takeyama et al.,2005). Increased smoking and alcoholic consumption were found among the employees working in continuous shifts (Caruso et al., 2004). Research reveals that the extended shifts, beyond the normal 8 hour shift (9^{th} to 12^{th} hours of works) were associated with feelings of increased fatigue, lower cognitive function, decline in vigilance on task measures and increased injuries (Caruso et al., 2004). Over time and extended shifts were associated with increased odds for unhealthy weight gain in men (Suwazono et al .,2008; Caruso et al .,2004).

It is observed that expansion of technology coupled with down sizing has increased the expectation about productivity, speed and efficiency which resulted in increased pressure on the employees (Conti et al., 2006; Vahtera et al., 2004; NIOSH, 2002).Increased work load and long working hours can leave the employees physically and emotionally drained. The

states to be achieved in this connection are (Mackay et al., 2004; Cox et al., 2000).

i. Organization provides employees with adequate and achievable demands in relation to the agreed hours of work
ii. People skills and abilities are matched to the job demands
iii. Jobs are designed to be with in the capabilities of the employees
iv. Employees should be provided with good work environment.

3.1.2 Control

Control and decision latitude are important issues in job design and work organization. This indicates "how much say the person has the way they do the work". This is the extent to which employees' participation in decision making process related to the work. It has been found that low control at work has been repeatedly associated with stress (Bond and Bunce, 2005) and leads to anxiety, apathy and increased incidence of cardiovascular symptoms (Wieclaw et al., 2008; Malinauskiene et al., 2004).

Researchers indicate that workers should be empowered to plan their work and control their workloads and make decisions about how that work should be completed and how problems should be tackled (Cox et al.,2000). Earlier research indicates that when there are greater opportunities for participating in decision making, greater satisfaction and higher feeling of self esteem are reported (Love et al., 2007; Bauer, 2004). Non- participation appears related to work stress and overall poor physical health (Cox et al.,2000). It has been found that lack of participation shows a strong correlation to job satisfaction (Bhardwaj and Srivastava, 2008; French and Caplan, 1973). The states to be achieved, in this connection are (Mackay et al., 2004 ; Cox et al., 2000).

i. Where ever possible, employees may have control over their pace of work
ii. Employees are encouraged to use their skills and take initiatives to do their work
iii. Employees can be encouraged to develop new skills to help them undertake new and challenging pieces of work
iv. Organizations may encourage employees to develop their skills
v. Employees should have freedom to take breaks, whenever required
vi. Employees are consulted over their work patterns.

3.1.3. Manager support

It includes encouragement, sponsorship and resources provided by the organization and time management. This is another factor that can buffer the effect of work place stress (Ben,2007) that an individual experiences . Managers and supervisors check the quality of work and are responsible for operational management at the work site. Superiors and managers often has to cope with lots of pressure, from the management as well as pleasing the customer and manage workers. The pressure that managers experience from their superiors and from the host companies is transferred to further down the line towards the workers on the lowest level of hierarchy. It has been found that superiors sometimes behave as authoritarian and unfair, with little respect for the team, encouraging favoritism and giving raise to distrust between workers. Earlier research work indicates that , manager support/ superior support are the one of the important predictors of both psychological ill heath and job dissatisfaction (Noblet, 2003), and leads to musculoskeletal complaints (Kjellberg and Wadman, 2007). The states to be achieved in this connection are (Mackay et al., 2004;Cox et al., 2000).

i. The organization has policies and procedures to adequately support employees
ii. Systems are in place to enable and encourage managers to support their staff

3.1.4 Peer support

This includes encouragement, sponsorship and resources provided by the colleagues at work. Many times it is found that employees are unable to get support from the colleagues. The earlier research work points out that due to high intensity at work (as a consequence of time pressure, frequent staff shortage etc ..), workers do not have possibility to get help from their colleagues to complete the work in time(Cox et al., 2000). Many workers report that support from others will not be available to complete the work, if the time of completion of the work is limited. This may result in high absence rate which in turn ,may lead to tension between colleagues as the employees present will have to take over the job of absenting workers(Unden,1996). Earlier research work reveals that low peer support leads to physical ill health problems like coronary heart diseases (Bacquer et al., 2005) and low job satisfaction (Cox et al., 2000). The states to be achieved in this connection are (Mackay et al., 2004 ; Cox et al., 2000).

i. Systems are in place to enable and encourage employees to support their colleagues.
ii. Employees should be aware – what support is available and how and when to access it.
iii. Employees should know, how to access the required resources to do their job.

iv. All the employees should receive regular and constructive feed back.

3.1.5 Relationship

This includes promoting positive working to avoid conflict and dealing with unacceptable behavior. Selye (1976) suggested that having to live with other people is one of the most stressful aspects of life .This is also true in the case of working relationships. For being 'at work' typically means significant interaction with other people, like collegues, bosses or subordinates . These relationships can be a major source of both stress and support (Mackay et al., 2004; Cooper et al.,2001; Arnold, et al., 1998). The poor relationships are defined as those having a lack of trust, little support, and low interest in listening and attempting to tackle work place problems. It has been found that good relationship among employees and members of the work group are essential for individual and organizational health (Hoel et al ;2010). Work place bullying and workplace violence are associated variables in connection with relationship factor, which result in work stress (Hoel et al., 2010;Vartia ,1996).

There are several studies that indicate a correlation between relationships and health outcome (Hoel et al., 2010).It is observed that "stress cases" that have been presented to the courts typically include some relationship difficulties underpinning the basic compliant. Mayhew and Chappel (2003) argue that bullying and violence have both personnel and organizational costs ; specifically they draw on supporting evidence that around 40% of the victims do not turn to any one at all for support, but as the bullying continues victims reduce their commitment and then leave the organization. Three important sets of relationship identified by the researchers (Cox et al., 2000) are relationship with superiors, relationship

with subordinates and relationship with colleagues, and the strained relationship in any one of the above may lead to work stress, The states to be achieved in this connection are (Mackay et al.,2004;Cox et al., 2000).

i. Organization to promote positive behavior at work to avoid conflict and ensure fairness
ii. Employees may share information relevant to their work
iii. The organization has agreed policies and procedures to prevent or resolve unacceptable behavior
iv. Systems are in place to enable and encourage employees to report unacceptable behavior

3.1.6 Role

This indicates whether people understand their role within the organization and whether the organization ensures that person does not have conflicting roles. The role can be explained with the help of three important aspects; role ambiguity, role conflict and role insufficiency.

Role ambiguity occurs when a worker has in adequate information about his /her work. Role ambiguity manifests itself a general confusion about objectives, lack of clarity among expectations and general uncertainty about the scope and responsibility of the job (Bliese and Castro, 2000). It has been found that workers suffering from role ambiguity are more likely to experience low job satisfaction and wide range of physical health problems (Colligan et al., 2005).

Role conflict occurs when the individual is required to play a role which conflicts with their values (Cox et al.,2000). Role conflict is defined as two or more set of incompatible demands concerning a work when

placed on a worker by the concerned parties or interface between two or more roles of the same person (Cooper et al., 2001). Researchers have shown that greater role conflict leads to low job satisfaction and greater work related stress (Cuhadar,2008).

Role insufficiency refers to failure of the organization to make full use of the individual abilities and training. Such insufficiency leads to work stress and greater amounts of psychological strain (Cox et al.,2000). The states to be achieved in this connection are (Mackay et al., 2004; Cox et al., 2000).

i. The organization to ensure that, as far as possible, the different requirements it places upon the employees are clear and compatible.
ii. The organization provides information to enable employees to understand their role and responsibilities.
iii. The organization ensures that, as far as possible, the requirements placed up on the employees are clear.
iv. Systems are in place to enable employees to raise concerns about any uncertainties or conflicts about their role and responsibilities.

3.1.7 Change

Work is essentially an economic activity, and industries are established in order to manufacture products or provide services for the market. In order to survive in the market, organizations are constantly striving for more functional and cost efficient production and service concepts (Cox et al., 2000).Such renewals occur both in the public and private sector as well as in the industrial and service organizations. It is found that logic of work activities (eg: technological systems, division of

labour) make the organization layered and more complex. Different concepts require different capabilities, management and expert methods and production learning systems (Launis and Pihlaja, 2007). Many times transformations are not correctly understood from the perspective of either organizations or individuals. These recurrent changes increase time pressure, stress, health complaints and safety problems of individuals. The states to be achieved are

i. The organization provides employees with timely information to enable them to understand reasons for proposed changes
ii. The organizations ensure adequate employee consultation on changes and provides opportunities for employees to influence the proposals
iii. Employees are aware of the probable impact of any changes in their jobs and if necessary, employees are given training to support the changes in their jobs
iv. Employees are aware of time table for changes
v. Employees have access to get relevant support during changes

3.2 Research methodology

The primary objective of the study was to identify the factors responsible for the work stress .An instrument was developed using these factors and the validity and reliability of the measuring instruments was tested, so that it can be effectively used by the practitioners. Confirmatory factor analysis is conducted for all the seven factors developed for checking the convergent validity, and unidimensionality. All the above analysis were carried out by means of soft wares SPSS-15 and AMOS-7.

3.3 Development of instrument for the measurement of work stress

An instrument was developed for the study using data obtained through exhaustive literature survey, discussion with safety professionals and experts in India , in the absence of a well defined measurement tool for the purpose .Moreover little study is made in this direction in India. Initially a pilot study was made, before the main research in order to check the feasibility of the instrument and to improve the design of questionnaire. Two industries were selected for this purpose.

The questionnaire initially developed for this study had 52 items which covered all the areas namely demand, control, manager support, peer support, relationship, role, and change . The content validity and face validity of the questionnaire was analyzed. As these were found satisfactory, a pilot survey was made among 75 employees in the selected industrial units in Kerala to check the clarity and suitability of the items mentioned in the questionnaire. Based on the comments and suggestion received during the pilot study particularly from the workers in these industries, it was decided to delete some of the complex usages from the questionnaire and decided to prepare the questionnaire in two versions in English and in the local language (given in Appendix). A very constructive feed back was received from the engineers and supervisors of these industries. Based on their suggestions some of the questions were removed, as they were repetitive in nature.

The final draft of the questionnaire had 35 items and seven subscales namely demand ,control, manager support, peer support, relationship, role, and change .All the questions were of Likert type with five fixed

alternatives (always, often, sometimes, rarely, never). The items of the questionnaire were in the sequential order of demand (8 items), control (6 items), manager support (5 items), peer support (4 items), relationship (4 items), role (5 items), change (3 items). In addition to this, the questionnaire contained 10 demographic questions related to the name of the industry, type of the industry, name of employee, designation, department, age, experience, gender specification - male/female and educational qualification. The respondents were requested to indicate the choice of preference in the questionnaire.

3.4 Subjects and methods

Five profit making public sector industries were selected for the study. As per government records there were only 11 profit making manufacturing industries in the public sector, during the year 2006-2007(Official web site of department of industries Govt. of Kerala; http:// www. kerala industry.org; The Hindu Daily dated 15 May 2010).The total sample size selected for the study thus consists of 45% of the population (the profit making manufacturing units in the public sector in Kerala state).Then these industries were divided in two categories namely, chemical and heavy engineering based on their work environment. Out of the five industries selected, three were in the chemical sector and two in the heavy engineering sector.

The chemical industries so selected are large scale type which are engaged in the production of caustic soda, titanium dioxide, white cement and allied products. The physical work environment in chemical industries is different from that in the heavy engineering industries. In chemical industries excessive airborne concentrations, vapours, gases or fumes

increases the work stress in addition to the hazard of inhalation (Wyman, 2000). It has been noted that many employees particularly at the worker level, may not be aware of the chemical used as the raw material and the nature of products manufactured and by products.

The heavy engineering industries selected are engaged in the design and manufacture of high voltage transformers and steel forgings. It has been noted that these industries are of product type where manufacture of the product depends on the market demand. Larger demand often raises the stress level of the employees (Melchlor et al., 2007).

Initially permission was obtained from the authorities of the industries for collecting data in connection with the proposed research work. All the industries were of large scale type and running profitably for the last 5 consecutive years and have employee strength of 300-1300. All the industries are in public sector , located in the state of Kerala, India . All the companies work on shifts of 8 hour duration each. Most of the employees in this organization are permanent and are aged between 20 and 55 yrs. The population of women employees are much lower compared to men. Only blue collar employees were selected for the study and the subjects belonged to 3 different categories namely engineers, supervisors and workers.

Before administering the questionnaire, the subjects were briefed about the aim of the study and the methodology of answering the question was explained to them . At the initial stage a few employees were selected for the study by stratified proportional sampling ,but this attempt turned out be a failure ,because many of the employees raised concern about the confidentiality of the duly filled in questionnaire .As a result only few

employees returned the questionnaire, even though the researcher had assured the confidentiality of the results. Therefore, it was decided to distribute the questionnaire to all the eligible employees and they were assured that the result would be strictly anonymous .Hence the sample size of the participants turned out be large. The details of the participants are given in Table 3.1.

Table 3.1 Number of participants

Designation	Chemical			Heavy Engineering		Total
	Industry 1	Industry 2	Industry 3	Industry 4	Industry 5	
Engineers	6	18	24	12	7	67
Supervisors	10	26	41	19	10	106
Workers	117	120	192	120	108	657

The questionnaire was made in two versions in English as well as in the local language. While preparing the questionnaire it was made sure that content validity is not changed. English version was mainly given to the engineers and supervisors and the local language version was given to the workers .It has been ensured that the different categories of employees namely engineers, supervisors and workers have the requisite educational qualification in their discipline.

The total number of participants selected initially for the study was 1020, but only 830 participants returned the questionnaire The filled up schedules are then carefully edited for completeness, consistency and accuracy etc and the details of the participants for the study are given in the Table 3.1 The response rate was 81.37%.

The total number of engineers selected for the study are 67 Nos which constitute about 8.1% of the total sample selected for the study, and supervisors and workers were 106 and 657 respectively , which constitute about 12.77% and 79.16% of the total sample size. The number of engineers and supervisors are very less compared to the workers in these organizations . It is learned that no fresh recruitment has been made in these companies for the last five years to replace the retired personnel. Further the number of engineers, supervisors and workers in the chemical industries are 48,77,and 429 respectively and in the heavy engineering industries are 19 ,29 and 228 respectively.

3.5 Scale refinement and validation

Validity is the most critical feature of an instrument (questionnaire) and indicates the degree to which the instrument measures what it is supposed to measure (Ahire et al., 1996; Cook and Campbell, 1979; Cronbach and Meehhl,1955). Validating the measuring instrument is necessary for reducing the error in the measurement. Validity requires that an instrument is reliable, but an instrument can be reliable without being valid. Only statistically reliable and valid instruments are used for research studies (Ahire et al., 1996). The major forms of validity are content validity, construct validity and face validity.

3.6 Different approaches to scale refinement and validation

The major approaches used by researchers for scale validation and refinement are exploratory factor analysis (EFA) approach, and confirmatory factor analysis (CFA) approach(Ahire et al .,1996). EFA approach is a conventional approach to scale refinement and it consists the

following steps (i) identifying the items relevant to the particular domain from literature (ii) designing a survey instrument to measure these items (iii) conducting a field survey d) performing exploratory factor analysis (often with varimax rotation) on the item responses to identify the major factors according to the item factor loading and (iv) refining the scales using Cronbach's scale reliability coefficient alpha (Cronbach and Meehl ,1955). The major disadvantage of pure exploratory factor analysis lies in the difficulty involved in interpreting the factors.

To overcome the inherent limitations of EFA approach, the scale refinement and validation were done using the alternative approach. This approach uses confirmatory factor analysis in various stages of scale refinement and validation. CFA is similar to EFA except that the hypothesis that form constraints are embedded in the analysis. Research in social sciences and marketing disciplines prefers CFA approach due to its conceptual strength (Ahire et al .,1996).

3.7 Confirmatory factor analysis

Confirmatory factor analysis (CFA)is a type of structural equation modelling (SEM), which deals specifically with measurement models (Harrington,2009;Brown,2006) , and indicate the is relationship between observed measures or indicators (eg. Test items , test scores etc) and latent variables or factors. A fundamental feature of CFA is its hypothesis –driven nature. In CFA, the researcher specifies the number of factors and the pattern of indicator factor loading in advance. Thus the researcher must have a firm a prior sense, based on past evidence and theory of the factors that exist in the data. CFA is used for four major purposes (i) psychometric evaluation of measures (questionnaires) (ii) construct validation (iii) testing

method effects and (iv) testing measurement in variance (across groups or population) (Brown, 2006).

In social research, researchers need to have measures (instruments) with good reliability and validity that are appropriate for use across diverse populations (Kendell and Jablensky,2003; Natemeyar et al., 2003; Devellis, 2003). Development of psychometrically sound measure is an expensive and time consuming process. It has found that CFA can be effectively used for the development of measures because researchers often do not have the time or resources to develop a new measure, and many times they depend on the existing measures (Brown,2006). By using the existing measures considerable amount of cost and time can be saved and more over this helps the researcher to compare the results , when same instrument is used for more than one study. However, when using existing measure, it is important to examine whether the measure is appropriate for the population included in the current study. In these circumstances, CFA can be used to examine whether the original structure of the measure works well in the new population.

3.8 Software for conducting confirmatory factor analysis

There are several very good soft ware packages available for conducting confirmatory factor analysis, AMOS .7 (Arbuckle,2006) was used in this research work.AMOS.7 was chosen because of its ease of use, particularly getting started with its graphics interface .(Byrne,2001). Other software packages are LISREL(see http://www.ssicentral.com/lisrel /index.html), Mplus (seehttp://www.statmodel.com/),EQS (see http:// www. mvsoft. com/index.htm), or SASCALIS (see http://v8doc.sas.com/sas html/ statml/ stat/chap19/sect1.htm).

3.9 Content validity

Content validity is a non statistical type of validity that involves "systematic examination of the test content to determine whether it covers a representative sample of the behavior domain to be measured" (Anastasi and Urbina, 1997) or it is the extent to which a measuring instrument provides adequate coverage of the topic under study (Devellis ,2003). If the instrument contains a representative sample of the universe, the content validity is good Its determination is primarily judgmental and intuitive. It can also be determined by using a panel of persons who shall judge how well the measuring instruments meet the standard, but there is no numerical way to express it (Cooper and schinder,2003). Accordingly the researcher consulted various safety experts and academic professionals in this field for this purpose and hence ensured that the questionnaire so prepared for the evaluation of work stress has sufficient content validity.

3.10 Face validity

This criterion is an assessment of whether a measure appears, on the face of it, to measure the concept it is intended to measure. Face validity is close to content validity, while the content validity concerns the extent which a measure adequately represent all facets of a concept. This is a very minimum assessment. If a measure cannot satisfy this criterion, then the other criteria are inconsequential. It can be assessed by an amateur (Devellis, 2003).

The present questionnaire had 52 items initially and it was given to six safety professionals from industries and five academicians ,working as professors in the department of safety and statistics. They have been asked

to examine the questionnaire for the consistency, coverage, clarity, and comprehensiveness, Based on their suggestions 17 items were removed and 35 items were retained in the questionnaire for study. Both content validity and face validity have been assured before finalizing the draft of the questionnaire.

3.11 Convergent validity

It is one of the approaches to the construct validity. Convergent validity refers to the degree to which a measure is correlated with other measures that are theoretically predicted. In other words convergent validity is gauged by comparing it with measure of the same concept developed through other methods to assess how well the items are together (Ahire et al., 1996). This involves empirical and theoretical support for the interpretation of the construct. Each item in the scale is treated as different approach to measure the construct (Devellis, 2003). Accordingly by using confirmatory factor analysis each item in the scale namely ,demand, control, manager support, peer support, relationship, change is checked with the help of coefficient called Bentler-Bonett fit index (NNFI or TLI). A scale with TLI values of 0.9 or above is an indication of strong convergent validity (Bentler and Bonnet,1980).It has been observed that the TLI values of each construct as well as overall TLI values are more than 0.90, and this indicate strong convergent validity of the instrument (Table-3.2).

3.12 Unidimensionality analysis

Unidimensionality is a necessary condition for reliability analysis and construct validation (Natemeyer et al., 2003; Ahire et al., 1996). Items in a unidimensional scale estimate one single construct. In the absence of unidimensionality a single member cannot be used to represent the value of the scale. One can reduce the problems associated with unidimensionality by carefully selecting the items in the scales .This may warrant removing those items from the scales that reduce the extent of unidimensionality. Confirmatory factor analysis (CFA), can be used to access the unidimensionality of the scale. To use CFA a measurement model is specified for each construct. In this model, individual items constituting the construct are examined to see how closely they represent the same item. Comparative Fit Index (CFI) of 0.90 or higher for the model suggests that there is no evidence of lack of unidimensionality (Ahire et al., 1996).The CFI for all the seven constructs are computed by using AMOS software version-7 and the results are given in the Table 3.2 . It has been observed that all the CFI values for the individual constructs are well above 0.90 and moreover the overall CFI value is 0.934, which indicates strong unidimensionality.

3.13 Reliability

Once Unidimensionality of the scales is established ,an assessment of the statistical reliability is necessary before any further validation analysis. Relaibility refers to degree of dependability, consistency or stability of a scale (Devellis ,2003). Unreliable scale will lack consistency of measuring the same item (Natemeyer et al., 2003) . There are four good methods of measuring reliaibilty: Test-retest technique, multiple forms,

inter-rater, and Split half reliability. Now a days , particularly for field survey internal consistency is estimated by using Cronbach's α (Cronbach and Meehl, 1955).An alpha value of 0.70 or above is considered to be criterion for demonstrating strong internal consistency , alpha value of 0.60 or above is considered to be significant (Ahire et al .,1996)

Table 3.2 Validity and Reliability of the Instrument

Sl No	Variables/Factors	No. of items	CFI	TLI	Cronbach alpha
1	Demand	7	0.901	0.900	0.713
2	Control	4	0.980	0.976	0.797
3	Manager support	4	0.942	0.930	0.794
4	Peer support	4	0.916	0.900	0.806
5	Relationship	4	0.900	0.900	0.771
6	Role	5	0.901	0.901	0.676
7	Change	2	0.998	0.987	0.640
Total	---------	**30**	**0.934**	**0.928**	**0.742**

For the present study Cronbach's α is calculated for the all the seven variables and the results are given in the Table 3.2.The evaluation has resulted in the removal of the items numbers 5,9.14.17and 35 from the questionnaire. The content validity of the questionnaire is not changed by removing these items .Values of cronbach's α show that the refined scale consisting of 30 items is more reliable.

Overall CFI and TLI values are 0.934and 0.928 respectively, which ensures that the refined scale has unidimensionality and convergent validity in addition to reliability. The scale thus developed can be used for measuring work stress in any organization effectively. There is enough scope for further development of scale depending on the industry.

3.14 Relationship between the factors

It has found from the literature review that, a number of factors were responsible for work stress in the organization. In the present research work seven factors or variables have been developed, which can be effectively used for the evaluation of work stress in any organization. To analyze the relation between the factors/variable correlation analysis was performed. The results are summarized in the Table-3.3.

Table 3.3 Correlation matrix

Variables/ Factors	Demand	Control	Manager Support	Peer Support	Relationship	Role	change
Demand	1	0.354	0.249	0.240	0.310	0.214	0.196
Control	0.354	1	0.279	0.227	0.310	0.168	0.251
Manager support	0.249	0.279	1	0.426	0.319	0.313	0.357
Peer support	0.240	0.227	0.426	1	0.498	0.313	0.461
Relationship	0.310	0.310	0.319	0.498	1	0.440	0.474
Role	0.214	0.168	0.313	0.313	0.440	1	0.353
Change	0.196	0.251	0.357	0.461	0.474	0.353	1

The above analysis was carried out with the help of software SPSS-15. It has been noted that all the correlations were positive, but no significant correlation was found between the variables/factors (< 0.5), Therefore the variables selected for the study can be treated as independent variables for the purpose of research.

3.15 Summary of findings

As only little work has so far been done in the area of work stress in India , an attempt is made to develop an instrument for the evaluation of work stress. With the available information, the factors which are responsible for the work stress is identified, and correlation between the variables were analyzed. Further validation and reliability of the instrument is made based on the data collected from the five selected industries in Kerala, India, out of which three are in the chemical sector and two in the heavy engineering sector. The result of the present study can be summarized as follows

- Initially seven factors / variables responsible for work stress is identified from the literature review, and these factors are demand, control, manager support, peer support, relationship, role and change.

- A measuring instrument to evaluate work stress among the employees is developed in the absence of a well defied measure to evaluate work related stress in India.

- Empirical validation of the above measuring instrument is done, so that it can be effectively used by the safety mangers and professionals working in this area, particularly in India, where only little research is done in this field.

Chapter - 4

INFLUENCE OF FACTORS RESPONSIBLE FOR WORK STRESS

CONTENTS

The overall objective of the study is to evaluate the work related stress factors among the employees working in the public sector industries in Kerala, India .Hence data were collected from the employees in five public sector profit making manufacturing industries in Kerala. The above industries were classified in to two types namely chemical and heavy engineering industries based on the product manufactured and the work environment (Shimizu et al., 1997).Initially factors identified for the evaluation of work stress were analyzed in these two type of industries, to know the difference in these factors .Then the effect of these factors were analyzed on different age groups, different categories of employees based on designation and employees of different experience levels in all the selected five industries.

4.1 Statistical methods

The Z-test is used for testing the mean of a population verses a standard or comparing the means of two populations, with large samples (N≥ 30).Accordingly a Z-test was conducted to compare the mean scores of the factors obtained in the chemical and heavy engineering industries(Kultarsingh ,2007). One- way ANOVA is used to compare the means of the employees , belonging to different age groups, designation and experience levels, for the factors identified for the study .All the analysis were performed by means of software SPSS-15. All the tests were conducted for 5% level of significance.

4.2 A comparative study of influence of factors in different types of industries

Initially the factors identified for the work related stress is analyzed among the employees working in chemical and heavy engineering industries. The total number of employees in the chemical industries is 554 and that in heavy engineering industries is 276 .The mean scores of the factors are analyzed by means of Z-test and the result of the test is given below the Table 4.1

From the Table 4.1 one can see that the mean scores of the factors under consideration for two sectors, namely chemical and heavy engineering have not much difference, which indicates that working environment in both chemical and heavy engineering industries have no bearing on the factors responsible for work stress .To test whether this holds good for the population, the following hypothesis was formulated..

H01: There is no difference between the mean score of the factors among two types of industries

To test the hypothesis Z-test was used .The results are given in Table-4.1and found to be non significant at 0.05 level .Which establish our argument.

Table 4.1 Results of Z-test

Factors/ Variables	industry types	n	mean	Std. deviations	Z- value	p-value
Demand	Chemical	554	25.58	4.16		
	Heavy engineering	276	25.87	3.92	-0.946	0.344
	Chemical	554	12.67	4.28		
Control	Heavy engineering	276	12.81	4.26	-0.439	0.661
Manager	Chemical	554	14.25	3.80		
support	Heavy engineering	276	13.98	3.40	0.982	0.327
Peer	Chemical	554	15.63	2.98		
support	Heavy engineering	276	15.20	3.10	1.948	0.052
Relationship	Chemical	554	16.36	3.09		
	Heavy engineering	276	16.71	2.63	-1.601	0.110
Role	Chemical	554	22.63	2.42		
	Heavy engineering	276	22.62	2.56	0.047	0.962
Change	Chemical	554	6.92	2.10		
	Heavy engineering	276	7.04	1.98	-0.833	0.405

The maximum mean score for each factor can be calculated from the five point Likert scale as 5 x number of items in the given factor. Hence maximum mean score for factors for the present study are computed as given in the Table 4.2.

Table 4.2 Maximum Mean score of the Factors

Factors / Variables	No. of Items	Maximum Mean Score
Demand	7	5 x 7 = 35
Control	4	5 x 4 = 20
Manager Support	4	5 x 4 = 20
Peer Support	4	5 x 4 = 20
Relationship	4	5 x 4 = 20
Role	5	5 x 5 = 25
Change	2	2 x 5 = 10
Total	30	----------

The analysis of mean score of the factor 'demand' shows that there is no significant difference of these variable among chemical and heavy engineering industries ($p>0.05$).The mean score of demand in chemical industries is 25.58 and that in heavy engineering industries is 25.87 . Even though these mean scores are below the maximum value 35, the result shows the existence of work stress in these industries .

While analyzing the mean score job 'control' in chemical and heavy engineering industries ,it is observed that, there is no significant difference for this factor in these industries($p>0.05$) . The mean score of job 'control' is found to be 65% of the required optimum level . This result points out that there exists lack of control or low decision latitude among the employees, in connection with the freedom to choose the job or shift, which they prefer .The analysis further points out that further improvement in this factor is required in both types of industries.

While analyzing the mean score 'manager support' among different industries no significant difference is observed ($P>0.05$) .The mean score obtained for this factor is found as around 14, which is about 70% of the required level for having 'no work stress'. The study points to the need for more support from the superiors or managers for effective working.

The mean score of 'peer support' in chemical and heavy engineering industries points out that, no significant difference in this factor ($P>0.05$). But it points out the need for more support from the colleagues is required as the mean score obtained for this factor around 78% of the desired score. The ideal score required for this factor is 20. Earlier research has revealed, the employee social behavior are affected by work stress in manufacturing industries (Cox et al ., 2000) .Therefore more amount of peer support is required for minimizing work related stress hazards in these industries.

Quality of working relationship is related to the culture of the organization (Cox et al., 2000). The quality of working relationship this supportive image needs to the encouraged, reinforced and acknowledged as a criteria for selection of employees in industrial sector ,since relationship with the immediate boss and the superiors seems to be the most significant

source of support affecting both job satisfaction and health of the employees (Bharadwaj and Srivasthava, 2008). No significant difference is found (P> 0.05) between the mean score for the factor 'relationship' among the two types of industries .The mean score obtained for this factor is about 82.5% of the required optimum mean score . This shows that employees work relationship with their superiors are not up to the mark . Therefore it is recommended for improvement in this factor in these industries to minimize work related stress hazards.

No significant difference in mean score of the factor 'role' is observed in these industries (P>0.05). The mean score obtained for this factor is around 22.6, which is about 90% of the required mean score for this factor The mean score for the variable role is 22.63 in chemical industries, which is about 90% of the required optimum score for this factor . The effect of role clarity and role conflict on work stress is well explained by several researchers earlier (Sutherland and Cooper, 1990). Working under more than one boss and continual change in the work environment also cause problem (Cox et al 2000).Therefore improvement of this factor is required for the reduction of work stress in these industries .However these mean score for the factor 'role' is found to be better than other factors in these industries.

No significant difference in the mean score of the factor 'change' is observed among the employees in these industries (P>0.05).The mean score obtained for this factor is around 7 ,which is about 70% of the desired mean score for having "no work stress" . This shows that employees are finding difficult to adjust with the sudden changes that are brought in to the system. Improvement in this factor is suggested for the minimization of work stress

4.3 Influence of factors responsible for work stress in all the selected industries

4.3.1 Variation of factors responsible for work stress with respect to age in all the selected industries

The variation of work stress factors on the individual characteristics such as personality, values, goals, age, gender, level of education and family situation are well studied by several researchers (Muthuvelu and Rose,2005; Wilkins and Beaudet,1998; Shimizu et al., 1997). Some researchers points out that , physical and psychological characteristics, such as physical fitness or high level of optimism ,has strong correlation with work stress.The Table 4.3 shown below gives the number of participants ,who had taken part in this study from the selected five industries. The organizations company 1,2 & 3 are belong to chemical sector and mean while 4 & 5 belong to heavy engineering sector .The total number of employees participated for this study from all these industries together are 830.

Table 4.3 Number of Participants selected for study

Industry	Number of participants	Percent	Cumulative percent
1	133	16	16
2	179	21.6	37.6
3	242	29.2	66.8
4	151	18.2	85
5	125	15	100
Total	830	100	

All the employees, who participated in the study group were regular employees of the organization and of the age group of 20-55yrs. For the purpose of study the employees were divided into seven age groups and the number of participants in different age groups are given in the Table 4.4

Table 4.4 The age groups selected for the study in all the selected industries

Age groups (Yrs)	Number of participants	Percent	Cumulative Percent
20-25	5	0.6	0.6
25-30	51	6.1	6.7
30-35	76	9.2	15.9
35-40	83	10	25.9
40-45	135	16.3	42.2
45-50	179	21.6	63.7
50-55	301	36.3	100
Total	830	100	

Almost 37% of the employees, who participated in the study belonged to the age group 50-55yrs. One–way ANOVA was used to analyze the mean score of the factors in these industries.

The mean score of the factors between different age groups is found to differ considerably in all cases. This shows a dependency between the factors and age (See Table 4.5).To verify whether any significant difference existed among the different age groups for the factors under consideration in the population, the following hypothesis was formulated.

H02: There is no difference between the mean score of the factors among different age groups in all the selected industries

Table 4.5 Mean Score of the Factors Based on Age in all the selected industries

Factors/Variables		AGE in Yrs							F-value	P-value
		20-25	25-30	30-35	35-40	40-45	45-50	50-55		
Demand	mean	25.16	26.96	24.78	25.65	27.16	26.22	25.57	2.5325	0.020
	S.D	1.92	3.09	4.31	4.24	3.97	4. 04	4.107		
Control	mean	12.20	12.31	11.07	12.54	12.39	13.42	12.98	3.204	0.004
	S.D	6.38	4.25	4.75	5.00	3.97	4.13	4.00		
Manager support	mean	15.00	15.82	14.60	14.65	12.71	14.35	14.13	6.054	<0.001
	S.D	3.60	3.00	3.37	4.01	3.73	3.47	3.65		
Peer Support	mean	15.8	15.76	15.43	15.97	14.69	15.56	15.62	2.140	0.047
	S.D	4.02	3.08	2.71	3.00	3.21	3.02	2.98		
Relationship	mean	16.4	16.08	16.32	16.70	15.89	16.73	16.53	1.362	0.227
	S.D	2.51	2.79	3.11	2.73	3.19	2.81	2.95		
Role	mean	20.40	23.10	22.55	22.84	22.02	22.68	22.79	2.639	0.015
	S.D	7.02	1.58	2.46	2.46	2.93	2.44	2.23		
Change	mean	7.40	7.00	6.67	7.06	6.69	7.11	7.03	0.0926	0.477
	S.D	240	2.14	1.91	1.97	2.09	2.10	2.07		

The variables except relationship and change were found to be significant in the test ($P<0.05$).So it was concluded that there existed a well established dependency among the variables and age, except for the relationship and change ,which leads to the rejection of the null hypothesis.

The analysis of the mean score for 'demand' shows significant difference in this factor among different age groups ($p<0.05$).Even though the mean score values are well below the maximum score 35, results point to the existence of work stress in all age groups. Relatively higher mean score for this factor is found among the age group of 40-45yrs ,than other groups and lowest score was noted among 20-25yrs age group. The studies conducted on 15 European countries show that the work related stress exists in all age groups particularly at higher age levels (Milczarek et al., 2007). Our results also support the above findings .

The mean score for the factor ' control' is found to be maximum for age group 45-50yrs and minimum for the30-35yrs age group .The variable 'control' represent decision latitude or freedom to choose the job which the employee prefers to do. In general, higher level of job control is observed among higher age group, and further significant difference in this factor is observed among different age groups.($p<0.05$) .The highest mean score observed is about 68% of the optimum mean score required .This shows that more job control is required for all the age groups.

The analysis of mean score points out a significant difference in the mean score of the factor 'manager support' in different age groups($p<0.05$).The higher mean score 15.82 was noted among the age group 25-30yrs and the lowest mean score of 12.71 was found among the middle age group 40-45yrs . Generally it is observed that lower level of

manager support exists among the higher age groups .The highest mean score obtained for this factor constitutes only about 79% of the optimum score, which represents 'no work stress'. In general, it is noted that 'manager support' is lacking among all the employees of different age groups.

The age group 20-40 yrs had higher values of mean scores for the factor 'peer support' and the lowest mean score was found for the middle age group of 40-45 yrs. Significant difference was observed among different age groups ($p<0.05$).The analysis points that considerable improvement in this factor is required among all age groups to attain the optimum mean score 20. Earlier researchers have pointed out the need for friendly and supportive colleagues for the prevention of work stress (Burt et al., 2008 : Bacquer et al., 2005). In general higher level of peer support is noticed among younger age group than the elder group. The close analysis of the above results reveals that 40-45 yrs age group has relatively higher demand, low control and low support at work and demand-control/support model of Karesek and Theorell holds good for this age group.

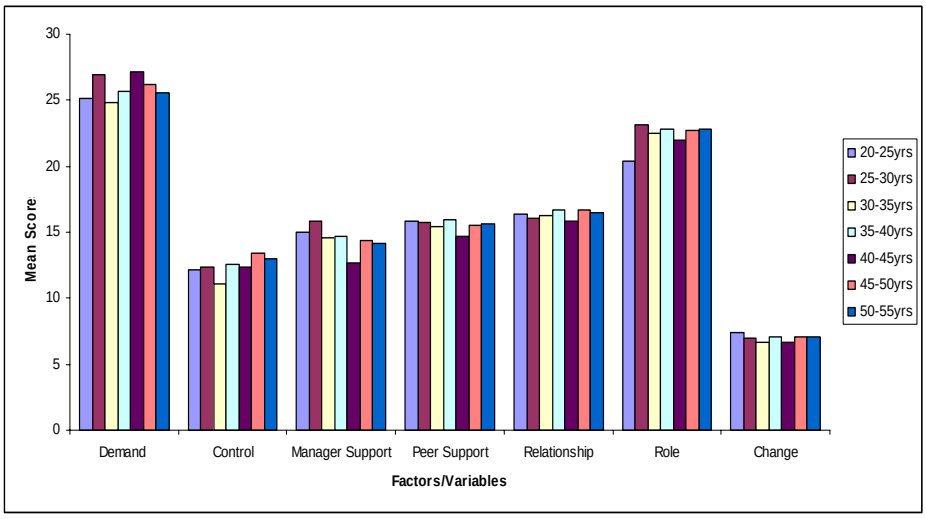

Figure 4.1 : Mean score of the factors –Age wise for all the selected industries.

No significant difference in mean score for the factor 'relationship' is observed among different age groups ($P>0.05$).The mean score obtained for the various age groups is around 16, which is about 80% of the desired optimum score for "no work stress". It has been noted by the earlier researchers (Cox et al., 2000; EASHAW,2009) that bullying at work by the superiors discrimination and harassment by the superior/ manager can affect the work relationship. In this study poor work relationship was noticed among all age groups .Therefore it is recommended to have good work relationship at the work place for minimizing work related stress hazards.

While analyzing the mean score of the variable 'role' at different age groups .significant difference is observed between the groups ($p<0.05$). Mean score of this variable for the age group of 40-45 yrs had a relatively

lower value (22.02) and the mean score was found lowest among 20-25 yrs age group. Lack of role clarity, role ambiguity, role insufficiency were observed among all the groups.The mean score obtained for all the age groups are below the desired mean score value of 25.The results stress the need for improvement in this factor is for the reduction of work stress.

Technological changes, changes in management, voluntary redun dancies are contributing to stress. In the present study area study the mean score for the factor "change" was found .nearly same for all the age groups ,and no significant difference is noted ($p>0.05$).The mean score value obtained for this variable is around 7, and this is around 70% of the desired level, which confirms the existence of work stress due to this factor in all age groups.

The significance in ANOVA does not indicate that all the participants have significant difference. To identify ,which among the age group has significant difference , a Tuckey's multiple comparison was conducted for the each of the factors considered and the results are given in the Table 4.6.

Table 4.6 Significant difference between Age groups in all the selected industries

Factors/Variables	Significant difference between age groups
Demand	25-30 yrs and 30-35 yrs
Control	30-35 yrs and 45-50 yrs 30-35 yrs and 50-55 yrs
Manager Support	25-30 yrs and 40-45 yrs 40-45 yrs and 35-40 yrs 40-45 yrs and 45-50 yrs
Role	40-45yrs and 50-55 yrs

Tukey's multiple comparison test shows considerable difference in the mean score of the factor 'demand' between the age groups 25-30yrs and 30-35ys. Difference in the mean score of the factor 'control' was found between the age groups 30-35yrs and 45-50yrs. Similarly significant difference was observed for this factor between the age groups 30-35yrs and 50-55yrs.The analysis shows significant differences in the mean score of the factor 'manager support' between the age group 40-45yrs, with the following age groups 25-30yrs, 35-40yrs and 45-50yrs. Significant difference in the mean score of the factor "role" was observed between the age groups 40-45yrs and 50-55yrs. No significance difference in the means score of the factor 'peer support' was found during the post – hoc analysis, as the p-value was found very close to 0.05.

4.3.2. Variation of factors responsible for work stress with respect to designation in all the selected industries

Many earlier studies show that stress differs as a function of individual (Cox et al., 2000), but it also differs as a function of one's occupation. Further it is noted that the amount of stress varies with individuals and different designation levels (Shultz et al., 1998).

The influence of factors responsible for work stress was studied among the participants of different designation in the selected five industries by using one-way ANOVA. Participants belonged to three different categories, namely, engineers, supervisors and workers. The details of the participants are given Table 4.7.

Table.4.7 List of participants based on designation in all the selected industries

Designation	Number of participants	Percent	Cumulative percent
Engineer	67	8.1	8.1
Supervisor	106	12.8	20.8
Worker	657	79.2	100
Total	830	100	------

The mean score of the factors between the employees of different designation levels differ considerably in all cases (Table 4.8), showing a dependency between the factors and designation .To verify whether any significant differences exist among different designation levels for the factors under consideration in the population, the following hypothesis was formulated.

H03: There is no difference between the mean score of the factors among different categories of employees in all the selected industries

The mean score of the factors 'control' and 'manager support' and 'peer support' is found to be significantly different among different designation level in the test ($P<0.05$), meanwhile the other factors not found to be significantly different .So we conclude that there exist well established dependency among these factors and the designation levels except the factors 'demand', 'relationship', 'role' and 'change', which leads to the rejection of null hypothesis.

While analyzing the factor 'demand', among different designation levels, no significant difference is found ($p>0.05$).The mean score obtained for this factor is around 26, which shows the existence of work demand at all categories of employees .The results point out that improvement of this factor is essential in the organization for the reduction of work stress.

While analyzing the factor 'control', the highest mean score was obtained for engineers, which is 15.09.The results show that there exists significant difference in this factor among different, categories.($p<0.05$). The mean score obtained for this factor among supervisors and workers are relatively low .This points to the low level of control or decision latitude among lower categories of employees, compared to engineers. The highest

mean score obtained for this variable is only 75% of the desired mean score, for the state of "no work stress". The difference in level of job control on different categories/grades of employees has been noted by several researchers (Karasek, 1998 ; Bosma et al., 1998) and our present results also are in tune with this.

Table 4.8 Mean score of the factors based on designation in all the selected industries

Variables/Factors		Designation			F-value	P-value
		Engineer	Supervisor	Worker		
Demand	**Mean**	25.72	26.08	25.61	0.603	0.548
	S.D	3.78	4.36	4.11		
Control	**Mean**	15.09	13.70	12.32	16.644	< 0.001
	S.D	2.96	3.85	4.35		
Manager support	**Mean**	14.64	15.19	13.94	5.953	0.003
	S.D	2.96	3.85	4.35		
Peer support	**Mean**	15.94	16.10	15.34	3.748	0.024
	S.D	1.87	2.98	3.12		
Relation-ship	**Mean**	16.28	17.01	16.41	2.035	0.131
	S.D	1.98	2.82	3.04		
Role	**Mean**	22.79	22.93	22.56	1.187	0.306
	S.D	2.03	2.14	2.56		
Change	**Mean**	6.69	6.77	7.02	1.313	0.270
	S.D	1.73	2.34	2.04		

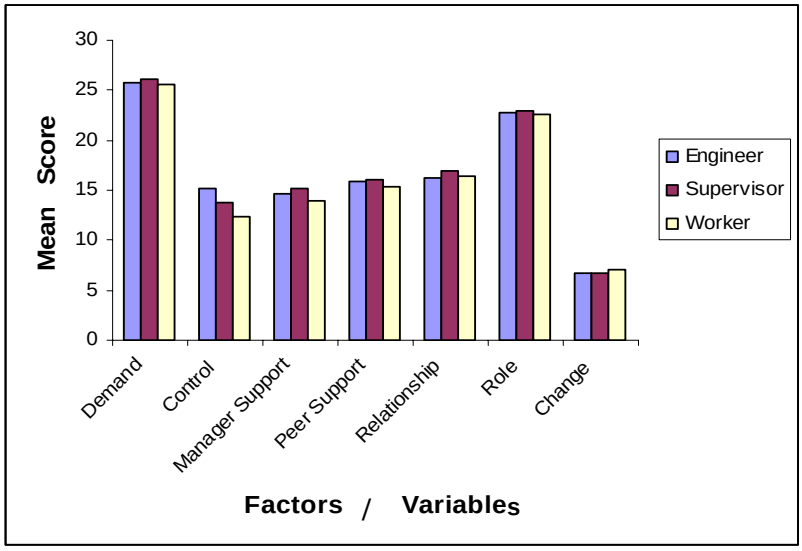

Figure 4.2 : Mean Score of the Factors - Designation wise for all the selected industries.

The mean score for the factor 'manager support' among various categories of employees shows , significant difference($p<0.05$).The highest support was found among supervisors ,the mean score being 15.19 and this constitutes only 76% of the optimum mean score required, for safe working .This indicates lack of manager support among different categories of employees. Lower mean score for the engineers means that ,they are unable to get sufficient support from their line mangers and this tends to increase in work stress (Mackay et al., 2004). Supervisors generally occupy middle level position in an organization, and are required to follow the instructions from the managers /superiors and the same should be executed with help of workers .The mean score of the factor "'manager support' for workers is found to be the lowest of all.Therefore it is recommended that organization should give sufficient manager support to all categories of employees including workers for safe working.

Significant difference in the mean score of the factor "peer support" is observed among different categories of employees ($p<0.05$). The highest mean score was obtained for supervisors ,which is 16.10 and this constitute only 81% of the mean score required for the desirable level of peer support for having "no work stress". The mean score obtained for this factor is lower among engineers and workers compared to supervisors.

No significant difference in the mean score of the factor 'relationship' was noticed among various categories of employees ($p>0.05$). The mean score of the factor was found around 17, which is about 85% of the desired mean score, which represents 'no work stress'. The result reveals the existence of strained relationship at all levels of employees. Earlier researchers has shown that work place bullying is one of the major reason for work stress (Hoel et al., 2010).Therefore it is essential to have a good work relationship particularly at the supervisory and worker level for the reduction of work stress.

The mean score for the factor 'role' or 'having voice' in the system was found more or less the same irrespective of various designation levels. No significant difference is observed among various categories of employees ($p>0.01$).Even though the mean score for this factor is found to be better than other factors, the analysis points out existence of lack of 'role' among various categories.

The mean score of the factor 'change' is found to be the same for different designation levels, which is 7 against the desired mean score 10.No significant difference in the mean score of this factor is found between various categories of employees ($p>0.05$).This shows that the employees find it difficult to adapt to the new and sudden changes brought

in to the system. This points to the need for making the employees aware about the new changes brought in the system.

To identify, the categories having significant difference, a Tuckey's multiple comparison test was conducted for each of the factors considered and the results are given in the Table 4.9.

The post - hoc analysis reveals that considerable difference in the mean score of the factor 'control' exists between engineers and worker as well as between supervisor and worker .While analyzing the variables manger support and peer support considerable difference is observed only between supervisors and workers.

Table 4.9 Significant Difference between Designation Levels in all the selected industries

Variables / Factors	**Difference between different designation levels**
Control	Engineer and Worker Supervisor and Worker
Manager support	Supervisor and Worker
Peer support	Supervisor and Worker

4.3.3.Variation of factors responsible for work stress with respect to experience in all the selected industries.

Employees are subjected to work stress if their ability to meet the job requirement is low .One of the major factor influencing work stress is 'experience', and it is noted that ,work stress varies with varying levels of experience. (Hong and Ismail 2011).The work stress can be reduced by adequate knowledge, job skills and support given by the superiors and co-workers (Cox et al., 2000) .In the present research the effect of variables namely, demand, control, manager support, peer support, relationship, role, change was studied among the employees who have different experience levels in all the five selected industries by using one-way ANOVA. For convenience the employees were divided in to 7 different groups ,based on their experience namely, up to 5 yrs, 5-10yrs, 10-15yrs, 15-20yrs, 20-25yrs, 25-30yrs and 30yrs and above and the percentage of these employees are furnished in Table 4.10.

Table- 4.10 The experience groups selected for study in all the selected industries

Experience Groups (Yrs)	Number of participants	Percent	Cumulative Percent
Up to 5 yrs	52	6.3	6.3
5-10yrs	76	9.2	15.4
10-15yrs	90	10.8	26.3
15-20yrs	154	18.6	44.8
20-25yrs	217	26.1	71.0
25-30yrs	130	15.7	86.6
30yrs and above	111	13.4	100
Total	**830**	**100**	**------**

The percentage of different experience levels shows that the highest number of employees belongs to 20-25yrs of experience group and the lowest being those who have experience up to 5-yrs . This reveals that most of the employees are working permanently in these industries and the number of newly recruited employees is relatively less.

The mean score of the factors between different experience groups differs considerably in all cases ,showing a dependency between the factors and the experience of the employees (See Table 4.11) .To verify whether any significant differences exist among the different experience groups for the factors under consideration in the population the following hypothesis was formulated.

H04: There is no difference between the mean score of the factors among different experience levels in all the selected industries.

The mean score of the factors except 'demand', 'peer support' ,and 'change' are found to be significantly different among the employees having different experience in the test ($p<0.05$).So we conclude that there exists a well established dependency among the factors, namely, control, manager support, relationship and role with the different experience groups. This leads to the rejection of null hypothesis.

Table -4.11 Mean Score of the Factors Based on the Experience in all the selected industries

Factors/Variables		Experience in Yrs								
		Up to 5yrs	5-10yrs	10-15yrs	15-20yrs	20-25yrs	25-30yrs	30 yrs and above	**F-value**	**p-value**
Demand	Mean	25.30	25.15	25.62	26.80	25.74	26.06	25.48	1.33	0.240
	SD	3.11	4.05	3.94	4.46	4.06	4.01	4.17		
Control	Mean	12.10	11.73	12.22	12.36	13.15	13.33	13.34	2.131	0.048
	SD	4.29	4.85	4.56	4.61	3.88	4.02	3.97		
Manager support	Mean	15.98	14.85	13.74	13.19	14.24	14.58	13.84	5.147	<0.001
	SD	2.93	3.40	3.99	3.90	3.40	3.71	3.61		
Peer support	Mean	16	15.51	15.28	15.08	15.27	16.11	15.66	1.959	0.069
	SD	3.19	2.80	3.34	2.86	3.09	2.86	3.08		
Relationship	Mean	16.79	16.89	16.23	15.90	16.67	17.02	16.23	2.3351	0.030
	SD	2.75	2.64	3.08	3.22	2.90	2.59	3.11		
Role	Mean	23.21	22.61	22.03	22.16	22.38	23.02	22.72	2.803	0.030
	SD	1.51	2.54	2.15	2.81	2.81	2.06	2.09		
Change	Mean	7.00	6.91	6.86	6.75	6.96	7.46	6.77	1.748	0.107
	SD	2.14	2.09	1.89	2.05	2.08	2.00	2.13		

No significant difference in work 'demand' is observed among different groups, ($p>0.05$) .The mean score for this factor for all the groups is found to be nearly 26,which shows the existence of work demand among all the employees irrespective of their experience.

While analyzing the variable job 'control' or freedom to choose work, the mean score was found high at different experience level groups and found to be low among less experienced groups and beginners .This is an expected result ,that is normally, high decision latitude ,is found more among the employees having more experience in their department. The same finding was reported by Karesek (1998).The highest mean score is found among the employees who have 30yrs and above experience. This mean score value is 13.34,which is about 67% of the required mean score ,which shows relatively higher job control for this group compared to other groups. The above analysis points out significant difference for this variable among different experience groups ($p<0.05$).The result points out that more job control is required for all the groups.

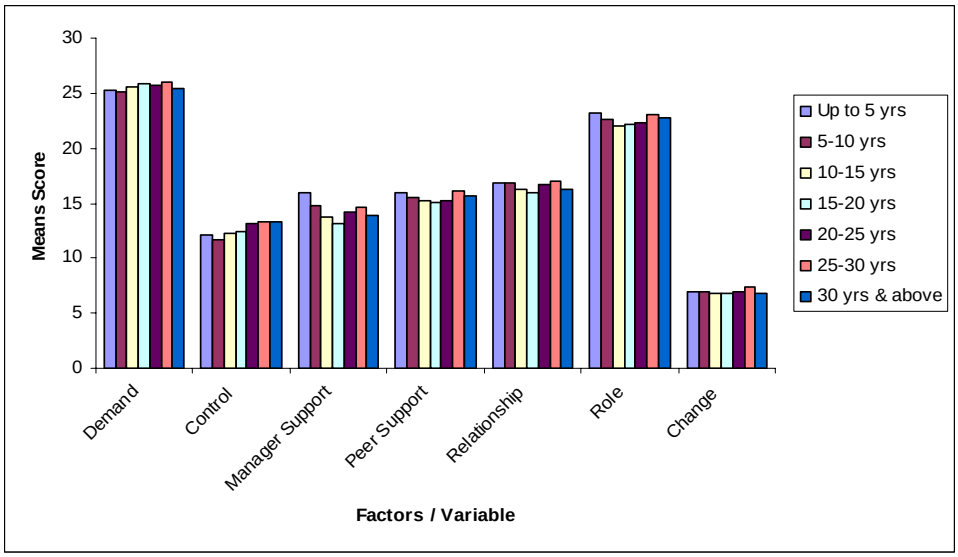

Figure 4.3 : Mean Score of the Factors – Experience wise for all the selected industries.

The mean score of 'Manager support' shows significant difference in this factor among different experience groups ($p<0.05$).The highest mean score for this group is observed to be 15.98,which is found among employees, who have less than 5yrs of experience .The lowest value was found among employees who have 15-20 yrs of experience. The result reveals that younger work groups, having less than 5yrs of experience are getting relatively better support from their superiors, even though they have low work demand .The highest mean score obtained here is only 80% of the desired score ,which points the, lack of support from the managers at all levels. In this analysis it is found that employees having 15-20yrs of experience have low job control and low manager support at work.

No significant difference in 'peer support' is found at different experience levels. ($p>0.05$).The mean score for this factor is around 16, which is about 80% of the desired level. This an indication of the lack of peer support among the employees irrespective of their experience in their organization.

While analyzing the mean score of the factor 'relationship' among different experience groups ,significant difference is observed ($p<0.05$).The mean score of this factor was high among employees who have experience of 25-30yrs. The mean score for this group is 17.02, and which is about only 85% of the required mean score .This indicates that improvement of this factor is required among all the groups. The mean score of this factor was found to be minimum among employees who have 15-20yrs of experience. In general this result indicates strained relationship at work of the employees.

Significant differences in the mean score of the factor 'role' is observed among different experience groups ($p<0.05$). The mean score of this factor was found to be higher among the employees who have experience up to 5yrs and 20-25yrs. The mean score for this group is around 23. Higher values of 'role' represents employees 'voice' in the system. But the values of mean score for different groups call for further improvement of this factor in these organizations.

Sudden changes in the, production concepts and technological changes lead to work stress (Launis and Pihlaja, 2007; Cox et al., 2000).The mean score of the factor 'change' at different experience levels ,reveals that no significant difference in this factor among various work groups ($p>0.05$).The mean score of the factor is around 7, which is 70% of the required mean score for having 'no work stress'. This points to the fact that measures are needed for minimizing the effect of work stress.

The ANOVA does not indicate significant difference among different categories of employees. To identify the categories having significant difference, Tuckey's multiple comparison test was conducted for the each of the factors considered and the results are given in the Table 4.12.

Table 4.12 Significant difference between Experience Groups in all the selected industries

Variables/Factors	Significant difference between experience groups
Manager support	Upto 5yrs and 10-15yrs Up to 5yrs and 15-20yrs Up to 5yrs and 20-25yrs Up to 5yrs and 30yrs and above 5-10yrs and 15-20yrs 15-20 yrs and 25-30yrs
Relationship	15-20yrs and 25-30yrs
Role	15-20yrs and 25-30yrs

Even though, mean score of the factor 'control' was found significant, among different groups as $p \approx 0.05$ the difference among the various groups could not be verified in post-hoc analysis. While analyzing the variable 'manager support', significant difference were found between employees having experience up to 5yrs and those with 10-15yrs, 15-20yrs, 20-25yrs and 30yrs and above experience. Similarly 5-10yrs of experience group had a significant difference with 15-20yrs group. A noticeable difference is also observed between 15-20yrs group and 25-30yrs experience group. Analysis of 'relationship' factor reveals that difference exists only between 15-20yrs group and 25-30yrs of experience group .For the factor 'role' difference exists only between 15-20yrs experience group and with the group having 25-30years experience.

4.4. Influence of factors responsible for work stress in Chemical industries .

The chemical industries comprises of the industries that produce industrial chemicals and which are generally called material related industry (Shimizu et al., 1997),where work environment is generally harsher than other type of industries . Chemical industries are engaged in the business of using chemical reactions to turn raw materials, such as coal, oil and salt in to variety of products. In chemical industries, employees are generally exposed to harmful chemicals, dusts and fumes etc. The three chemical industries selected for the study are engaged in the production of caustic soda, titanium dioxide, white cement and cement paints (Table 4.13). All these industries are in the public sector, which are making profit continuously for the past 5 yrs. All the units were functioning in three shifts of 8-hr duration each.

Table 4.13 The Number of Participants in Chemical Industries

Industry	Number of participants	Percent	Cumulative Percent
1	133	24	24
2	179	32.3	56.3
3	242	43.7	100
Total	554	100	------

The number of participants in the study from these organizations is given Table 4.14.. One way ANOVA was used to analyze the mean score of the factors in these industries . The mean score of the factors between different chemical industries was found to differ considerably in all the cases, showing a dependency between the factors and the chemical industries .To verify whether any significant differences exist among the different industries for the factors under consideration in the population, the following hypothesis was formulated.

H05: There is no difference in mean score of the factors in all the selected chemical industries

Table 4.14 Mean Score of the Factors in Chemical Industries

Variables/ Factors	Mean			F-value	P-value
	Industry-1	Industry-2	Industry-3		
Demand	24.53	25.93	25.50	5.724	0.003
Control	11.12	13.12	13.18	11.935	< 0.001
Manager support	11.30	14.53	15.64	71.271	<0. 001
Peer support	14.69	16.36	15.60	12.49	<0. 001
Relationship	14.39	17.06	16.92	40.90	<0. 001
Role	21.93	22.71	22.95	7.996	<0. 001
Change	6.01	7.30	7.14	17.516	<0. 001

All the factors were found to be significant in the test ($p<0.05$), so we conclude that there exists well established dependency among these factors and different chemical industries , and hence rejecting the null hypothesis.

The analysis of mean score of the factor 'demand' in different chemical industries show significant difference ($p <0.05$) among these industries .The calculated mean score varies around 25-26, which is about 71-74% of the desired mean score ,which indicates the existence of work demand in these industries and more over work demand /work load is not uniform in these industries . Therefore it is suggested to evaluate the optimum workload, that can be demanded from the employees for elimination of work related stress.

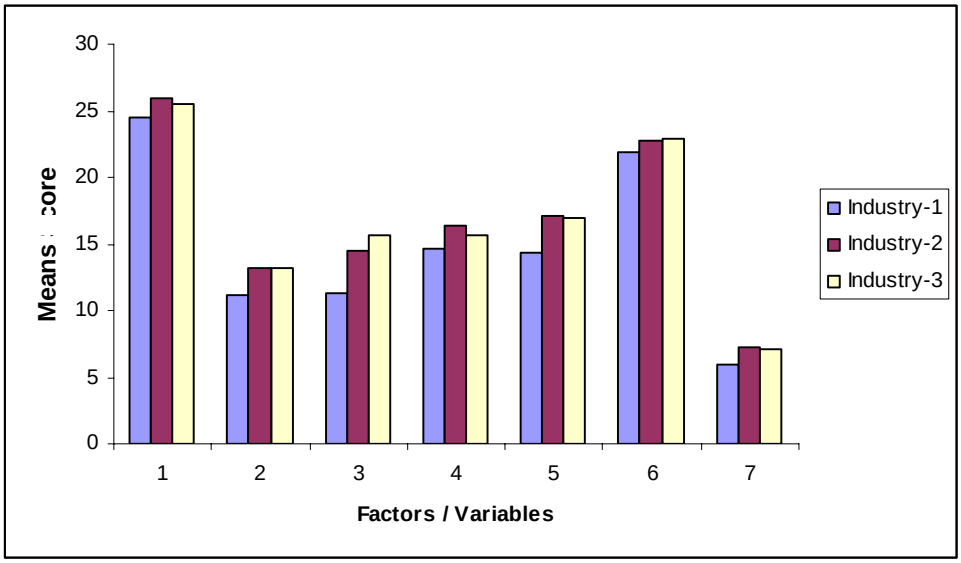

Figure 4.4 : Mean score of the factors –Chemical industries

Significant differences in the factor 'control' is noted among these companies ($p<0.05$) .The mean score points the existence of lack of control or decision latitude in these industries .The company -1 had relatively lower control compared to other industries .The mean score for this factor in company-1 is 11.2 ,which is only about 56% of the desired level .It is also noted that this mean score is much lower than that in the heavy engineering industries. There fore it is recommended to take enough measures for the improvement of this factor among the employees in these industries.

While analyzing the factor 'manager support', significant differences in the mean score is observed among these companies ($p<0.05$), which implies that manager support differs in these industries. Further the lowest mean score is obtained for industry-1, which is 11.30, and this is about 57% of the desired level. Even though the other two industries had relatively better score for this factor, the result points out that lack of support from the managers or superiors is existing in all these companies.

The analysis of the factor 'peer support' reveals lack of support in all these industries .The mean score of the factor was found to be significantly different in these industries ($p<0.05$). The highest mean score for this factor is found in industry-2 ,for which the mean score is 16.36,and this is about 82% of the optimal score. This indicates the insufficient peer support in the industries .How ever these values are close to the scores obtained for heavy engineering industries.

Analysis of the factor 'relationship' shows strained relationship at work and bullying at work exists in these industries .Significant difference of the mean score of this factor is noticed among these industries ($p<0.05$). Highest mean score was obtained in industry-3,which is 16.92 and this score is about 85% of the desired mean score .Even though this factor has a safer score ,further improvement in this factor is required for safe working .

Significant differences in the factor 'role' is observed in these industries ($p<0.05$). The result points out the existence of role ambiguity, and lack of role clarity . The highest mean score for this factor is 22.95 against the desired value 25.It is noted that the mean score for this variable is relatively better when compared to other factors in these industries.

The analysis of mean score of factor 'change' in various chemical industries yielded the same result as those obtained in heavy engineering industries. The results indicate the existence of work stress due to this factor in these industries and more over significant difference is noticed in these industries ($p<0.05$) .

The significance in ANOVA does not indicate that all the industries have significant difference .To identify, which among the industries having significant difference, a Tuckey's multiple comparison test was conducted for the each of the factors and the results are given in the Table 4.15 below.

While examining the mean score of the 'demand' factor, significant difference is observed between Industry 1and 2 and between Industry -1 and 3.Similarly cross comparison of the factor 'control' also yielded the same result. Mangers support was different between the Industries 1and 2 , 1and 3, and between 2 and 3 .The peer support also yielded a result similar

to that of mangers support, which indicates that support from the superiors at work, and support from the colleagues at work are different in these industries.

Cross comparative study of relationship, role and change reveals that these factors are different between industries 1and 2, and 1 and 3.

Table 4.15 Significance difference between the Chemical industries

Variables/Factors	Difference between the Industries
Demand	Industry 1 and 2 Industry 1 and 3
Control	Industry 1and 2 Industry 1and 3
Manager support	Industry 1and 2 Industry 1and 3 Industry 2and 3
Peer support	Industry 1and 2 Industry 1qnd 3 Industry 2and 3
Relationship	Industry 1and 2 Industry 1and 3
Role	Industry 1and 2 Industry 1and 3
change	Industry 1and 2 Industry 1and 3

4.4.1. Variation of factors responsible for work stress with respect to age in Chemical industries

All the industries selected for the study are large scale and have employees of different age levels from 20-55yrs.For the purpose of analysis, the employees were divided in to seven different age groups 20-25yrs, 25-30yrs, 30-35yrs, 35-40yrs, 40-45yrs, 45-50yrs, and 50-55yrs.All the employees are working permanently and the number of employees belonging to particular age groups is shown in the Table 4.16.

Table 4.16 The Age groups selected for study in Chemical Industries.

Age group (Yrs)	Number of participants	Percent	Cumulative percent
20-25	3	0.5	0.5
25-30	48	8.7	9.2
30-35	64	11.6	20.8
35-40	66	11.9	32.7
40-45	92	16.6	49.3
45-50	128	23.1	72.4
50-55	153	27.6	100
Total	554	100	------

It has been observed that , the largest number of participants belong to 50-55 yrs age group, which is about 27.6 % of the total participants .It is also noted that number of freshly recruited employees is very less in these industries. The total number of employees selected for the study is 554.

Table 4.17 Mean score of the factors based on Age in Chemical Industries

Variables / Factors		Age in yrs 20-25	25-30	30-35	35-40	40-45	45-50	50-55	F-value	P-value
Demand	**Mean**	25.07	26.98	24.31	25.30	26.33	26.14	25.61	2.62	0.016
	SD	1.52	4.39	3.01	4.12	4.04	4.01	4.34		
Control	**Mean**	14	12.38	10.98	12.59	12.52	13.63	12.75	2.913	0.008
	SD	6.24	4.16	4.75	4.71	3.89	4.04	4.13		
Manager Support	**Mean**	17.33	16.10	14.39	14.59	12.72	14.74	13.90	5.685	<0.001
	SD	2.31	2.74	3.33	4.19	3.96	3.43	3.96		
Peer Support	**Mean**	18.33	15.81	15.20	15.80	14.96	15.86	15.84	1.740	0.110
	SD	2.08	3.15	2.71	3.01	3.10	2.90	2.98		
Relationship	**Mean**	17.67	16.77	16.11	16.39	15.86	16.77	16.26	1.098	0.362
	SD	2.08	2.85	3.17	2.87	3.22	3.00	3.22		
Role	**Mean**	23.33	23.17	22.45	22.65	22.28	22.63	22.73	0.846	0.535
	SD	1.53	1.53	2.49	2.59	2.64	2.59	2.28		
Change	**Mean**	7.50	7.08	6.61	6.93	6.70	7.05	6.96	1.031	0.404
	SD	2.18	2.17	1.89	2.04	2.16	2.13	2.13		

The mean score of the factors between different age groups differ considerably in all cases ,showing a dependency between the factors and the age (Table. 4.17) .To verify whether any significant differences exist among the different age groups for the factors under consideration in the population ,we formulate the following hypothesis.

H06 : There is no difference between the mean score of the factors among different age groups in chemical industries

The variables except peer support, relationship, role and change are found to be significantly different among the age groups in the test ($P<0.05$) .So we conclude that there exist a well established dependency among the variables and age , except for the variables relationship and change ,which leads to the rejection of the null hypothesis.

The analysis of mean score of 'demand' indicates the existence of moderate level of 'work demand' in all age groups in chemical industries .Significant differences in the mean sores for this variable were found among different age groups ($p<0.05$).Relatively higher work demand was observed among the age groups 40-45yrs,25-30yrs and 45-50yrs.The results are similar to the result obtained during the analysis of this factor among all the selected industries .The analysis further points out relatively lower value of work demand among the age groups 20-25yrs and 30-35yrs .This factor needs to be improved for all the age groups for minimizing the work related stress hazards.

While analyzing the 'control" factor among different age groups ,the mean score of 14 was found among younger age group of 20-25yrs ,which is the maximum score among the different age groups .This was followed by a score of 13.63 for the age group 45-50.The mean score points lack of

job control among all age groups. The optimum score representing high job control is 20.The analysis further indicates significant difference in job control among different age groups ($p<0.05$).Job control was found low among middle age groups of 30-35yrs and 40-45 yrs .This factor was found relatively higher among senior level employees of age group 45-55 Yrs. The middle age group showed a low level of control over their job inspite of having a high work demand .During the survey, most of the complaints were related to the freedom to choose the work shift. Therefore, improvement in these factors is suggested to minimize work related stress.

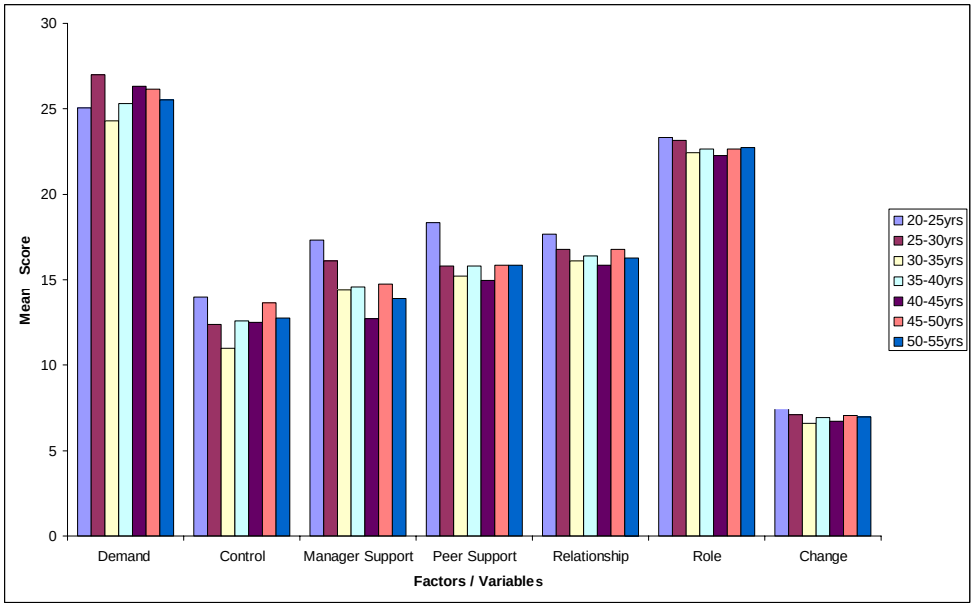

Figure 4.5 : Mean score of the factors - Age wise for Chemical industries .

As far as the mean score for the factor 'manager support' is con cerned, the maximum mean score value of 17.33 is obtained for the younger age group of 20-25 yrs. But this value is quite less when compared to the desired maximum score required, which is 20.which shows that 'manager support' is generally less for all age groups .Significant difference in this variable is observed among different age groups ($p<0.05$). The minimum value of mean score 12.72 is found among middle aged group of 40-45 yrs .This result is in tune with the result obtained during the analysis of this factor among all selected industries. The industries may develop a good team spirit and better relationship among the work team to minimize work related stress.

For the factor 'peer support', no significant difference is observed among different age groups ($p>0.05$) .Relatively higher amount of mean score was observed among younger age group of 20-25yrs ,which is 18.33,against a desirable maximum mean score of 20 .This shows that peer support is very close to the required level .But this value is found minimum among 40-45 yrs age group.The mean score for this age group is only 14.96 which is about 75% of the required level .Therefore it is recommended to develop a work environment ,where all the employees get good support at work from the colleagues. The result indicates that middle age group 40-45yrs are subjected to relative higher work demand ,low control and low support at the work place According to demand – control/support theory of Karasek and Theorell (1990), such situation may accelerate the effect of work stress.

The mean score of the factor 'relationship' is found to be relatively higher among younger age group of 20-25yrs. It is also observed that these age groups have low demand and better control and support at work. The mean score value obtained for this factor is much below the desired score 20,which shows that improvement in this factor is required among all age groups.

The mean score of the factor 'role', shows no significant difference among different age groups ($p>0.05$). But these mean scores were much below the desired score 25, which is an indication of lack of role clarity. The organizations must look into this factor for minimize work related stress.

No significant difference in the mean score of the factor 'change' is observed among different age groups ($p>0.01$).The low mean score for this factor indicates the existence of work stress due to this factor among all the age groups. Therefore it is suggested that the employees must be consulted by their superiors before introducing a change in the system.

In general the analysis points out that, generally middle aged group particularly of the age group 40-45 yrs ,are having relatively high demand, low control and low support at work, and a reverse trend is observed for the age group 20-25yrs .

The significance in ANOVA does not indicate that all among the age group have significant difference .To identify , the age group having significant difference, a Tuckey's multiple comparison test was conducted for the each of the factors considered and the results are given in the Table 4.18.

It is observed that significant difference in the factor 'demand' between the age groups 25-30 yrs and 30-35yrs. Significant difference in 'control' is observed between 30-35yrs age groups with 40-45yrs age group. While a analyzing the factor 'manager support' significant difference is observed between 25-30yrs age group and with 40-45yrs and 50-55yrs age groups .Further a noted difference is found between 35-40yrs age groups with 40-45yrs age group. Similarly significant difference is noted between 40-45 yrs age group with 45-50yrs In general significant difference in the variable 'manager support' was found among almost all age groups, except 20-25yrs age groups. The maximum difference is observed between 40-45yrs and with other age groups.

Table 4.18 Significant difference between the age groups in Chemical Industries

Variables/Factors	Significant difference between age groups
Demand	25-30 yrs and 30-35yrs
Control	30-35yrs and 45-50yrs
Manager support	25-30yrs and 40-45yrs 25-30yrs and 50-55yrs 35-40yrs, and 40-45yrs 40-45yrs and 45-50yrs

4.4.2.Variation of factors responsible for work stress with respect to Designation in Chemical Industries

The following different categories of employees selected for the study are Engineers, supervisors and workers .The educational qualification for the these different categories are degree, diploma and certificate in the respective discipline. All the employees are permanent and have experience ranging from 0-30yrs and above . The details of the employees are given in the Table 4.19.

Table 4.19 List of participants based on designation in Chemical Industries.

Designation	Number of Participants	Percent	Cumulative percent
Engineer	48	8.7	8.7
Supervisor	77	13.9	22.6
Worker	429	77.4	100
Total	554	100	------

The effect of factors, namely demand ,control, managers support ,peer support, relationship, role and change were analyzed among the different categories of employees of chemical industries by means of one-way ANOVA.

The mean score of the factors between different categories of employees differs considerably in all the cases ,showing a dependency between the factors and designation (see Table 4.20). To verify whether any significant difference exist among the different designation levels for the factors under consideration in the population, the following hypothesis the following hypothesis was formulated.

H07: There is no difference between the mean score of the factors among different categories of employees in the chemical industries

The mean score of the factor 'control' is found significantly different in different designation levels ($P<0.05$), .So we conclude that there exist dependency among these factors and the designation levels ,which leads to the rejection of null hypothesis.

Table 4.20 Mean Score of the factors based on designation in Chemical Industries wise

Variables/ Factors		Designation			F-Value	p-value
		Engineer	Supervisor	Worker		
Demand	Mean	25.35	25.97	25.54	0.439	0.645
	S.D	3.39	4.18	4.24		
Control	Mean	15.14	13.55	12.24	12.34	<0.001
	S.D	2.80	3.90	4.37		
Manager support	Mean	14.52	14.79	14.12	1.163	0.313
	S.D	3.34	3.62	3.87		
Peer support	Mean	15.96	16.29	15.48	2.743	0.065
	S.D	1.83	2.78	3.11		
Relationship	Mean	16.02	16.90	16.30	1.581	0.207
	S.D	2.03	2.67	3.25		
Role	Mean	22.50	22.94	22.59	0.731	0.482
	S.D	2.02	2.25	2.49		
Change	Mean	6.46	6.84	6.98	1.422	0.242
	S.D	1.64	2.33	2.10		

While analyzing the mean score of the factor 'demand' at designation levels it was noticed that at a moderate level of demand exists among all the categories of employees namely engineers, supervisors and workers. No significant difference in demand is observed among different categories of employees($p>.0.05$) .The mean score obtained for this factor is around 26 ,which shows the existence of work demand among all the categories of employees.

The mean score of the factor 'control' shows, significant difference among various categories of employees ($p <0.05$). Engineers had relatively the highest level of control with a mean score 15.14 followed by supervisors with mean score 13.55. The workers had the lowest mean score for their factor which is 12.24 for this factor. The highest mean score obtained in this analysis is only around 76% of the desired mean score, which indicates lack of control among the employees in the organization. The workers had the lowest level of control which is an indication of the little voice they have over the way they work and little freedom to choose the work. Many earlier studies point out lower level of control on lower category/grades of workers (Park et al., 2007; Bosma et al., 1997). Therefore it is suggested that this factor should be improved among all categories of workers to minimize the work related stress hazards for improvement of this factor among all categories of workers to minimize the work related stress hazards.

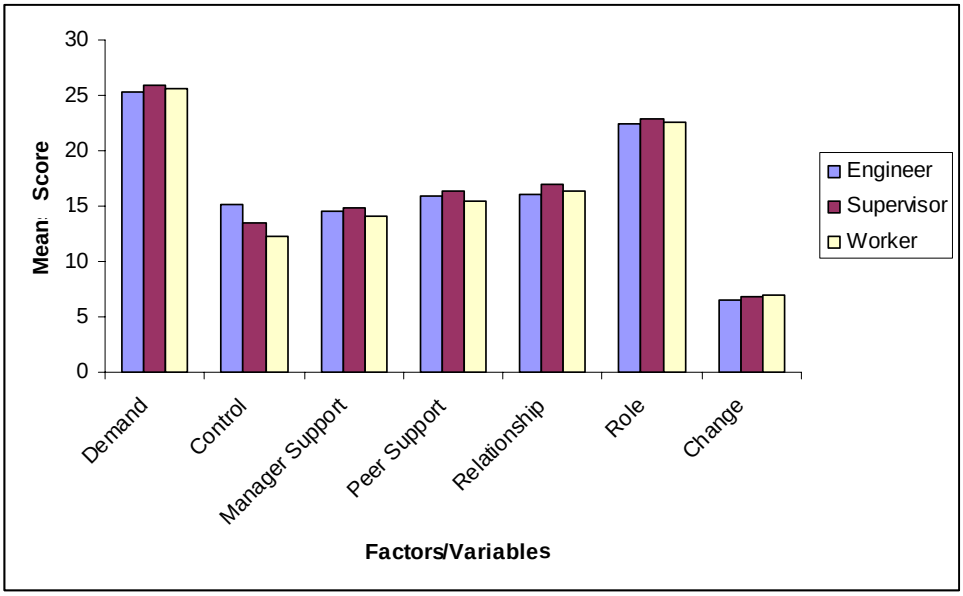

Figure 4.6 : Mean score of the factors - Designation wise for Chemical industries

The mean score of the factor 'manager support' shows no significant difference among different categories of employees ($p>0.05$). Mean score managers support is almost the same among engineers, supervisors and workers, and this contribute only 73% of the required safe mean score 20. This suggests that more amount of manager support is required at all levels to minimize the work related stress hazards.

The mean score of the factor 'peer support' reveals that there is no significant difference in the mean score of its value at various categories of employees ($p>0.05$). The mean score of this factor was found around 16 which contributes only 80% of the required level . The analysis calls for the more support of the colleagues at work to all levels of employees to improve the productivity and minimize work related stress hazards.

The mean score of the factor 'relationship' at work, shows no significant difference in the mean score of the variable among different categories ($p>0.05$) The mean score of the factor is found to be around 17 among all the categories of employees , which constitutes only 85% of the required score . This show strained relationships at work among the employees . The study suggests that the organization should look into the matter and take measures to the improvement of work relationships, to minimize stress hazards.

Lack of role clarity is observed among the employees. The difference in the mean score of the factor 'role' was not significant among various categories ($p>0.05$) . The mean score observed for this factor is around 23, which is less than the desired maximum mean score of 25 .Even though the deviation is comparatively less, it is advisable to improve the factor in the industries for better productivity and elimination of work related stress.

The mean score of the factor 'change' is approximately around 7, which is about 70% of the highest desired mean score. No significant difference is noticed in the mean score of the factor among the various categories of employees ($p>0.05$). The result reveals that the changes in the production concept and the systems are often inducing work stress among different categories of employees. Therefore it is recommended that proper training be imparted among the different categories of employees as soon as the changes are introduced.

The significance in ANOVA does not indicate that all among the different categories of employees have significant difference. To identify the categories having significant difference, a Tuckey's multiple comparison test for the each of the factors was conducted and the results are given in the Table 4.21.

The results of the test reveals significant difference in the factor 'control' between engineers and supervisors and between engineers and workers.The result indicates lack of control among workers and , supervisors when compared to engineers in chemical industries.

Table 4.21 Significant difference between designation levels in Chemical Industries

Variable/ Factor	Significant Designation Levels
Control	Engineers and Supervisor Engineer and Worker Supervisor and Engineer

4.4.3.Variation of factors responsible for work stress with respect to experience in Chemical Industries.

In the influence of factors, namely demand, control, manager support, peer support, relationship, role, and change among employees having different experience in chemical industries was analyzed by one way ANOVA.

Table 4.22 The experience groups selected for study in Chemical Industries.

Experience Groups (Yrs)	Number of participants	Percent	Cumulative percent
Up to 5 yrs	47	8.5	8.5
5-10 yrs	69	12.5	20.9
10-15 yrs	70	12.6	33.6
15-20 yrs	101	18.2	51.8
20-25 yrs	148	26.7	78.5
25-30 yrs	67	12.1	90.6
30 yrs and above	52	9.4	100
Total	554	100	

For the purpose of analysis the experience levels of the employees are divided into 7 different groups based on their level of experience in all three chemical industries. The groups for the analysis are having experience up to 5 yrs, 5-10 yrs, 10-15 yrs, 15-20 yrs, 20-25 yrs, 25 -30 yrs and 30 yrs and above (See Table 4.22).

The maximum number of employees (148nos) were having experience 20-25yrs followed by employees having15-20yrs of experience . All the participants were belonged to 20-55yrs age group.

Table 4.23 Mean score of the factors based on experience in Chemical industries

Variables/Factors		Experience in Yrs							F-value	p-value
		Up to 5 yrs	5-10 yrs	10-15 yrs	15-20 yrs	20-25 yrs	25-30 yrs	30 yrs and Above		
Demand	Mean	25.84	25	25.37	26.63	25.99	25.88	28.92	1.602	0.144
	S.D	3.14	4.14	4.20	4.78	3.93	4.05	4.28		
Control	Mean	12.19	11.75	12.45	12.50	13.20	12.73	13.34	1.274	0.267
	S.D	4.23	4.72	4.51	4.54	3.76	4.23	4.27		
Manager support	Mean	16.02	14.97	13.80	13.14	14.60	14.39	13.25	1.210	<0.001
	S.D	2.78	3.25	4.27	4.13	3.42	4.77	3.96		
Peer support	Mean	15.87	15.46	15.38	15.16	15.79	15.78	16.21	1.020	0.481
	S.D	3.24	2.74	3.29	2.87	2.81	3.26	2.91		
Relationship	Mean	16.64	16.81	15.95	15.68	15.69	17.00	15.92	2.128	0.049
	S.D	2.79	2.70	3.20	3.48	2.98	2.69	3.46		
Role	Mean	23.17	22.58	22.83	22.16	22.52	22.99	22.73	1.423	0.204
	S.D	1.51	2.49	2.22	2.82	2.62	2.23	1.94		
Change	Mean	6.94	6.90	6.77	6.76	6.99	7.42	6.63	0.978	0.439
	S.D	2.14	2.09	2.00	2.10	2.09	2.13	2.21		

The mean score of the factors between different experience groups differs considerably in all cases ,showing a dependency between the factors and the experience of the employees (Table 4.23).To verify whether any significant difference exist among the different experience groups for the factors under consideration in the population ,the following hypothesis were formulated.

H08: There is no difference between the mean score of the factors among different experience levels in chemical industries

The mean score of the factors manager support and 'relationship' is found to be significantly different in the test ($p<0.05$).So we conclude that there exist a well established dependency among the factors with the different experience groups. This leads to the rejection of null hypothesis.

The mean score of the factor 'demand' at various experience levels shows, no significant difference among the employees in chemical industries.($p>0.05$). Even though the mean score of this factor is well below the maximum score of 35 , the result indicates the existence of work stress due to this factor among all groups . Therefore it is advisable to allot optimal work load to the employees to avoid work related stress problems.

The mean score of the factor 'control' among various experience level shows, no significant difference ($p>0.05$). The mean score of this factor for the different categories is around 13 , which constitute only 65% of the desired optimum level of control required . This is an indication of lack of freedom to choose the job, or do the job. Therefore it is necessary to develop a work environment, which will provide necessary job control to the employees and minimize the impact of work related stress.

The analysis of the factor 'manager support' at different experience levels indicate that, lack of management support exists among all the age groups. Significant difference is observed among different groups ($p<0.05$) The mean score values obtained for this factor is well below the optimum level. The lowest mean score was obtained for 15-20yrs experience group. The mean score values indicate the need for greater manager support to all the groups.

No significant difference is observed in the mean score of the factor ' peer support' among different experience groups ($p>0.05$). The mean score for this factor is around 16, which is approximately 80% of the desired mean score for this factor and this shows the need for greater amount of peer support to all the groups.

Significant difference in 'relationship' factor was noticed among different experience groups ($p <0.05$).This is an indication of the strained relationship between employees and their superiors . It is observed that none of the groups have the desired optimum mean score of 20 for this factor .The minimum score was found for the employees having 15-20 years of experience, and this score is only around 78% of the desired optimum mean score. Therefore in general the research points out that improvement of relationship factor is essential for minimizing work related stress.

The mean score for the factor 'role' is found better than the other factors. But the analysis points out that there is no significant difference for this factor($p >0.05$) among different experience groups. The mean score for this factor is around 23 in all the groups, which is a relatively better score and is approximately 92% of the desired optimum mean score of 25. However, there is still scope for improvement.

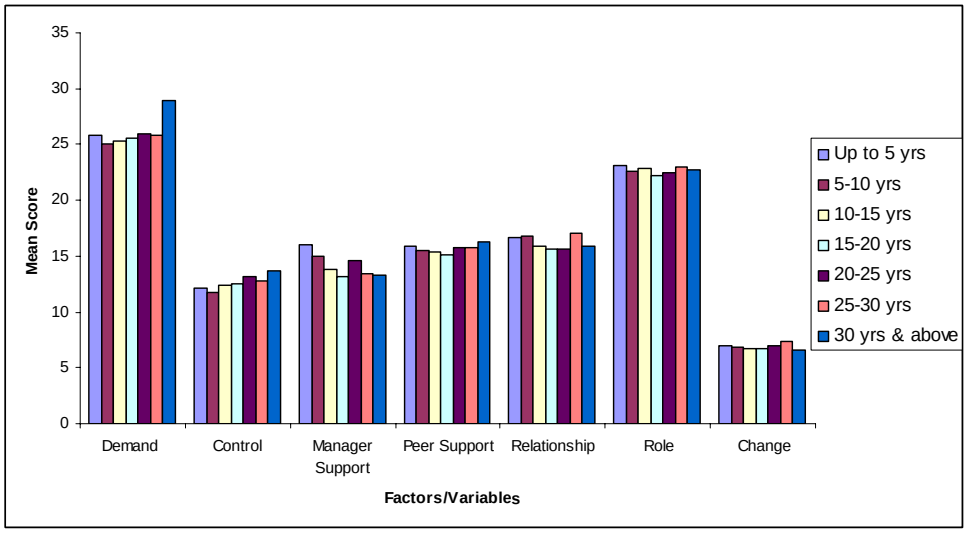

Figure 4.7 : Mean score of the factors - experience wise for Chemical industries

While analyzing the mean score of the factor 'change', it has been found that there is no significant difference among the employees of different experience levels($p>0.05$). But the result shows the existence of this factor in chemical industries selected for the study. The mean score obtained for this factor among various experience levels is merely 7, which is around 70% of the optimum mean score to be achieved. This shows inability of the employee to adjust to the sudden changes in the production systems, and also many of them point out that, employees are not consulted, while implementing sudden changes that are brought in to the system.

The significance in ANOVA does not indicate that all among the different categories of employees have significant difference .To identify the groups having significant difference, a Tuckey's multiple comparison test was conducted for the each of the factors considered and the results are given in the Table 4.24.

Table 4.24 Significant difference between experience groups in Chemical Industries

Factors/Variables	**Significant difference between experience groups**
Manager Support	up to 5 yrs and 10-15 yrs
	up to 5 yrs and 15-20 yrs
	up to 5 yrs and 30 yrs and above
	5-10 yrs and 15-20 yrs
	15-20 yrs and 20-25 yrs

The result of the post hoc test shows variation for the factor 'manager support'. between the groups with experience up to 5 yrs and with 10-15 yrs, 15-20 yrs and 30 yrs and above. Similarly 5-10yrs of experience groups had difference with 15-20 yrs group. Further 15-20 yrs of experience group had a difference with 20-25 yrs group. As the p-values for the variable relationship is 0.048, which is very close to 0.05, the difference between the groups is very negligible.

4.5 Influence of factors responsible for work stress in Heavy Engineering industries

Heavy engineering industries are engaged in the manufacturing of products which are heavy in weight, and these industries are more capital intensive than light industries (Shimizu et al., 1997). Considerable environmental impacts are associated with heavy engineering industries compared to light industries.

Two heavy industries, one engaged in the manufacturing of transformers and the other in steel forgings were selected for the study. Both these industries are located in Kerala and are profit making for the last 5yrs. The details of employees in these industries are given in the Table 4.25.

Table 4.25 The number of participants in Heavy Engineering industries

Industry	Number of participants	Percent	Cumulative percent
1	151	54.7	547
2	125	45.3	100
Total	276	100	----

Z-test is used to analyze the influence of factors identified for the study in these industries and the results given in the Table 4.26.

The mean score of the factors between two industries is found to differ considerably, which shows a dependency between the factors and industry.. To test whether this holds in the population, the following hypothesis was formulated.

H09: There is no difference between the mean score of the factors among two Heavy Engineering industries

To test the hypothesis we use Z-test The results are given in the Table 4.26 and found that factors control and role are significantly different in these industries ($p<0.05$), hence rejecting the null hypothesis.

While analyzing the mean score of the factor 'demand', no significant difference is observed in these industries ($p>0.05$).But the mean score of the factor is found to be around 26 in both industries ,which reveals that work demand exists in both.

The mean score for the factor-control reveals, significant difference among the two industries ($p<0.05$).Industry-1 had a relatively higher score ,which is only 66.25% of the required optimal score .Therefore in general it is found that lack of control exists in both industries.

Table 4.26 Mean score of the factors in Heavy Engineering industries

Factors/Variables	Industries	Mean	Std. deviations	z-value	p-value
Demand	Industry-1	25.99	3.96	0.592	0.645
	Industry-2	25.71	3.90		
Control	Industry-1	13.25	4.28	1.939	0.032
	Industry-2	12.26	4.26		
Manager support	Industry-1	14.67	3.80	3.817	0.440
	Industry-2	13.14	3.40		
Peer support	Industry-1	15.79	2.92	3.593	0.286
	Industry-2	14.47	3.18		
Relationship	Industry-1	16.90	2.56	1.370	0.839
	Industry-2	16.47	2.71		
Role	Industry-1	22.99	1.95	2.665	<0.001
	Industry-2	22.17	3.10		
Changes	Industry-1	7.20	1.94	1.460	0.814
	Industry-2	6.85	2.02		

The mean score for the factor 'manager support' reveals, no significant difference in these industries ($p>0.05$).The mean score obtained for this factor is around 14 ,which is well below the required optimum score of 20 and this points out that there is lack of manager support in both industries.

No significant difference is found in the mean scores of the factor ' peer support' is found among the employees of these industries ($p>0.05$).The mean score is found to be around 15 and this is only around 75% of the optimum mean score which represents sufficient support from colleagues at work .Therefore there is a need for greater peer support at all the levels of the employees .

Analysis of mean score for the factor 'relationship', shows strained relationship at work and the employees are subjected to work place bullying .The ideal mean score for this factor is 20.However no significant difference is seen among these industries ($p>0.05$).

Significant difference is observed in the mean score of the factor 'role' among the two industries selected for the study ($p<0.05$). The role factor is found better among the employees in industry-1, which is around 23 ,against the required optimal score of 25 .However further improvement in this factor is required among the employees in these industries .

Analysis of mean score of the factor 'change' reveal existence of this factor in these industries. The mean score obtained for this factor is around 7 in these industries, which represents 70% of the optimum score and this certainly calls for improvement of this factor in these industries. How ever no significant difference is noted for this factor in these industries ($p>0.05$).

4.5.1. Variation of factors responsible for work stress with respect to age in Heavy Engineering Industries

The effect of factors identified for the study namely demand, control, manager support peer support, relationship; role and change were analyzed among the different age groups in the above selected heavy engineering industries. For the purpose of analysis the employees were divided in to 7 different age groups namely 20-25yrs,25-30yrs,30-35yrs,35-40yrs, 40-45yrs,45-50yrsand 50-55yrs and the details are given in the Table 4.27.

Table 4.27 The Age group selected for studying in Heavy Engineering Industries.

Age group (Yrs)	Number of participants	Percent	Cumulative percent
20-25	2	0.7	0.7
25-30	3	1.1	1.8
30-35	12	4.3	6.2
35-40	17	6.2	12.3
40-45	43	15.6	27.9
45-50	51	18.5	46.4
50-55	148	53.6	100
Total	276	100	----

It is observed that a large number of participants belong to the age groups 50-55yrs ,similar to the chemical industries, discussed earlier. It is found that this age group constitutes 53.6% of the total participants.

The mean score of the factors between different age groups differs considerable in all cases ,showing a dependency between the factors and the age (see Table 4.28) .To verify whether any significant difference exist among the different age groups for the factors under consideration in the population ,the following hypothesis was formulated.

H10: There is no difference between the mean score of the factors among different age groups in Heavy Engineering industries

The variables control and role are found to be significant in the test ($P<0.05$) . So we conclude that there exist a well established dependency among the variables and age , except the factors demand, manager support, peer support relationship and change. This leads to the rejection of null hypothesis.

Table 4.28 Mean score of the factors based on age in Heavy Engineering industries

Variables/Factors		Age in Yrs								
		20-25	25-30	30-35	35-40	40-45	45-50	50-55	F-value	p-value
Demand	Mean	25.33	27	26.43	27.25	28.67	28.50	28.55	1.148	0.335
	SD	2.15	5.03	2.96	3.18	3.83	4.15	3.99		
Control	Mean	9.5	11.33	11.50	12.35	12.09	12.90	13.21	0.912	0.487
	SD	7.78	6.50	4.95	6.15	4.17	4.34	3.87		
Manager	Mean	11.50	11.33	15.75	14.88	12.69	13.47	14.37	2.874	0.010
Support	SD	0.71	4.16	3.49	3.37	3.24	3.44	3.30		
Peer	Mean	12.00	15.00	16.67	16.65	14.12	14.82	15.40	2.596	0.018
Support	SD	2.83	1.73	2.46	2.96	3.40	3.22	2.96		
Relation ship	Mean	14.50	17.33	17.25	17.88	15.95	16.62	16.26	1.556	0.160
	SD	2.12	1.53	2.70	1.73	3.15	2.27	2.65		
Role	Mean	16.00	21.33	23.08	23.58	21.49	22.80	22.86	4.842	<0.001
	SD	11.31	1.53	2.31	1.73	3.44	2.03	2.16		
Change	Mean	6.00	5.67	7.00	7.52	6.65	7.24	7.10	1.152	0.333
	SD	1.18	1.15	2.04	1.62	1.95	2.05	2.00		

The mean score of the factor 'demand ' among different age groups reveals no significant difference in this factor among the various groups ($p>0.05$) The mean score of this factor is well below the maximum value of 35.This is an indication of the existence of work demand in all age groups in these industries .

No significant difference in the mean score of the factor 'control' is observed among these groups.($p>0.05$).However low level of control is found among all age groups. Therefore the research points out that, these industries should take necessary steps to improve the level of decision latitude among the employees in these industries.

A noticeable difference in the mean score of the factor 'manager support' is observed among different age groups ($p<0.05$).the lowest mean score was found among younger work groups of 25-30yrs of age, followed by 20-25yrs.The mean score for this age group is 11.33 and 11.50 respectively and this is about 60% of the optimum mean score value, which shows that younger work group lacks of manager support at work. The highest mean score was noted among 30-35yrs age group. Further this is relatively lower among 40-45yrs age groups, the mean score being 12.69, which is below the optimum mean score value 20.More over the mean score for this factor is generally lower in heavy engineering industries than in chemical industries.

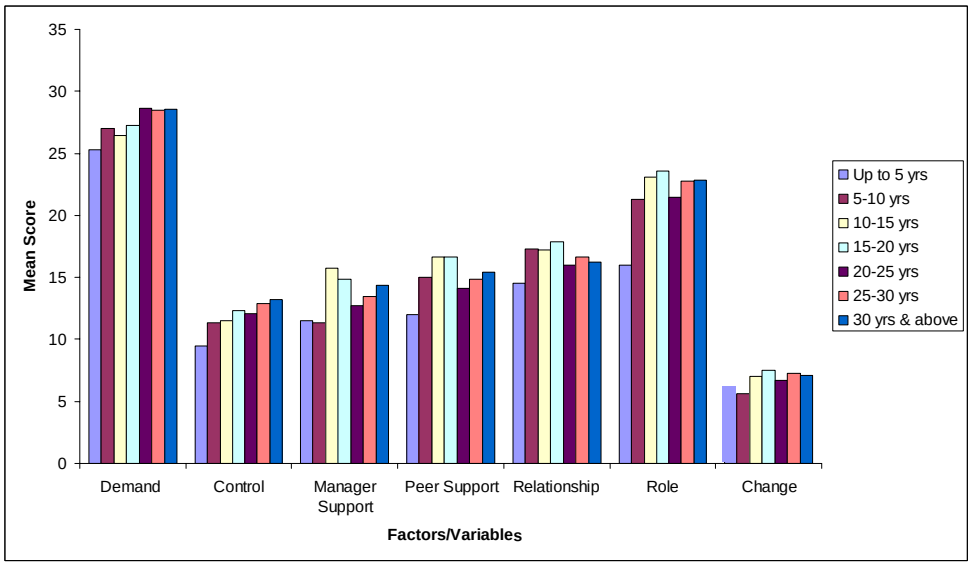

Figure 4.8 : Mean score of the factors - Age wise for Heavy Engineering industries

A significant difference in the mean score of the factor 'peer support' is observed among various age groups in heavy engineering. ($p<0.05$).But it is noted that there exists lack of peer support among all age groups .The mean score of all the groups is below the optimum mark of 20.The highest mean score is 16.67found among 30-35 yrs age group, Further a relatively lower mean score was observed among 40-45yrs age group, which is about 71% of the optimum value required to avoid work stress .The mean score for this factor was found maximum among the age group of 50-55yrs .There fore in general, relatively a higher level of job demand ,low control, and low support is found among 40-45yrs age group, which is in tune with the result obtained for the chemical industries.

No significant difference in the mean score is observed among different age group, for the factor 'relationship' ($p>0.05$). The mean scores obtained for different age groups is well below the desirable mean score value of 20. How ever the mean scores obtained here is very close to the values obtained for the chemical industries.

For the factor 'role', it is observed that significant difference exists among various groups($p< 0.05$) .The mean score for this factor is found to be less among younger work groups .This value is about 64% of the mean score required at the desired level. This shows that younger work groups of 20-25yrs of age have little idea about their responsibilities in their organizations .The mean score of this factor was found better among other age groups .The highest score for this factor was found among 35- 40yrs age group. Improvement of this factor is suggested to avoid work related stress problems.

The 'change 'due to sudden technological changes is the major problem causing work stress. While analyzing this factor among different age groups, no significant difference is observed ($p>0.05$) . The mean score for this factor is found to be lower than the desired mean score of 10, which shows the existence of work stress due to this factor among all age groups in heavy engineering industries.

The significance in ANOVA does not indicate that all among the age group have significant difference .To identify, the age group having significant difference, Tuckey's multiple comparison test was conducted for the each of factors considered and the results are given Table 4.29.

Table 4.29 Significant different between different age groups in Heavy Engineering industries

Variables/Factors	Significant difference between different age groups
Manager support	25-30yrs and 30-35yrs 35-40yrs and 40-45yrs 40-45yrs and 50-55yrs
Peer support	20-25yrs and 30-35yrs 20-25yrs and 35-40yrs 30-35yrs and 40-45yrs 35-40yrs and 40-45yrs 35-40yrs and 45-50yrs 40-45yrs and 50-55yrs
Role	20-25yrs and 25-30yrs 20-25yrs and 30-35yrs 20-25yrs and 35-40yrs 20-25yrs and 40-45yrs 20-25yrs and 45-50yrs 20-25yrs and 50-55yrs 35-40yrs and 40-45yrs 40-45yrs and 50-55yrs

While analyzing the factor 'manager support' among different age groups significant difference exists between the 25-30yrs group and 30-35yrs age group. Further noted difference is observed between 35-40yrs group with 40-45yrs group. Similarly, difference is observed for this factor between 40-45yrs and 50-55yrs .

For factor 'peer support' between various age groups ,a noted difference is observed between 20-25yrs and 30-35yrs and 35-40 yrs . A noticeable difference is observed between 30-35yrs and 40-45yrs. Further significant difference is observed between 35-40 yrs and 40-45 yrs and 45-50 yrs. The difference in this factor is also noted between the age group 40-45 yrs and 50-55 yrs.

The post-hoc analysis of the factor 'role' reveals that significant difference exists between 20-25yrs age group and all other age groups. Further a noted difference is observed between 35-40yrs and 40-45yrs and further a noticeable difference is observed between 40-45yrs and 50-55yrs age group.

4.5.2.Variation of factors responsible for work stress with respect to designation in Heavy Engineering industries.

276 participants from two heavy engineering industries were selected for the study and the details are shown in the Table 4.30

Table.-4.30 List of Participants based on designation in Heavy Engineering Industries

Designation	Number of participants	percent	Cumulative : percent
Engineer	19	6.9	6.9
Supervisor	29	10.5	17.4
Worker	228	82.6	100
Total	276	100	------

The educational qualification for the categories of engineer, supervisor and worker are degree, diploma, and certificate, respectively in the respective disciplines The mean score of concerned the factors between different categories of employees differs considerably in all the cases ,showing a dependency between the factors and designation (See table 4.31).To verify whether any significant difference exist among the different designation levels for the factors under consideration in the population , the following hypothesis was formulated.

H11: There is no difference between the mean score of the factors among different categories of employees in Heavy Engineering industries.

The mean score of the factors 'control' and 'manager support' is found to be significant in the test ($P<0.05$), meanwhile the other factors not found to be significant (Table 4.31) .So we conclude that there exist well established dependency among these factors and the designation levels except the factors demand' ,'peer support', 'relationship', 'role' and 'change', which leads to the rejection of null hypothesis.

Table 4.31 Mean score of the factors based on designation in Heavy Engineering Industries .

Variables/ Factors		Designation			F-value	p-value
		Engineer	Supervisor	worker		
Demand	Mean	26.63	26.34	25.74	0.690	0.502
	S.D	3.25	4.89	3.84		
Control	Mean	14.94	14.10	12.46	4.589	0.011
	S.D	3.40	3.75	4.31		
Manager support	Mean	14.94	16.24	13.61	9.005	<0.001
	S.D	3.17	2.93	3.36		
Peer support	Mean	15.89	15.62	15.08	0.899	0.408
	S.D	2.02	3.44	3.14		
Relation-ship	Mean	16.95	17.28	16.62	0.885	0.414
	S.D	1.75	3.23	2.61		
Role	Mean	23.52	22.93	22.51	1.621	0.200
	S.D	1.93	1.87	2.67		
Change	Mean	7.26	6.59	7.08	0.944	0.390
	S.D	1.88	2.41	1.93		

While analyzing the mean score of the factor 'demand' among various categories of employees in heavy engineering industries, it was found that work demand or time pressure exists among all the categories of the employees. But, no significant difference was found among the different categories of employees ($p>0.05$).The mean score of the factor is around 25, which is less than the maximum value 35, This shows the existence of greater work load among all the categories of the employees .

While analyzing the mean score of the factor 'control', significant difference is found among different categories of employees($p<0.05$). This factor was found relatively higher among engineers, compared to other categories of employees. The mean score of this factor is found 14.94, which is 74.7% of the desired optimum score. This further indicates more amount of control, or decision latitude is required in the organization. The amount of control is found to be less among supervisors and workers . This factor was found lowest among workers .The mean score is found to be only 62.3% of the desired level. Such a situation calls for the attention of authorities, who can make work environment better by giving more decision latitude for the employees to improve the motivation and thus reducing the hazards due to the work related stress.

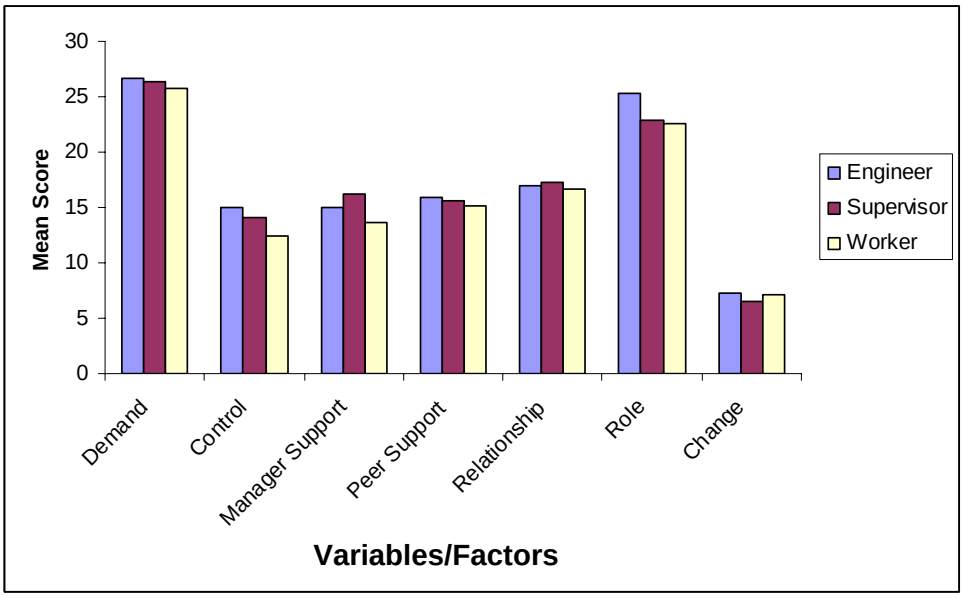

Figure 4.9 : Mean score of the factors – designation wise for Heavy Engineering industries

Significant difference is observed in mean score of the factor 'manager support' among different categories of employees. It is found that manager support is relatively higher among engineers and supervisors than workers .This is similar to the result obtained in chemical industries, but however an improvement in this factor is observed in heavy engineering industries. The highest mean score obtained for this variable is 16.24,which is about 81.2%of the ideal mean score required , and this points out the need for greater support from the managers for all the categories of employees.

The 'peer support' among various categories of employees is around 16, and no significant difference for this factor is found among various categories ($p>0.05$). But while analyzing this factor, it is found that 'peer support' is insufficient to various categories. The mean score for this factor is only about 80% of the ideal score, which clearly indicates that, irrespective of the designation level, the employees are not getting full support at work, and more over colleagues are not listening properly to the problems connected with the individuals. Therefore it is suggested that, greater support from the colleagues is required at work to eliminate the work related stress hazards.

The average mean score of the factor 'relationship' is almost the same for all categories of employees .But this score(17) is only 85% of the safe value required for the effective functioning .Although no significant difference is found for this factor ($p>0.05$) among various categories, the average mean score points out that , employees are not able to maintain good relationship with their superiors and further this reveals that certain amount of work bullying exists in the heavy engineering industries .Therefore ,improvement in this factor is required at all different categories of employees irrespective of their designation.

No significant difference is found in the mean score of the factor 'role' among different categories of employees ($p>0.05$).The mean score of the factor is around 23,which is about 92% of the desired score .This factor was found to be better among engineers ,compared to workers .For workers the mean score was observed as 22.51 which is only 90% of the ideal mean score. Though the mean score of this variable better than the other variables among the different categories, it is observed that ,there exist confusion among individuals about their roles and responsibilities in the organization. Therefore, it is recommended that the organizations look into the matter for effective functioning.

The mean score of the factor' change' reveals no significant difference in this factor among different designation levels ($P>0.05$). However the analysis points out that the mean score of this factor is less than the desired level. The mean score for this factor is around 7 among the different categories of employees ,which is about 70% of the desired mean score .This shows that many employees are not able to cope with the sudden changes brought in the system and more over there exists complaints like 'superiors are not discussing the changes with the subordinates'. Therefore improvement in this factor among all the categories of employees.

The significance in ANOVA does not indicate that all among the different categories of employees have significant difference .To identify , categories having significant difference, Tuckey's multiple comparison test was conducted for the each of the factors considered and the results are given in the Table 4.32.

Table 4.32 Significant difference between designation levels in Heavy Engineering industries

Variables/Factors	Difference between designation levels
Control	Engineer and Worker
Manager support	Supervisor and Worker

The post–hoc test revels that significant difference exists between engineers and workers as far as the 'control' factor is concerned. A similar result was obtained for chemical industries. The analysis shows significant difference in the factor 'manager support' exists between supervisors and workers. Such a result is new one when compared to the chemical industries. This trend was not observed in the case of chemical industries. This definitely calls for providing more support at the lower categories of employees in the heavy engineering industries.

4.5.3. Variation of factors responsible for work stress with respect to experience in Heavy Engineering industries.

The effect of factors namely demand ,control, manager support, peer support, relationship, role and change are analyzed among the employees having different experience in two heavy engineering industries in Kerala ,by means of one way ANOVA. For the purpose of analysis, the experience levels of the employees are divided in to seven different groups. The groups taken for the analysis have experience up to 5yrs, 5-10yrs, 10-15yrs, 15-20yrs, 20-25yrs, 25-30yrs and 30yrs and above.

The maximum number of employees was found to be in the experience group 20-25 yrs, which is about 25% of total number of the employees. (see Table 4.33). The number of employees, who have experience up to 5yrs, was the least. This may be due to the fact that the selected heavy engineering units are in the public sector, where employees are permanently employed and fresh recruitment is very limited.

Table 4.33 The experience groups selected for study in Heavy Engineering industries .

Experience in (Yrs)	Number of participants	Percent	Cumulative percent
Up to 5yrs	5	1.8	1.8
5-10yrs	7	2.5	4.3
10-15yrs	20	7.2	11.6
15-20yrs	53	19.2	30.8
20-25yrs	69	25	55.8
25-30yrs	63	22.8	78.6
30 yrs and above	59	21.4	100
Total	276	100	------

The mean score of the factors between different experience groups differs considerably in all cases ,showing a dependency between the factors and the experience of the employees Table 4.34 .To verify whether any significant difference exist among the different experience groups for the factors under consideration in the population , the following hypothesis was formulated.

H12: There is no difference in the mean score of the factors among different experience levels in Heavy Engineering industries.

The mean score of the factor "peer support' found significant in the test ($p<0.05$).Mean while all other factors were not significant .So we conclude that there exist a well established dependency among the factor peer support with the different experience groups. This leads to the rejection of null hypothesis.

The analysis of the mean score of factor 'demand' at different experience levels reveal that, there is no significant difference in the effect of this factor on different groups($p>0.05$) The mean score obtained for the different experience levels are below the maximum value 35.The analysis thus points out that there exist work demand among different experience groups in these industries.

Table 4.34 Mean Score of the factors based on experience in Heavy Engineering Industries.

Variable/factor		Experience in Yrs								
		Up to 5 yrs	5-10 yrs	10-15 yrs	15-20 yrs	20-25 yrs	25-30 yrs	30 yrs and above	F-value	p-value
Demand	Mean	26.19	26.71	26.5	28.4	25.20	26.25	25.40	1.116	0.201
	SD	2.50	2.75	2.76	3.66	4.30	4.00	4.10		
Control	Mean	11.20	11.57	11.40	12.09	13.04	13.37	13.34	1.201	0.306
	SD	5.36	6.45	4.75	4.78	4.16	3.80	3.74		
Manager Support	Mean	15.6	13.71	13.55	13.30	13.46	14.79	14.37	1.621	0.141
	SD	4.56	4.85	2..89	3.46	3.24	3.46	3.22		
Peer Support	Mean	17.20	16.00	14.90	14.92	14.13	16.46	15.16	3.831	0.001
	SD	2.68	3.56	3.55	2.86	3.34	2.33	3.16		
Relation-Ship	Mean	18.20	17.71	17.20	16.32	16.53	17.03	16.50	1.011	0.419
	SD	2.05	1.98	2.42	2.64	2.75	2.51	2.76		
Role	Mean	23.6	22.86	23.75	22.15	22.09	23.06	22.71	1.936	0.075
	SD	1.67	3.18	1.74	2.80	3.19	1.87	2.22		
Change	Mean	7.6	7.00	7.15	6.75	6.91	7.50	6.90	0.941	0.466
	SD	2.30	2.23	1.46	1.98	2.08	1.87	2.07		

The mean score for the factor 'control' indicates the existence of work stress among all groups irrespective of their experience. The mean score for this factor is around 13, which is about 65% of the optimum score required.Improvement in this factor is suggested for reduction of work stress.

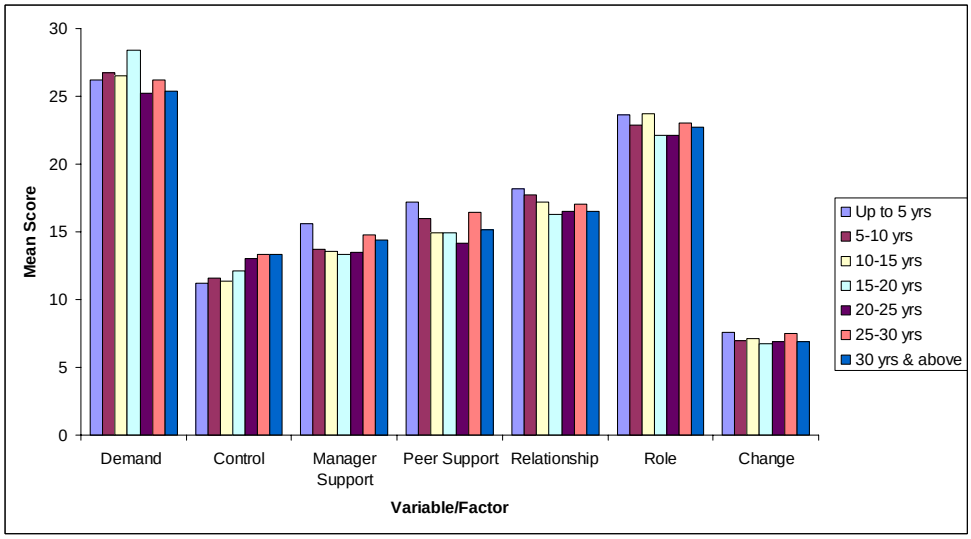

Fig 4.10 Mean score of the factors – Experience wise for Heavy Engineering industries

The mean score for the factor 'manager support' shows that no significant difference in this factor among various experience groups selected for the study ($p>0.05$).But however the mean score values obtained for this factor is lesser than the optimum score required. The result shows that employees are not getting sufficient support from their managers /superiors at work.

Relatively higher mean score for the factor demand and lower mean score for the factors control and support were found among the employees having 15-20yrs of experience compared to the rest of the group. The demand – control / support model of Karasek and Theorell suits for this groups (Karasek and Theorell, 1990).

Significant difference in 'peer support' ($p < 0.05$) is observed among various groups having different experience levels .But in general this factor is found inadequate at different experience groups .The highest mean score for this factor is found among employees having experience upto 5 yrs .The mean score for this group is 17.20, which is only 86% of the required optimum mean score .Therefore it is found that employees are unable to get sufficient support from their colleagues ,as and when required at the work, irrespective of their experience. Several researchers point out the need for support from the colleagues for the improvement of health and safety of the employees. (Burt et al., 2008;Bacquer et al., 2005).

No significant difference in the variable –relationship was found among different experience groups ($p>0.05$),. In general the analysis shows that work relationship is not satisfactory in the case of heavy engineering industries. The highest mean score obtained for this factor is 18.20, which is only about 90% of the required level .It is suggested that improvement in this factor is required for minimizing work related stress hazards.

No significant difference is observed in the mean score of the factor 'role' ($p>0..05$).The variations in the mean score observed is very little .The average mean score of this factor is around 23 among all the groups and it is only 92% of the desirable level. This indicates that all the employees are not fully aware about their roles and responsibilities in the

organization. The mean score of this factor is found to be better than other factors.

While analyzing the mean score of the factor 'change' in different experience groups, no significant difference is observed($p>0.05$) The mean score for this factor for different groups is below the desired score 10. This shows that the work groups ,irrespective of experience , find it difficult to cope with the new technology, or the sudden changes brought in to the system.

The significance in ANOVA does not indicate that all among the different categories of employees have significant difference .To identify, the category having significant difference , a Tuckey's multiple comparison test was conducted . The result of the test reveals that only one factor 'peer support' had significant difference between the experience groups 20-25yrs and 25-30yrs .

4.6 Summary of findings

- The analysis points to work related stress resulting from the factors developed for the study exists all the selected industries, irrespective of age, designation and experience of the employees.

- No significant difference in the mean score of the factors is found between the chemical and heavy engineering industries.

- However, significant difference in the mean score of the factors was found among the chemical industries selected for the study.

- Significant difference in mean score is observed only in the case of control and role among the employees of heavy engineering industry selected for the study.

- Relatively higher amount of demand , lower levels of job control and manager support were found among the age group 40-45yrs and the Demand –Control/Support Model suits for this age group. Similar result is observed among chemical and heavy engineering industries.

- Lack of control was noted among supervisors and workers over engineers and similar result were obtained in chemical as well as heavy engineering industries.

- Relatively higher demand, lower levels of control and manager support were found among the employees those who have experience of 15-20yrs and (Demand –Control/Support model suits this group). A similar trend is observed chemical and heavy engineering industries.

Chapter - 5

MODELLING OF WORK STRESS

CONTENTS

Modeling of work stress has been done earlier by several researchers (Hsieh et al., 2004; Palmer et al., 2003), and these models are useful in analyzing work stress under the influence of different variables. Attempts are made to develop the following three types of work stress models i).Factor modeling ii).Structural equation modeling,iii).Multinomial logistic regression modeling and the methodology of developing the models are discussed in detail in the following sections .

5.1 Factor modelling

Factor analysis is a general term for several specific computational techniques (Costello and Osborne, 2005; Fabrigar et al., 1999; Tucker and Mc Callum,1997). The main objective of factor analysis is to reduce the number of variables that belong together and have overlapping measurement characteristic.

Factor analysis can be used to model the relationship (correlations, covariance) between the variables. The factor analysis model assumes that interrelationships are due to latent variables called ***"common factors".*** An assumption explicit in this factor model is that the observed variation in each variable is attributable to the underlying common factors. Most factor analysis models also assume that variables are fixed and the subjects are randomly sampled from the population. There are many methods of factor analysis out of which, the alpha method of factor analysis is designed to model the relations between the variables under study.

One of the uses of factor analysis is for the development and validation of scales in an inventory or test battery (Mc Dermeit et al., 2000). Factor analysis can be used to identify groups of similar items there by, reduce the number of variables used in further analysis.

Factor analysis is used in the present study to establish relationship between the variables and work stress

5.1.1. Methodology

In this modelling the variables developed for evaluation of work stress were used. The alpha extraction method with "***varimax"*** rotation was used to develop the factor model (Kaiser and Coffery, 1965) .The rotated factor matrix displays how each variable 'loads' on each factor. A loading is a partial correlation between the item and factor .Loading higher than 0.4 indicates that the variable is highly correlated with the factor. By examining the pattern of load a given factor, interpretation can be made. The procedure is adopted for all the industries selected for the study initially and further used for developing models for chemical and heavy engineering industries .the software used for this modeling is SPSS-15.

5.1.2 Factor Model-1

Factor model-1 was developed based on the data collected from all the five industries selected for the study .The alpha extraction method of factoring yielded two factor structure for work stress as shown in the Table 5.1. It is noted that for each of the factors some variables had a higher factor loading (≥ 0.4).For Factor-1, the variables manger support, peer support, relationship, role and change had a high loading . The variables demand and control had a high loading on Factor 2. It is noted that variables namely demand and control are personnel based variables while the other variables (manager support, peer support, relationship, role and change), are team based .Hence Factor-1 and Factor-2 are named as stress-personnel (Stress-P) and stress-team (Stress-T)

Table 5.1 Factor matrix for all the selected industries

Variables	Factor	
	1	2
Demand (De)	0.167	0.968
Control (Cl)	0.328	0.501
Manager support(Ms)	0.748	0.178
Peer support (Ps)	0.473	0.089
Relationship (Re)	0.689	0.304
Role (Rl)	0.435	0.217
Change(Ch)	0.654	0.238

The model equations for Factor-1 and Factor-2 can be written as

Stress-P = 0.968 De +0.501 Cl and

Stress-T = 0.748 Ms + 0.473 Ps + 0.689Re + 0.435Rl + 0.654 Ch

Where De, Cl, Ms, Ps, Re, Rl, Ch represents the variable demand, control, manager support, peer support, relationship, role and change and the above two models can be effectively used for the evaluation of work stress.

5.1.3 Factor Model –2

The model equations were developed using the data collected from three chemical industries alone and the rotated factor matrix for the above industries is given in Table 5.2.

Table 5.2 Factor matrix for Chemical industries

Variables	Factor	
	1	2
Demand(De)	0.203	0.646
Control (Cl)	0.204	0.552
Manager support(Ms)	0.681	0.260
Peer support(Ps)	0.452	0.235
Relationship(Re)	0.720	0.307
Role(Rl)	0.499	0.115
Change(Ch)	0.633	0.198

It is noted that 'team variables' namely manager support, peer support, relationship, role and change had a high loading on Factor-1 meanwhile personnel variables like demand and control had a high loading on Factor-2. The factor model equations can be written as

Stress-P = 0.646De +0.552 Cl and

Stress-T = 0.681 Ms +0.452 Ps +0.720 Re +0.499 Rl +0.633 Ch

5.1.4 Factor Model-3

This model was developed based on the data collected from two heavy engineering industries .The factor structure yielded the following result (Table 5.3).

Table 5.3. Factor Matrix for Heavy Engineering industries

Variables	Factor	
	1	2
Demand(De)	0.279	0.401
Control (Cl)	0.063	0.950
Manager support(Ms)	0.631	0.104
Peer support(Ps)	0.627	0.255
Relationship(Re)	0.650	0.236
Role (Rl)	0.526	0.163
Change(Ch)	0.626	0.035

The factor structure so obtained shows that, the team variables namely, manger support, peer support, relationship, role and change had a higher loading for Factor-1, and personnel variables , namely demand and control had a high loading for the Factor-2.

Stress –P =0.401 De +0.950 Cl and

Stress –T = 0.631 Ms +0.627 Ps +0.650 Re+ 0.526Rl +0.626 Ch

5.2 Structural equation modelling

Structural equation modelling (SEM), also known as latent variable analysis (Hair et al.,1998; Baumgartner and Homburg, 1996) is a development from multiple regression analysis to combine a series of multiple regression equations within one structural model (Hair et al., 1998). The approach simultaneously runs several multiple regression equations, and has been used in this research to combine the relationship investigated in to one broad model that integrates the relationships of the variables/factors and work related stress .

SEM is a confirmatory approach and is used to test theory rather than to develop theory(Byrne , 2001:Tabachnick and Fidell, 2001).SEM has a number of benefits over a multiple regression in that it recognizes interdependence and allows a dependent variable in one multiple regression to become an independent variable in a subsequent equation (Hair et al., 1998).It also allows for independent variables to act simultaneously on more than one dependent variable, thus identifying both direct and indirect effects on a dependent variable (Hair et al., 1998). In addition the approach enables the inclusion of latent variables with in the model. Latent variables are hypothesized but unobserved variables

(Byrne, 2001; Tabachnick and Fidell , 2001; Hair et al., 1998). Finally an additional strength of structural equation modelling is the treatment of error variance. In most of the data it is likely that there will be elements of error incorporated in to the data and the SEM includes estimates of error variance in contrast to other multivariate approaches that ignore such error (Byrne, 2001; Hair et al., 1998).

Although SEM provides a number of advantages over other statistical approaches there are also limitations associated with its use .These limitations include a need for a larger sample than may be used in the case for other statistical tests ,sensitivity to non –normality although with large sample sizes sensitivity to non-normal distributions is reduced (Lei and lomax, 2005; Hu and Bentler, 1998) and the need to ensure an absence of multicollinearity (Tabachnick and Fidell, 2001).It is important ,when using SEM, to ensure that the model is correctly specified as SEM is vulnerable to specification error whereby a predictor variable is omitted from a model thus distorting results for the included variables (Hair et al., 1998).

There are a number of indicators that are used to assess the validity of a hypothesized model, that is the fit between the sample and the estimated population covariance matrix (Tabachnick and Fidell, 2001; Hair et al, 1998). Although the chi-square is accepted as the conventional overall test of fit , a number of alternative fit indices have been developed to overcome concerns with the chi-square statistic mainly associated with the issues of sample size (Hu and Bentler,1995).Whilst model fit is important -the issue of over fitting the model is also of consequence, with it,being necessary to balance the model fit with parsimony (Hair etal.,1998) The fit indicators can be grouped into the categories of absolute fit indices ,incremental or

comparative fit indices and parsimonious fit indices (Byrne, 2001; Hair et al.,1998).

Absolute fit indices include chi-square (χ^2), goodness of fit index (GFI), adjusted goodness of fit index (AGFI) ,root mean square residual (RMR) and the root mean square error of approximation (RMSEA).The incremental fit measures includes the normed fit index (NFI) and the comparative fit index (CFI). The parsimonious fit indices include the Akaike information criteria (AIC) and the normed chi-square statistic. In addition the standardized root mean residual (SRMR) can be reported and reflects the difference between the sample observed and hypothesized correlation matrices and there fore indicates the average error to which the hypothesized model explains the correlations (Byrne ,2001). The SRMR has been found to be more effective in discriminating between the models and is not affected by non normality (Hu and Bentler,1995).

The chi-square (χ2) statistic is recognized as the conventional overall test of fit (Hu and Bentler,1995). However research has shown than the chi-square statistic is not entirely reliable as an indicator of good model –fit and can reject an acceptable hypothesized model (Byrne, 2001; Hu and Bentler, 1995).In particular chi-square static is sensitive to sample size, with large samples often resulting in high values of chi- square indicating a poor fit where as alternatives measures suggest an acceptable fit.

Absolute fit indices, such as the goodness of fit index (GFI) effectively compare the hypothesized model with the null model and measure the relative level of variance and co variances(Byrne,2001) and there are reports that GFI performs better than other absolute fit indices (Marsh et al., 1999) .Although theoretically negative result is possible if

the hypothesed model is a worse fit than the null model .The results for the GFI are normally in the range of zero to one with higher values indicating better fit (Byrne ,2001). A GFI value of above 0.90 is generally accepted as indicative of a good fit (Hair et al 1998; Hu and Bentler,1995).

The adjusted goodness of fit index (AGFI) is similar to the GFI but addresses the issue of parsimony by adjusting for the degrees of freedom. As like the GFI the result will normally range between zero and one, with higher values indicating a better fit (Byrne ,2001), as with the GFI values above 0.90 are seen as acceptable (Hair et al.,1998).

The root mean square residual (RMR) represents the average residual value resulting from a comparison of the variance –covariance matrix of the hypothesized model with that of the data (Byrne, 2001). The range of values, for the RMR, range from zero to one with lower values reflecting better fit (Hair et al., 1998).

The root mean square error of approximation (RMSEA) is recognized as one of the most informative criteria in covariance structure modelling (Byrne, 2001) The RMSEA reports the discrepancy ,or misfit , in the fit of the model to the population and adjusted for the degrees of freedom (Byrne ,2001). RMSEA is affected by sample size and there is a tendency to reject acceptable models, when the sample size is small (Byrne ,2001). Values range from zero to one with lower values indicating better fits.Values between 0.05 and 0.08 are representing well fitted models, values between 0.08 and 0.10 mediocre fits and above 0.10 a poor fit (Byrne 2001; Hair et al., 1998). Although a lower value indicates a better fit, a result of zero would indicate a perfect fit and this is seen as optimistic (Byrne ,2001).

In contrast to the absolute fit indices the incremental or comparative indices of fit compare the hypothesized with a baseline model, normally null model (Byrne,2001;Hair et al.,1998). The normed fit index (NFI) is recognized as the principal incremental fit index but has been criticized for underestimating fit with small sample sizes. The results for the NFI range from zero to one with larger results indicating better fit .The results of above 0.90 is indicative of good fit (Byrne ,2001;Hair et al ,1998).

Comparative fit index (CFI) was developed by Bentler(1990) to reflect the criticisms associated with the NFI. As with the NFI the results for the CFI range from zero to one with larger results indicating better fit . A result of above 0.90 is indicative of a good fit. (Bentler and Bonnet, 1980).

The Tucker – Leiws index (TLI) or Non-Normed fit index (NNFI) is an another incremental fit index. NNFI measures parsimony by assessing the degrees of freedom from the proposed model to the degrees of freedom of the Null model. NNFI also seems resilient against variations in sample size and thus, it is highly recommended (Hu and Bentler, 1995). The acceptable threshold for this index is 0.90 or greater (Hair et al; 1998; Ahire et al., 1996)

The normed chi-square statistic was proposed by Joreskog (Hair et al., 1998) to overcome some of the concerns over the chi-square statistic and is chi-square statistic divided by the degrees of freedom. The statistic provides a range of acceptable results thus indicating models that are either over or under fitted .An over fitted model is typically represented by a value less than one ,whilst a model that is not reflective of the data is represented by a value above three (Hair et al., 1998), although a more

liberal limit of five has been suggested as appropriate (Wheaton et al., 1977).

The standardized root mean square residual(SRMR), is an improvement on the RMR as it avoids interpretation problems resulting from the size of residuals being relative to the size of the variances and covariances (Byrne,2001) .SRMR is not dependent on a normal distribution and thus has a superior capability (Hu and Bentler,1995). The SRMR results range from zero to one with smaller values being indicative of a better model fit with values below 0.05 indicative of a good fit.

It is clearly mentioned that chi-square (χ^2) and RMR are difficult to interpret (Brown 2006), as they are dependent on the sample size and affected by the metric of the input variables. So we used normed chi-square, which is a ratio of (χ^2 /df), for a good fit value of normed chi-square should be with in 3. Similarly instead of RMR, we used the standard root mean square residual (SRMR) ,which is based on the discrepancy between the correlations in the input matrix and the correlations predicted by the model.(Brown, 2006).

5.2.1.Methodology

Structural equation modelling of work stress using the seven factors /variables was done by means of software AMOS-7.An Initial model /input model was developed and it was modified further ,tested and verified by using the following indices : χ^2, normed χ^2, GFI, AGFI, NFI,TLI, CFI, RMR, RMSEA and SRMR. Attempt also has been made for developing model for chemical and heavy engineering industries. For modelling the following fit indices values are noted, Chi-square is used as one of the measure of the proposed model to the actual covariance data, and this value

should be small and non-significant, normed chi-square for the model should be less than 3 , and fit indices ,GFI,AGFI, NFI,TLI, CFI, should be ≥ 0.90 and RMSEA ≤ 0.05, ≥0.08 and SRMR should lie between 0 and 1(Harrington ,2009; Arbuckle,2007).

5.2.2 Structural equation modelling of work stress for all the selected industries.

With the help of entire data available, structural equation models were developed and the same was tested by using the indices as mentioned earlier. The two standardized final models proposed for this data are found to be equally good in representing the work stress.

5.2.2.1.Initial /Input structural equation model for all the selected industries.

Initially an input model was developed by using AMOS-7 graphics . The result of the input model is given in Table 5.4.

Table 5.4 Model fit indices of Input Model for all the selected industries.

χ^2	Normed χ^2	df	P-Value	GFI	AGFI	NFI	TLI	CFI	RMR	RMSEA	SRMR
31.239	2.403	13	0.003	0.990	0.978	0.976	0.977	0.986	0.217	0.041	0.00325

The estimated values for nor med chi-square is found as 2.403 ,which is well with in the acceptable limit. The TLI,CFI, RMSEA values are 0.977,0.986 and 0.041 respectively, which indicate very good fit for the data . The SRMR value is obtained as 0.00325, which is well with in the tolerable limit of, 1. But it is found that chi-square value has become significant ($\chi 2$ =31.239 ,P =0.003. . There fore it is decided to go for an alternate model .Hence model -1 was developed.

5.2.2.2. Structural equation Model - 1 for all the selected industries

The model 1 shows considerable improvement in the fit indices value and the result of the model is given in Table 5.5.

Table 5.5 Model fit indices of Model -1 for all the selected industries

$\chi 2$	Normed $\chi 2$	df	P-Value	GFI	AGFI	NFI	TLI	CFI	RMR	RMSEA	SRMR
18.336	1.528	12	0.106	0.994	0.986	0.986	0.991	0.995	0.202	0.025	0.0012

This is shown in figure 5.1 the rectangle represents observed factors/variables, which are demand, control, manager support, peer support, relationship, role and change, for our analysis. Ovals are drawn in the diagram to represent unobserved variable, here it is work stress, which has been shown as two types, which are stress-personnel (Stress-P) and stress-team (Stress-T), analysis. The variable error is enclosed in a circle and which is not an observed one .The double headed arrows in the path diagram connect the variables, which are correlated to each other. (Arbuckle, 2006).The standardized regression weights are shown over the arrows and squared multiple correlations of each observed variables /factors are represented over the each respective rectangles.

The correlations between the stress-P and Stress-T is obtained as 0.64, and all the regression weights are above 0.4. The chi-square value was not significant at 0.05 level, the normed chi-square values for the present model is found as 1.528, which is found to be lower than the previous model. TLI and CFI are well with in the acceptable limit (> 0.90)and RMSEA value were found lower compared to the previous model ,which indicate better fit .SRMR value was found to be very close to zero ,indicate good fit. (Arbuckle, 2006).

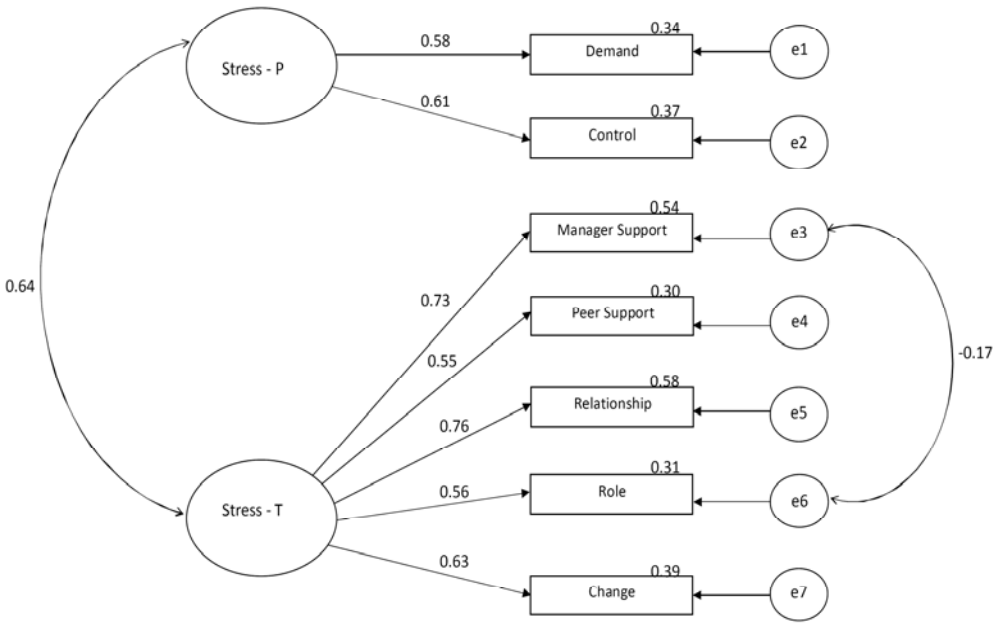

Figure 5.1 : Structural equation Model-1 of work stress for all the selected industries

5.2.2.3 Structural equation Model-2 for all the selected industries

One more Model (Model-2) was developed using the whole data. Even though the Model-1 proposed is good enough .In this the researcher tried to modify Model-1, by removing some of the factors/variables from the Model, When one of the factor namely-role, was removed from the Model-1, considerable improvement in the model fit values were obtained (Figure 5.2). The analysis result of this model is given in the Table 5.6

Table 5.6 Model fit indices of Model -2 for all the selected industries

χ^2	Normed χ 2	df	P-Value	GFI	AGFI	NFI	TLI	CFI	RMR	RMSEA	SRMR
11.752	1.469	8	0.163	0.995	0.988	0.989	0.993	0.996	0.194	0.024	0.0024

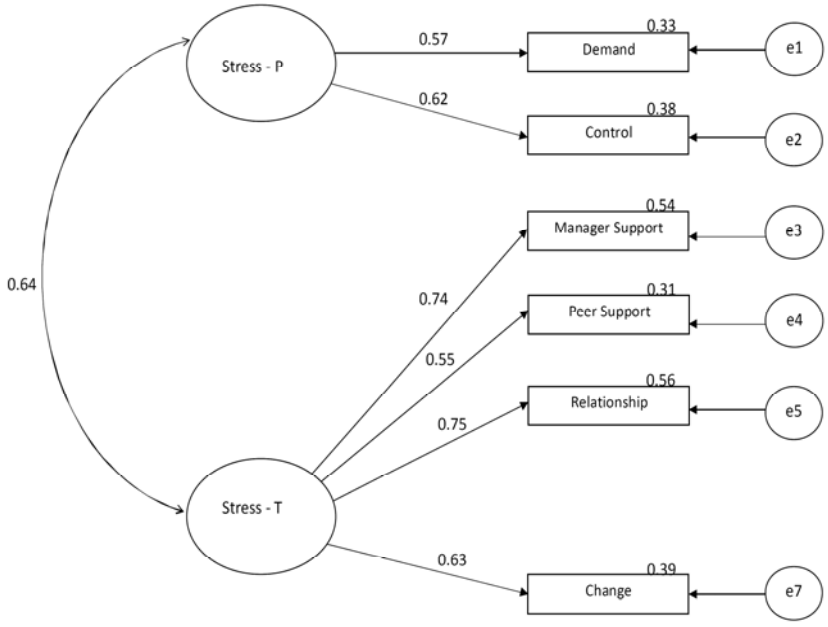

Figure 5.2 : Structural equation Model-2 of Work stress for all the selected industries

The fit indices values for this model shows that, Model -2 (Fig 5.2) is as good as the alternate Model -1 and the results shows that the normed chi-square value of 1.469 ,TLI, CFI values are well with in the acceptable range (> 0.90) , SRMR ,and RMSEA has a value close to zero, an indication of good fit . Therefore it is suggested to use any one of the above models as both models are found to be equally good.

5.2.3. Structural equation modelling of work stress for Chemical industries

The data obtained from the chemical industries were used to develop, structural equation models. Initially an input model was developed which, further was modified to get the standardized final model.

5.2.3.1. Initial /Input structural equation Model for Chemical industries

Initially an input model was developed for chemical industries, using the factors. The model fit indices for the input model are shown in the Table 5.7.

Table 5.7 Model fit indices of Input Model for Chemical industries

χ2	Normed χ2	df	P-Value	GFI	AGFI	NFI	TLI	CFI	RMR	RMSEA	SRMR
187.486	10.416	18	<0.01	0.912	0.864	0.799	0.783	0.814	1.344	0.130	0.00425

It is noted that the chi-square value was significant at 0.05 level and normed chi-square value is not with in the acceptable limit .The NFI,TLI, CFI and RMSEA values indicate poor fit for the data and this made us to go for another model and hence Model-1 was developed.

5.2.3.2 Structural equation Model-1 for Chemical industries

The Normed chi-square value for the alternate model is 2.969,which is found well with in the acceptable limit and the other Model fit indices NFI,TLI,CFI,RMSEA are also found well with in the acceptable limit (see Table 5.8).But the chi-square value was found significant at 0.05 level and this made us to go for another model, and hence Model-2 was developed shown in the Figure 5.3

Table 5.8 Model fit indices of Model-1 for Chemical industries

$\chi 2$	Normed $\chi 2$	df	P-Value	GFI	AGFI	NFI	TLI	CFI	RMR	RMSEA	SRMR
20.780	2.969	7	0.004	0.989	0.958	0.978	0.955	0.985	0.624	0.060	0.00252

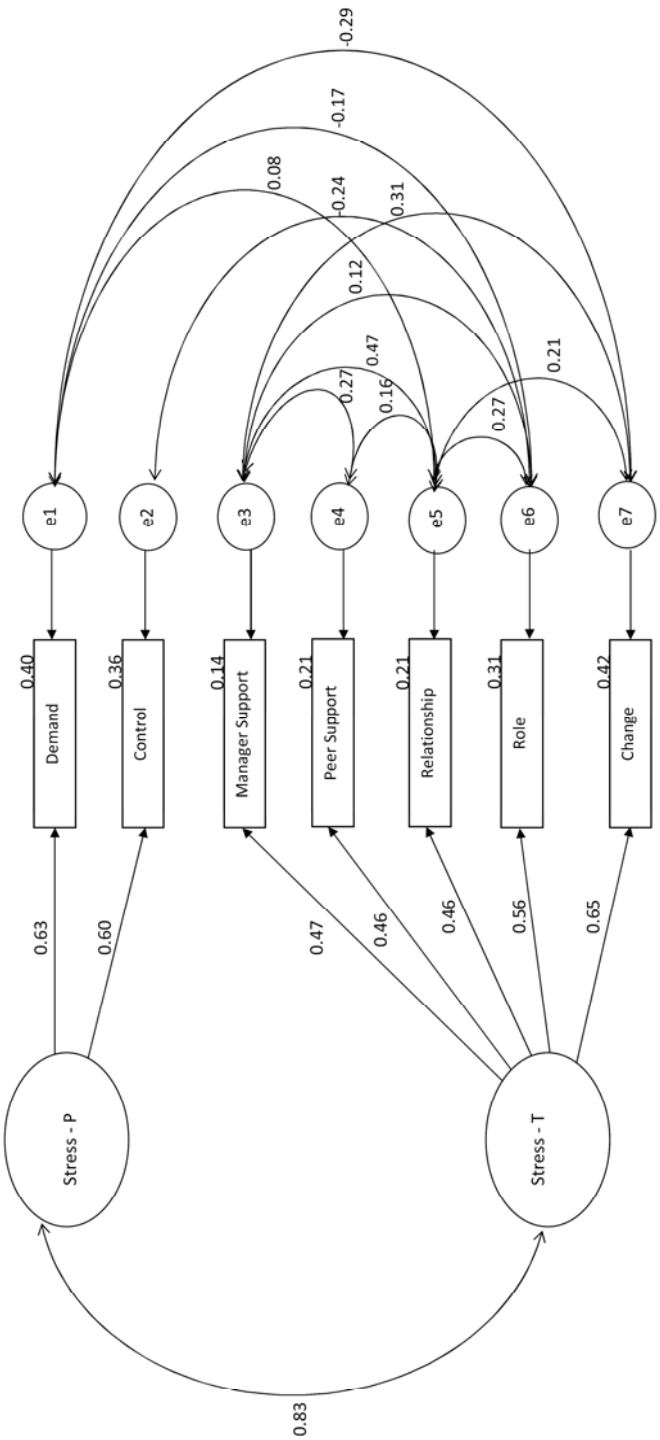

Figure 5.3 : Structural equation Model-1 of work stress for Chemical industries

5.2.3.3 Structural equation Model-2 for Chemical industries

When one of the variable namely 'manager support' was removed from the Model -1, a considerable improvement in this model was noticed. The normed chi-square value obtained is lower than the previous model and fit indices values show very good fit for the data (Table 5.9). This model (Model-2) is found more suitable for chemical industries (Fig.5.4)

Table 5.9 Model fit indices of Model-2 for Chemical industries

$\chi 2$	Normed $\chi 2$	df	P-Value	GFI	AGFI	NFI	TLI	CFI	RMR	RMSEA	SRMR
5.215	1.304	4	0.266	0.997	0.983	0.991	0.992	0.998	0.214	0.023	0.00114

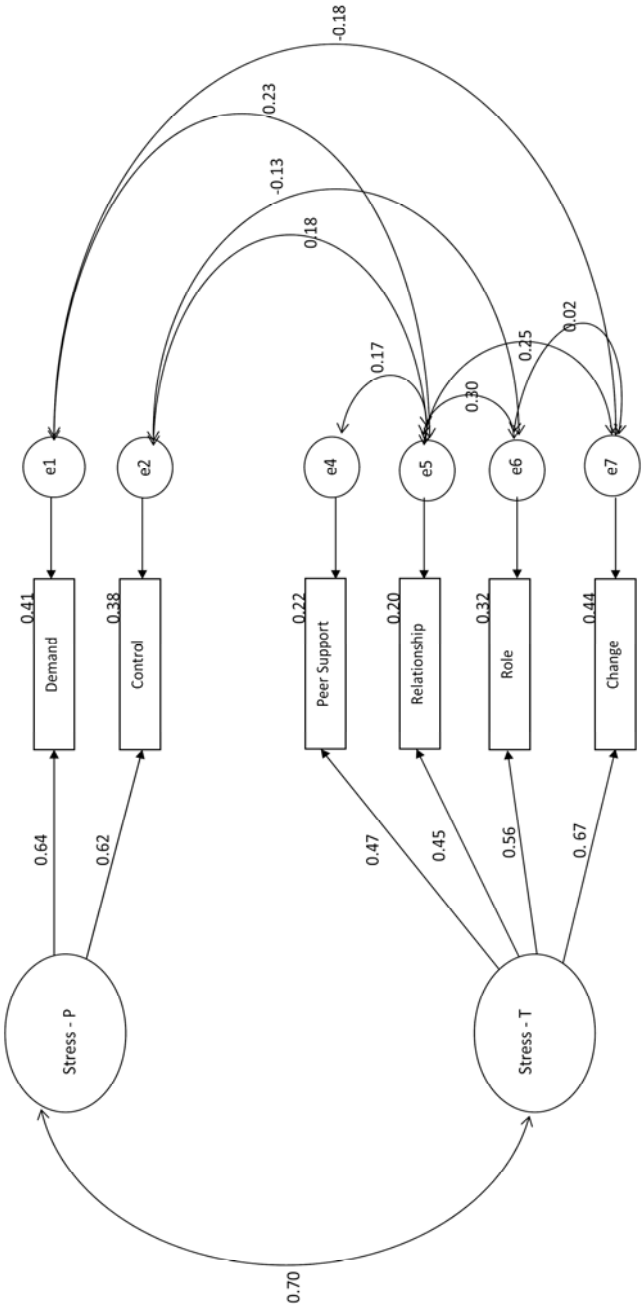

Figure 5.4 : Structural equation Model-2 of work stress for Chemical industries

5.2.4 Structural equation modelling of work stress for Heavy Engineering industries

The data obtained from the heavy engineering industries were used to develop structural equation models. For this initially an input model was developed and this is further modified to get a standardized final model

5.2.4.1 Initial /Input Structural equation Model for Heavy Engineering industries

The initial model for the heavy engineering industries were developed using the data .The normed chi-square values and other fit indices are found well with in the acceptable limit (see Table 5.10), except NFI and RMR This model was modified further as chi-square value is found large and significant at 0.051

Table 5.10 Model fit indices of Input Model for Heavy Engineering industries

χ2	Normed χ2	df	P-Value	GFI	AGFI	NFI	TLI	CFI	RMR	RMSEA	SRMR
49.188	2.733	18	0.000	0.946	0.916	0.879	0.906	0.919	0.890	0.079	0.00424

5.2.4.2 Final Structural Equation Model for Heavy Engineering industries

The Final Model for the heavy engineering industries was obtained by modifying the initial model. It is noted that all the fit indices are well with in the acceptable limit, showing a good fit for the data (Table 5.11) and hence this model is proposed as optimum model for the heavy engineering industries (Fig 5.5).

Table 5.11 Model fit indices of Final Model

for Heavy Engineering industries

χ2	Normed χ 2	df	P-Value	GFI	AGFI	NFI	TLI	CFI	RMR	RMSEA	SRMR
21.788	1.556	14	0.083	0.978	0.957	0.946	0.970	0.980	0.682	0.045	0.00234

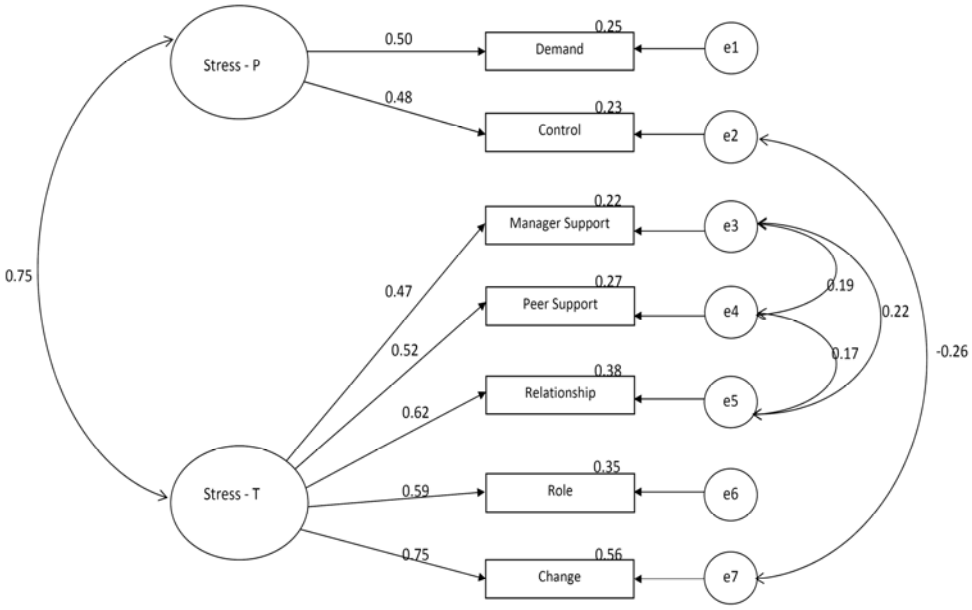

Figure 5.5 : Final Structural equation Model of Work stress for Heavy Engineering industries

5.3 Multinomial logistic regression modelling

Regression methods have an integral component of data analysis concerned with describing the relationship between the response variable and one or more of explanatory variables. What distinguishes a logistic regression model from linear regression model is that the outcome variable in logistic regression is binary or dichotomous (De Maris.,2003).

Over the last decade, the logistic regression model has been adopted in many fields including medical sciences and marketing apart from social sciences. Logistic regression model can be developed in univariable context as well as multivariable context .

Multinomial logistic regression is the extension of (binary) logistic regression (Hosmer and Lameshow,2000), when categorical dependent outcome has more than one levels .Multinomial logistic regression models are mainly used for predictive analysis(Mala et al., 2010; Chan, 2005) .The main focus in this analysis lies in establishing a mathematical equation as model to represent the interactions between the different factors under considerations.

The goal of the analysis is to develop multinomial logistic regression models /equations by developing the relationship with the factors/ predictor variables with the dependent variables .The dependent variables for the study are different age groups, designation levels and experience groups of the employees .

5.3.1 Methodology of Multinomial logistic regression modelling

The factors responsible for work stress were found to be prominent in all the age groups, different designation levels and experience levels of the employees.

In the present study the employees were divided in to seven groups based on the age viz 20-25yrs, 25-30yrs, 30-35yrs , 35-40yrs, 40-45yrs, 45-50yrs and 50-55yrs .The designation level of the employees considered were; engineers , supervisors and workers. The employees were divided in to seven groups based on their experience , and these groups are; up to 5yrs, 5-10yrs, 10-15yrs,15-20yrs, 20-25yrs , 25-30yrs and 30yrs and above . Usually in multinomial logistic regression models, the analysis is made with respect to a reference category (De Marris, 2003). For analysis for different age groups the reference category was chosen as 50-55yrs age group as they have very little service left in the organizations . Similar strategy is adopted for developing models for different experience group, where for which the reference category was chosen as employees those who have experience of 30yrs or more in the organization. For modelling different designation levels, workers are chosen as the reference category as the engineers and supervisors are more prone to stress than workers in the organization . The analysis was further extended to the chemical and heavy engineering industries.

The natural log of the odds of an event is equal to the natural log of the probability of the event occurring divided by the probability of the event not occurring that is ,

In odds (event) = In {prob(event)/ prob(non event)}

The multinomial logit function/equation , can be expressed as

$Z = B_0 + B_1 X_1 + B_2 X_2 + \ldots\ldots\ldots + B_k X_k$ Where Z is the multinomial log odds of the event, Z = In odds (event),which is also known as multinomial logit. B_0 is a constant and B_1, B_2,B_3……, B_k are the regression coefficients and X_1, X_2, X_3, ……X_k are the predictor or the independent variable .

The predictor variables for work stress is same as the factors identified for evaluation in the chapter-3 , These variables are demand , control ,manager support, peer support, relationship, role and change . In this method the relative improvement in work stress due to unit change in the any one of the predictor variable responsible for it is studied by holding the other predictor variables constant.

Initially log likelihood model was developed by using the predictor variables for the different categories/ groups under study .The initial log likelihood of the model was evaluated with no predictor / independent variable (Shown in the model fitting table as- Intercept only. Final log likelihood of the model was computed by considering all predictor/ independent variables. The difference between the two, is the model chi-square value .If the observed significance level is small, that is less than 0.05. (In this analysis the significance was set at 0.05 level) one can reject the null hypothesis, that all the regression coefficients in the model) are equal to zero. By doing so one can conclude that the final model is better than the intercept only model.

The estimated multinomial logistic regression coefficients is shown in the column B in Tables 5.13, 5.15, 5.17, 5.19, 5.21, 5.23, 5.25 and 5.29. An important feature of the multinomial logit model is that , if our dependent variable has J possible values , the number of nonredundant logits we can form is J-1.

The relative improvement in work stress for the one group over the reference group is explained by means of odds ratio (OR), shown under the column Exp (B). The odds ratio for this event at 95% confidence level is also evaluated.(see the parameter estimates for the different groups under study) All the analysis was performed by using the software SPSS-15. The following abbreviations are used for the multinomial logit modeling. De-demand, Cl-control, Ms-manager support, Ps-peer support, Re- relationship, Rl- role , Ch -change

5.3.2 Multinomial logistic regression model for all the selected industries

Multinomial logistic regression models were developed for the employees belongs to different age groups, designation levels and experience groups in all the selected five industries for the study.

5.3.2.1 For the different age groups in all the selected industries

The model fitting information (Table 5.12), reveals that the initial log likelihood value obtained for the model with no independent variables (intercept only model) is 2687.81.The final log likelihood value obtained for the model by considering all independent variables is 2599.76.the chi-square value obtained is 88.05. As the p-value obtained is below 0.05, so it can be concluded that the final model is better than the intercept only model.

Table 5.12 Model fitting information of different age groups for all the selected industries.

Model	Model Fitting Criteria	Likelihood Ratio Tests		
	-2 Log Likelihood	Chi-Square	df	p-value
Intercept Only	2687.81			
Final	2599.76	88.05	42	<0.001

Table 5.13 Parameter estimates of different age groups in all the selected industries

Age group (yrs)		B	Exp(B)	95% Confidence Interval for Exp(B)	
				Lower Bound	Upper Bound
20-25	Intercept	-2.299			
	Demand	-.040	.960	.884	1.497
	Control	-.089	.915	.728	1.149
	Manager support	.096	1.101	.753	1.609
	Peer support	.049	1.050	.702	1.571
	Relationship	-.007	.993	.660	1.495
	Role	-.371	.690	.515	.924
	Change	.229	1.258	.674	2.347
25-30	Intercept	-4.854			
	Demand	.-052	.949	1.025	1.219
	Control	-.081	.922	.856	.993
	Manager support	.212	1.236	1.100	1.389
	Peer support	-.056	.945	.837	1.067
	Relationship	-.051	.950	.833	1.083
	Role	.021	1.022	.877	1.190
	Change	-.105	.900	.757	1.070
30-35	Intercept	.184			
	Demand	.-.016	.984	.920	1.053
	Control	-.108	.897	.841	.957
	Manager support	.109	1.115	1.019	1.220
	Peer support	.002	1.002	.908	1.104
	Relationship	-.001	.999	.895	1.116
	Role	-.035	.966	.859	1.086
	Change	-.093	.911	.789	1.052
35-40	Intercept	-1.834			
	Demand	-.006	.994	.941	1.076
	Control	-.040	.960	.902	1.023
	Manager support	.049	1.051	.962	1.147
	Peer support	.037	1.037	.942	1.143
	Relationship	.003	1.003	.896	1.123
	Role	-.009	.991	.879	1.118
	Change	-.033	.968	.838	1.117
40-45	Intercept	2.309			
	Demand	.-008	.992	.954	1.065
	Control	-.005	.995	.942	1.052
	Manager support	-.094	.910	.846	.979
	Peer support	-.056	.945	.877	1.019
	Relationship	.037	1.037	.944	1.140
	Role	-.092	.913	.833	1.000
	Change	.047	1.048	.928	1.185
45-50	Intercept	-.797			
	Demand	-.039	.961	.988	1.096
	Control	.013	1.013	.964	1.066
	Manager support	.013	1.013	.947	1.084
	Peer support	-.028	.972	.905	1.044
	Relationship	.019	1.019	.933	1.113
	Role	-.045	.956	.874	1.045
	Change	.007	1.007	.900	1.125

The reference category : 50-55yrs.

The multinomial logit model shown in the Table 5.13 has six parts ,labeled with outcome variable age . They correspond to six equations as shown below

Log p (age = 20-25yrs)/ p (age = 50-55 yrs)

= -2.299-0.040 De-0.089Cl+.096 Ms+0.049Ps-0.007 Re-0.371 Rl+0.229Ch

→ 5.3.2.1 (1)

Log p(age=25-30yrs)/p(age=50-55yrs)

= -4.854-0.052De-0.081Cl+0.212Ms-0.056 Ps-0.051Re+0.021Rl-0.105Ch

→ 5.3.2.1 (2)

Log p(age=30-35yrs)/p(age=50-55yrs)

= 0.184-0.016 De-0.108 Cl+.109Ms+0.002Ps-0.001 Re-0.035Rl-0.093 Ch

→ 5.3.2.1 (3)

Log (p(age=35-40yrs)/p(age=50-55yrs)

= -1.834-0.006 De-0.040Cl +0.049 Ms+0.037 Ps+0.003 Re-0.009 Rl

-0.033Ch → 5.3.2.1 (4)

Log (p(age=40-45yrs)/p(age=50-55yrs)

= 2.039-0.008 De-0.005 Cl-0.094 Ms-0.056 Ps+0.037 Re

-0.092 Rl+ 0.047 Ch → 5.3.2.1 (5)

Log p(age=45-50yrs)/p(age=50-55yrs)

= -0.797-0.039De+0.013Co+0.013Ms-0.028Ps +0.019 Re-0.045 Rl

+0.007 Ch → 5.3.2.1 (6)

The intercept (See the Table 5.13) is the multinomial logit estimate for the different age groups relative to reference age group 50-55yrs. This is shown in the equations 5.3.2.1 (1) to 5.3.2.1(6).

The above equations can be interpreted as follows. One unit increase in the variable demand, the log ratio(log odds) of the probabilities, ie p(age=20-25yrs)/p(age=50-55yrs) will be decreased by 0.040 when all other predictor variables are held constant. Similarly for one unit change in the variable manager support, the ratio of the log of the probabilities (logodds) will be increased by 0.096.

The another way of interpreting the result can be done by means of odds ratio (OR), that is, for one unit increase in the variable –demand, the multinomial odds of improvement of work stress is expected to be decrease by the factors 0.960, 0.949,0.984,0.994,0.992,0.961 for all the age groups 20-25yrs, 25-30yrs , 30-35yrs, 35-40yrs, 40-45yrs and 45-50yrs respectively taken for the study , over the reference group when all other predictor variables are held constant. (See the column Exp(B) in the Table 5.13). Similar trend is observed while analyzing the variable – control over the different age groups ,except for the group 45-50yrs, where odds of improvement in work stress is expected to increase by a factor 1.013.

For a unit increase in the variable –manager support , the multinomial odds of improvement in work stress is expected to increase by a factor of 1.101,1.236,1.115,1.051and 1.013 for the age groups 20-25yrs, 25-30yrs, 30-35yrs,and 45-50yrs over the reference group .But for the age group 40-45yrs ,the multinomial odds of work stress is expected to decrease by a factor 0.910.

In the case of–peer support, a unit increase in the variable, the multinomial odds of improvement in work stress is expected to increase for all age groups 20-25yrs, 30-35yrs and 35-40yrs by a factor of 1.050, 1.002 and 1.037 respectively. A reverse trend is observed for the remaining age groups over the reference group(OR<1).

Analysis of the variable -relationship among the various age group show that multinomial odds of improvement of work stress for the age group 35-40yrs,40-45 yrs and 45-50yrs is expected to increase by a factor of 1.003, 1.037 and 1.019 respectively over the reference group ,and a reverse trend is observed for the remaining age groups over the reference group.

The analysis of the variable –role, show that, the multinomial odds of improvement in work stress is expected to increase by a factor of 1.002 for 25-30yrs age group over the reference group. A reverse trend is obtained for the other age groups (OR<1).

For a unit increase in the variable –change the multinomial odds of improvement in work stress is expected to increase for the age group 20-25yrs, 40-45 yrs and 45-50yrs by the factors 1.258, 1.048 and 1.007 respectively over the reference group and reverse trend is observed for the other age groups.

5.3.2.2 For different designation levels of the employees in all the selected industries

The model fitting information (Table5.14), reveals that the initial log likelihood value obtained for the model with no independent variables (intercept only model) is 1076.51.The final log likelihood value obtained for the model by considering all independent variables is 1003.57 the chi-square value obtained is72.94. As the p-value obtained is below 0.05, so it can be concluded that the final model is better than the intercept only model.

Table 5.14 Model fitting information of different designation levels in all the selected industries

Model	Model Fitting Criteria	Likelihood Ratio Tests		
	-2 Log Likelihood	Chi-Square	df	p-value
Intercept Only	1076.51			
Final	1003.57	72.94	14	<0.001

The associations of predictor variables is found with different designation level of the employees. For this analysis, we choose base category as workers

Table 5.15 Parameter estimates of different designation levels in all the selected industries

Designation		B	Exp(B)	95% confidence interval for Exp(B)	
				Lower bound	Upper bound
Engineer	Intercept	-4.002			
	Demand	.068	1.070	.869	1.004
	Control	.240	1.272	1.165	1.388
	Manager support	.074	1.076	.983	1.179
	Peers support	.073	1.075	.969	1.193
	Relationship	-.124	.884	.790	.989
	Role	.064	1.066	.938	1.211
	Change	-.215	.807	.693	.939
Supervisor	Intercept	-4.548			
	Demand	.016	1.016	.928	1.043
	Control	.076	1.079	1.019	1.143
	Manager support	.104	1.109	1.028	1.197
	Peer support	.063	1.065	.979	1.160
	Relationship	.011	1.012	.915	1.119
	Role	.046	1.047	.943	1.162
	Change	-.230	.795	.704	.897

The reference category : Worker.

The multi nomial logit model is shown in the Table-5.15, has two parts labeled with out come variable designation .This correspond to two equations shown below

Logp(designation=engineers)/p(designation=workers)

=-4.002+.068De+0.240Cl+0.074Ms+0.073Ps-0.124Re+0.064Rl-0.215Ch

.....► 5.3.2.2(1)

Log(p(designation=supervisors/p(designation=workers)

= -4.548+0.016De+0.076Cl+0.104Ms+0.063Ps+0.011Re+0.046Rl

-0.230Ch .....► 5.3.2.2(2)

The above equations can be interpreted by means of odds ratio as One unit increase in the variable- demand the mutinomial odds of improvement of work stress among engineers over workers is expected to increase by a factor 1.070.Similar trend is obtained on supervisors over worker (OR >1),while keeping all other predictor variables constant.

Similarly one unit increase in variables –control, manager support, and peer support ,the multinomial odds of improvement of work stress expected to increase among engineers over workers by the factors 1.272,1.076and 1.075 respectively. Similar trend is noticed for supervisors over workers (OR>1).

The multinomial odds of improvement in work stress, for the unit change in the variable –relationship is expected to increase among supervisors over workers is expected to increase by a factor of 1.012 and

reverse trend is noticed for the same variable among engineers over workers (OR<1).

One unit increase in the variable – role the multinomial improvement in work stress is expected to increase among engineers over workers by a factor 1.066and similar trend is noticed for this variable among supervisors over the reference group

The multinomial odds of improvement in work stress for the unit change in the variable – change is expected to decrease among engineers over the workers by a factor 0.807 and similar trend is noticed for this variable among supervisors over workers(OR<1)

5.3.2.3 For employees having different experience

The model fitting information (Table- 5.16), reveals that the initial log likelihood value obtained for the model with no independent variables (intercept only model) is 3033.28.The final log likelihood value obtained for the model by considering all independent variables is 2945.84 .The chi-square value obtained is 87.44.As the p-value obtained is below 0.05, it can be concluded that the final model is better than the intercept only model.

Table 5.16 Model fitting information of different experience groups in all the selected industries

Model	Model Fitting Criteria -2 Log Likelihood	Likelihood Ratio Tests		
		Chi-Square	df	p-value
Intercept Only	3033.28			
Final	2945.84	87.44	42	<0.001

The model shown in the Table.5.17 has six parts, labeled with outcome variable experience group. This corresponds to six equations called multinomial logit models

Log(p(experience=up to 5yrs)/ p(experience=30yrs and above)

=-4.672-0.108 De-0.131Cl+0.235 Ms-0.048Ps-0.033Re+0.042Rl-0.059Ch

.....► 5.3.2.3 (1)

Log p (experience =5-10yrs/p(experience = 30yrs and above)

= 0.336+0.002De-0.122Cl+0.104Ms-0.051Ps+0.118Re-0.079Rl-0.002Ch

.....► 5.3.2.3 (2)

Logp(experience =10-15 yrs / p(experience =30yrs and above)

1.325-0.034De-0.080Cl+0.002Ms-0.054Ps+0.005Re+0.075Ro+0.043Ch

.....► 5.3.2.3 (3)

Log(p(experience =15-20 yrs / p(experience =30yrs and above)

=2.563-0.025De-0.056Cl-0.036Ms-0.046Ps+0.026Re-0.089Rl+0.091Ch

5.3.2.3 (4)

Log(p(experience =20-25yrs / p(experience =30yrs and above)

=1.843-0.026De-0.030Cl+0.035Ms-0.076Ps+0.065Re-0.098Rl+0.056

5.3.2.3 (5)

Log(p(experience =25-30yrss / p(experience =30yrs and above)

=-1.731-0.033De-0.061Cl+0.004Ms+0.005Ps+0.064Re-0.018Rl+0.148Ch

5.3.2.3 (6)

Table 5.17 Parameter estimates of different experience groups in all the selected industries

Experience groups in Yrs.		B	Exp(B)	95% confidence interval for Exp(B)	
				Lower Bound	Upper Bound
up to 5 yrs	Intercept	-4.672			
	Demand	-.108	.897	.852	.941
	Control	-.131	.877	.805	.955
	Manager support	.235	1.265	1.114	1.436
	Peer support	-.048	.953	.832	1.091
	Relationship	-.033	.967	.839	1.115
	Role	.042	1.043	.876	1.241
	Change	-.059	.943	.778	1.142
5-10 yrs	Intercept	.336			
	Demand	.002	1.002	.922	1.081
	Control	-.122	.885	.819	.956
	Manager support	.104	1.109	.998	1.233
	Peer support	-.051	.951	.848	1.066
	Relationship	.118	1.125	.978	1.295
	Role	-.079	.924	.804	1.062
	Change	-.002	.998	.843	1.183
10-15 yrs	Intercept	-1.325			
	Demand	-.034	.966	.959	1.117
	Control	-.080	.923	.857	.995
	Manager Support	.002	1.002	.910	1.103
	Peer Support	-.054	.948	.853	1.053
	Relationship	.005	1.005	.889	1.135
	Role	.075	1.078	.936	1.241
	Change	.043	1.043	.887	1.228
15-20 yrs	Intercept	2.563			
	Demand	-.025	.975	.959	1.096
	Control	-.056	.946	.884	1.012
	Manager support	-.036	.964	.885	1.050
	Peer support	-.046	.955	.870	1.048
	Relationship	.026	1.027	.921	1.144
	Role	-.089	.915	.816	1.025
	Change	.091	1.096	.948	1.266
20-25 yrs	Intercept	1.843			
	Demand	-.026	.974	.963	1.093
	Control	-.030	.971	.911	1.035
	Manager support	.035	1.036	.955	1.124
	Peer support	-.076	.927	.848	1.012
	Relationship	.065	1.068	.961	1.186
	Role	-.098	.907	.813	1.011
	Change	.056	1.057	.924	1.210
25-30 yrs	Intercept	-1.731			
	Demand	-.033	.967	.963	1.109
	Control	-.061	.941	.878	1.009
	Manager support	.004	1.004	.917	1.099
	Peer support	.005	1.005	.909	1.111
	Relationship	.064	1.066	.945	1.203
	Role	-.018	.982	.864	1.116
	Change	.148	1.159	.994	1.352

a The reference category is: 30 yrs and above.

The above equations can be interpreted by means of odds ratio as – a unit increase in the variable–demand, the multinomial odds of improvement of work stress among the groups having experience up to 5yrs over the reference group, is expected to decrease by a factor 0.897 while holding all other predictor variable in the model constant. A similar trend is observed for the groups having experience10-15yrs,15-20yrs,20-25yrs and 25-30yrs over the reference group(OR<1). But a reverse trend is observed for the group having experience 5-10yrs over the reference group (OR>1).

While analyzing the factor/variable –control the multinomial odds of improvement in work stress is expected to decrease among all the experience groups, over reference group.

For unit increase in the variable –manager support, the multinomial odds of improvement of work stress is expected to increase among all the groups over the reference group, except for the experience group 15-20yrs, where multinomial odds of improvement in work stress is expected to decrease by a factor 0.964 over the base/reference group.

The analysis of variable-peer support among different experience group, the multinomial odds of improvement in work stress is expected to decrease in the groups having experience , upto 5yrs, 5-10yrs ,10-15yrs, 15-20yrs and 20-25yrs by a factor 0.953, 0.951, 0.948,0.955,0.927 respectively and a reverse trend is observed on other age groups over the reference groups.

The analysis of factor/variable –relationship multinomial odds of improvement in work stress is expected to increase in experience groups 5-10yrs, 10-15yrs, 15-20yrs, 20-25yrs and 25-30yrs over the base group(OR>1).But a reverse trend is observed for the rest of the group over the base/reference group.

The analysis of the variable –role, the multinomial odds of improvement in work stress in the experience groups up to 5yrs and 10-15yrs is found to be increased over the base group by a factor 1.043 and 1.078 respectively. A reverse trend is observed for the rest of the groups over the reference group (OR<1)

While analyzing the factor/variable –change, the multinomial odds of improvement is found is expected to increase on the experience groups 10-15yrs, 15-20yrs, 20-25yrs and 25-30yrs by the factors 1.043, 1.096,1.057and 1.159 respectively over the reference group. A reverse trend is observed for the other groups over the base group.

5.3.3 Multinomial logistic regression models for Chemical industries

Multinomial logistic regression models were developed for the employees working in the chemical industries. The models were developed for the different age groups, designation levels, and employees having different experience as mentioned earlier.

5.3.3.1.For different age groups in Chemical industries

The model fitting information (Table 5.18), reveals that the initial log likelihood value obtained for the model with no independent variables (intercept only model) is 1890 The final log likelihood value obtained for

the model by considering all independent variables is 1811 .The chi-square value obtained is 79 As the p-value obtained is below 0.05, so it can be concluded that the final model is better than the intercept only model.

The multinomial logit model for the three chemical industries selected for the study is shown below .In this association of the predictor variables/factors is found with different age groups of the employees . For this we choose base category as taken as employees of age group 50-55yrs. The multinomial logit model shown in the Table 5.19, has six parts, labeled with outcome variable age group. They corresponds to six equations as shown below.

Table 5.18 Model fitting information of different age groups in Chemical industries

Model	Model Fitting Criteria	Likelihood Ratio Tests		
	-2 Log Likelihood	Chi-Square	df	p-value
Intercept Only	1890			
Final	1811	79	42	<0.001

Table 5.19 Parameter estimates of different age groups for Chemical industries.

Age group in Yrs		B	Exp(B)	95% Confidence Interval for Exp(B)	
				Lower Bound	Upper Bound
20-25	Intercept	-13.189			
	Demand	-.061	.940	.688	1.285
	Control	-.005	.995	.732	1.353
	Manger support	.284	1.329	.771	2.291
	peer support	.334	1.396	.687	2.837
	Relationship	-.139	.870	.511	1.481
	Role	-.115	.892	.476	1.671
	Change	.025	1.025	.900	1.056
25-30	Intercept	-4.869			
	Demand	-.068	.0.934	1.007	1.224
	Control	-.064	.938	.861	1.023
	Manger support	.283	1.327	1.157	1.522
	peer support	-.121	.886	.777	1.011
	Relationship	-.082	.922	.795	1.069
	Role	.067	1.069	.895	1.278
	Change	-.114	.893	.735	1.084
30-35	Intercept	1.853			
	Demand	.047	1.048	.882	1.032
	Control	-.087	.916	.848	.991
	Manger support	.121	1.129	1.016	1.254
	peer support	-.071	.932	.832	1.044
	Relationship	.023	1.023	.900	1.163
	Role	-.042	.959	.835	1.102
	Change	-.081	.922	.778	1.093
35-40	Intercept	-.113			
	Demand	.025	1.025	.900	1.056
	Control	-.010	.990	.916	1.070
	Manger support	.086	1.090	.981	1.211
	peer support	-.022	.978	.873	1.096
	Relationship	-.001	.999	.877	1.137
	Role	-.021	.979	.851	1.127
	Change	-.050	.952	.802	1.129
40-45	Intercept	1.962			
	Demand	.012	1.012	.919	1.061
	Control	.011	1.011	.942	1.085
	Manger support	-.080	.923	.842	1.012
	peer support	-.069	.933	.847	1.028
	Relationship	.051	1.052	.937	1.182
	Role	-.055	.947	.839	1.068
	Change	.037	1.038	.887	1.213
45-50	Intercept	-.332			
	Demand	-.009	0.991	.943	1.079
	Control	.040	1.041	.975	1.111
	Manger support	.066	1.068	.979	1.165
	peer support	-.039	.962	.877	1.056
	Relationship	.036	1.037	.928	1.158
	Role	-.052	.949	.847	1.064
	Change	-.050	.951	.826	1.096

The reference category : 50-55yrs.

Log p(age=20-25yrs) /p(age=50-55yrs)

= -13.189-0.061De-0.005Cl+0.284Ms+0.334Ps-0.139 Re

-0.115Rl+0.025Ch- ⟶ 5.2.5.1(1)

Log p(age=25-30yrs)/p(age=50-55yrs)

= -4.869-0.068De-0.064Cl+0.283Ms-0.121Ps-0.082Re+0.067Rl-0.114Ch

⟶ 5.2.5.1(2).

Log p(age=30-35yrs)/p(age=50-55yrs)

= 1.853+0.047De-0.087Cl+0.121Ms-0.071Ps+0.023Re-0.042Rl-0.081Ch

⟶ 5.2.5.1(3)

Logp(age=35-40yrs)/p(age=50-55yrs)

= -0.113+0.025De-0.010Cl+0.086Ms-0.022Ps-0.001Re-0.021Rl-0.050Ch

⟶ 5.2.5.1(4)

Logp(age=40-45yrs)/p(age=50-55yrs)

= 1.962+0.012De+0.011Cl-0.080Ms-0.069Ps+0.051Re-0.055Rl+0.037Ch

⟶ 5.2.5.1(5)

Logp(age=45-50yrs)/p(age=50-55yrs)

=-0.332-0.009De+0.040Cl+0.066Ms-0.039Ps+0.036Re-0.052Rl-0.050Ch

⟶ 5.2.5.1(6)

The interpretation of the above equations can be explained by means of odds ratio as follows.

One unit increase in the variable demand, the multinomial improvement in work stress is expected to decrease by a factor of 0.940 among 20-25yrs age group over the reference group, when all other predictor variables are held constant. Similar trend is observed for 25-30yrs and 45-50yrs over the reference group. A reverse trend is observed for the age groups, 30-35yrs, 35-40 yrs and 40-45yrs over the reference group(OR>1).

The multinomial odds of work stress due to unit increase in the variable -control is expected to increase by a factor 1.011and 1.041 for the age groups 40-45yrs and 45-50yrs respectively over the reference groups and a reverse trend is observed for the age groups 20-25yrs, 25-30yrs, 30-35yrs and 35-40yrs over the reference groups(OR<1).

A unit increase in the variable –manager support , the multinomial odds of improvement in work stress among age groups 20-25yrs, 25-30yrs ,30-35yrs, 35-40yrs and 45-50yrs over 50-55yrs expected to increase by the factors 1.329,1.327,1.129,1.090and 1.068 respectively. But a reverse trend is observed for 40-45yrs over 50-55yrs.

The unit increase in the variable - peer support reveals that the multinomial odds for improvement in work stress is expected to increase by a factor 1.396 among the age group 20-25yrs over the reference group. A reverse trend is noticed for all the other age group ,over the reference group(OR<1).

A unit increase in the variable – relationship ,the multinomial odds of improvement in work stress is expected to increase for the age groups 30-35yrs , 40-45yrs and 45-50yrs by the factors 1.023,1.052and 1.037 respectively over the reference group. a reverse trend is noticed for the other age groups over the reference groups.

The analysis of the factor–role, the multinomial odds for improvement in work stress is expected to decrease on the age groups 20-25yrs, 30-35yrs, 35-40yrs, 40-45yrs and 45-50yrs over the reference group. But reverse trend is observed among the age groups 25-30yrs over the reference group (OR>1).

The analysis of factor –change, reveals that, the multinomial odds for the improvement of work stress is expected to increase among the age groups 20-25yrs and 40-45yrs, over the reference group by the factors 1.025 and 1.038 respectively ,but a reverse trend is observed on other age groups over the reference group (OR<1).

5.3.3.2 For different designation levels of the employees in Chemical industries

The model fitting information (Table 5.20), reveals that the initial log likelihood value obtained for the model with no independent variables (intercept only model) is 756.72.The final log likelihood value obtained for the model by considering all independent variables is 701.56. The chi-square value obtained is 55.16.As the p-value obtained is below 0.05, so it can be concluded that the final model is better than the intercept only model.

Table 5.20 Model fitting information of different designation levels in Chemical industries.

Model	Model Fitting Criteria	Likelihood Ratio Tests		
	-2 Log Likelihood	Chi-Square	df	p-value
Intercept Only	756.72			
Final	701.56	55.16	14	<0.001

Table 5.21 Parameter estimates of different designation levels for in Chemical industries

Designation		B	Exp(B)	95% Confidence Interval for Exp(B)	
				Lower Bound	Upper Bound
Engineer	Intercept	-2.872			
	Demand	.102	1.107	.828	.985
	Control	.288	1.334	1.197	1.486
	Manager support	.081	1.084	.968	1.214
	Peer support	.078	1.081	.954	1.224
	Relationship	-.115	.891	.776	1.023
	Role	.032	1.033	.888	1.201
	Change	-.291	.748	.622	.898
Supervisor	Intercept	-4.354			
	Demand	.026	1.026	.908	1.045
	Control	.083	1.087	1.014	1.164
	Manager support	.026	1.026	.940	1.120
	Peer support	.090	1.094	.991	1.208
	Relationship	.037	1.037	.921	1.169
	Role	.048	1.049	.926	1.189
	Change	-.182	.834	.722	.963

The reference category is: Worker.

The multinomial logit model in the Table 5.21 has two parts labeled with outcome variable designation. They corresponds to two equations given below.For this analysis we choose base/reference category as workers.

Logp(designation=engineers)/p(designation=workers)

=-2.872+0.102De+0.288Cl+0.081Ms+0.078Ps-0.115Re+0.032Rl-0.291Ch

→ 5.3.3.2(1)

Log(p(designation=supervisors/p(designation=workers)

=-4.354+0.026De+0.083Cl+0.026Ms+0.090Ps+0.037Re+0.048Rl-0.182Ch

→5.1.5.2(2)

The above equations can be explained in terms of the odds ratio as,

One unit increase of variables namely demand , control, manager support, peer support the multinomial odds of improvement of work stress were expected to increase on engineers over workers by the factors 1.107,1.334,1.084 and 1.081 respectively when all predictor variables are held constant. Similar trend was noted for the unit increase in these variables for the supervisor over workers.

While analyzing variable-role the multinomial odds of improvement in work stress is expected to increase for engineers over the workers by a factor 1.033 and the similar trend was noticed for the supervisor over workers.

A unit change in the variable relationship , the multinomial odds of improvement in work stress is expected to increase among supervisors over workers by a factor 1.049 and a reverse trend was noted for the engineers over the reference group(OR<1).

A unit increase in the variable –change ,the multinomial odds of improvement in work stress is expected to decrease for the engineers over the reference group by a factor 0.748 and a similar trend is noticed for the supervisors over the workers .

5.3.3.3.For the employees having different experience in Chemical industries

The model fitting information (Table 5.22), reveals that the initial log likelihood value obtained for the model with no independent variables (intercept only model) is 2037. The final log likelihood value obtained for the model by considering all independent variables is1962. The chi-square value obtained is 75. As the p-value obtained is below 0.05, it can be concluded that the final model is better than the intercept only model.

Table 5.22 Model fitting information of different experience groups in Chemical Industries

Model	Model Fitting Criteria	Likelihood Ratio Tests		
	-2 Log Likelihood	Chi-Square	df	p-value
Intercept Only	2037			
Final	1962	75	42	<0.001

Table 5.23 Parameter estimates of different experience groups in Chemical industries

Experience Groups (Yrs)		B	Exp(B)	95% Confidence Interval for Exp(B)	
				Lower Bound	Upper Bound
up to 5 yrs	Intercept	-2.592			
	Demand	-.098	.906	.982	1.239
	Control	-.126	.881	.790	.983
	Manager support	.331	1.392	1.191	1.627
	Peer support	-.183	.833	.709	.979
	Relationship	-.063	.939	.787	1.121
	Role	.048	1.049	.845	1.302
	Change	-.070	.932	.737	1.179
5-10 yrs	Intercept	2.750			
	Demand	.016	1.016	.888	1.090
	Control	-.129	.879	.795	.972
	Manager support	.183	1.201	1.053	1.370
	Peer support	-.171	.843	.728	.976
	Relationship	.118	1.125	.951	1.331
	Role	-.105	.900	.752	1.078
	Change	.020	1.020	.823	1.264
10-15 yrs	Intercept	1.242			
	Demand	-.014	0.986	.916	1.122
	Control	-.068	.935	.846	1.032
	Manager support	.085	1.089	.961	1.234
	Peer support	-.141	.869	.755	1.000
	Relationship	-.014	.986	.843	1.153
	Role	.026	1.027	.855	1.233
	Change	.040	1.041	.842	1.287
15-20 yrs	Intercept	4.398			
	Demand	.009	1.009	.902	1.089
	Control	-.048	.953	.867	1.047
	Manager support	.026	1.027	.914	1.153
	Peer support	-.138	.871	.764	.993
	Relationship	.025	1.026	.885	1.188
	Role	-.099	.905	.768	1.067
	Change	.114	1.120	.917	1.369
20-25 yrs	Intercept	2.382			
	Demand	-.029	0.971	.940	1.128
	Control	-.049	.952	.871	1.042
	Manager support	.118	1.126	1.006	1.259
	Peer support	-.124	.884	.778	1.004
	Relationship	.051	1.052	.912	1.213
	Role	-.097	.907	.774	1.064
	Change	.037	1.038	.860	1.254
25-30 yrs	Intercept	.165			
	Demand	-.027	0.973	.926	1.140
	Control	-.090	.914	.826	1.010
	Manager support	.048	1.049	.922	1.193
	Peer support	-.139	.870	.753	1.005
	Relationship	.115	1.122	.946	1.331
	Role	-.044	.957	.794	1.154
	Change	.176	1.192	.956	1.488

The reference category : 30 yrs and above.

The associations of these with factors/predictor variables with different experience groups is found .For this analysis we choose base category as employees, who have experience 30yrs and above. The multinomial logit model shown in the Table 5.23 has six parts labeled with outcome variable experience group.This corresponds to six equations as shown below .

Log(p(experience=up to 5yrs)/ p(experience=30yrs and above)

= -2.592-0.098De-0.126Cl+0.331Ms-0.183Ps-0.063Re+0.048Rl-0.070Ch

→ 5.3.3.3(1)

Log(p(experience =5-10yrs / p(experience =30yrs and above)

= 2.750+0.016De-0.129Cl+0.183Ms-0.171Ps+0.118Re-0.105Rl+0.020Ch

→ 5.3.3.3 (2)

Log(p(experience =10-15 yrs / p(experience =30yrs and above)

=1.242-0.014De-0.068Cl+0.085Ms-0.141Ps-0.014Re+0.026Rl+0.040Ch

→ 5.3.3.3 (3)

Log(p(experience =15-20 yrs/p(experience =30yrs and above)

=4.398+0.009De-0.048Cl+0.026Ms-0.138Ps+0.025Re-0.099Rl+0.114Ch

→ 5.3.3.3 (4)

Log(p(experience =20-25yrs / p(experience =30yrs and above)

=2.832-0.029De-0.049Cl+0.118Ms-0.124Ps+0.051Re-0.097Rl+0.037Ch

→ 5.3.3.3 (5)

Log(p(experience =25-30yrss / p(experience =30yrs and above)

=0.165-0.027De-0.090Cl+0.048Ms-0.139Ps+0.115Re-0.044Rl+0.176Ch

5.3.3.3 (6)

The above equations can be interpreted in terms of odds ratio as

A unit increase in the variable –demand the multinomial odds of improvement in work stress among the employees having experience up to 5yrs, 10-15yrs, 20-25yrs, and 25-30yrs expected to decrease by the factor of 0.906,0.986,0.971and 0.973 respectively over the reference group, when all other predictor variables are held constant. A reverse trend is observed among the experience groups 5-10yrs, 15-20yrs over the reference group(OR>1).

While analyzing the variable –control among different experience groups, the multinomial odds of improvement of work stress ,due to unit increase in this variable among different groups is expected to decrease over the reference group(OR<1).

For unit increase in the variable - manager support, the multi nominal odds of improvement of work stress is expected to increase among all groups over the reference groups (OR >1).

The analysis of variable- peer support the multinomial odds of improvement of work stress is expected to decrease among all the groups with the reference group(OR<1)

The mutinomial odds of improvement of work stress for the variable –relationship is expected to decrease among groups having up to 5yrs,

10-15yrs,over the reference group, by a factor 0.939and 0.986 and a reverse trend is observed among other groups over the reference groups(OR>1).

The analysis of the variable –role, the multinomial odds of improvement of work stress is expected to increase among the groups upto 5yrs ,10-15yrs over the reference group by a factor 1.049 and 1.027 respectively and a reverse trend is observed for the other groups over the reference groups (OR <1).

The analysis of variable–change, the multinomial odds of improvement in work stress is expected to decrease among the group having experience up to 5yrs over the reference group by a factor 0.932 ,where a reverse trend is observed for all other groups over the reference group (OR>1)

5.3.4 Multinomial logistic regression models for Heavy Engineering industries

Multinomial logistic regression models were developed for different age groups, designation levels and the employees having different experience in the three selected heavy engineering industries .

5.3.4.1. For different age groups in Heavy Engineering industries

The model fitting information (Table5.24), reveals that the initial log likelihood value obtained for the model with no independent variables (intercept only model) is 725.13.The final log likelihood value obtained for the model by considering all independent variables is 668.29. The chi-square value obtained is 59.84. As the p-value obtained is below 0.05, it can be concluded that the final model is better than the intercept only model.

Table 5.24 Model fitting information of different age groups in Heavy Engineering industries .

Model	Model fitting criteria	Likelihood ratio test		
	2log[likelihood]	Chi-square	df	p-value
Intercept only	725.13	59.84	42	0.036
Final	668.29			

Table 5.25 Parameter estimates of different age groups in heavy engineering industries

Age Group (Yrs)		B	Exp(B)	95% Confidence Interval for Exp(B)	
				Lower Bound	Upper Bound
20-25	Intercept	-5.864			
	Demand	-.497	.608	.812	3.324
	Control	-.026	.974	.597	1.589
	Manager support	-.181	.834	.404	1.721
	Peer support	-.235	.790	.377	1.656
	Relationship	.426	1.531	.694	3.378
	Role	-.510	.601	.367	.984
	Change	-.403	.668	.468	1.010
25-30	Intercept	-6.905			
	Demand	-.254	.775	.848	1.963
	Control	-.139	.870	.643	1.178
	Manager support	-.489	.614	.344	1.095
	Peer support	.115	1.122	.651	1.934
	Relationship	.734	2.084	.888	4.889
	Role	-.363	.696	.427	1.134
	Change	-.330	.719	.339	1.523
30-35	Intercept	-7.232			
	Demand	-.151	.859	.965	1.401
	Control	-.158	.854	.744	.979
	Manager support	.137	1.147	.922	1.426
	Peer support	.234	1.264	.924	1.730
	Relationship	-.015	.985	.756	1.283
	Role	-.045	.956	.706	1.296
	Change	-.261	.770	.535	1.110
35-40	Intercept	-9.134			
	demand	-.095	.909	.942	1.283
	Control	-.097	.908	.805	1.023
	Manager support	-.048	.953	.782	1.162
	Peer support	.111	1.117	.883	1.414
	Relationship	.185	1.203	.861	1.682
	role	.080	1.083	.791	1.482
	Change	-.056	.945	.686	1.302
40-45	Intercept	3.288			
	Demand	-.039	.961	.946	1.143
	Control	-.021	.979	.890	1.077
	Manager support	-.111	.895	.787	1.018
	Peer support	-.070	.932	.815	1.067
	Relationship	.041	1.041	.867	1.250
	Role	-.164	.849	.730	.988
	Change	.039	1.040	.840	1.288
45-50	Intercept	-1.496			
	Demand	-.075	.927	.984	1.180
	Control	-.012	.988	.906	1.078
	Manager support	-.093	.911	.809	1.025
	Peer support	-.065	.937	.827	1.062
	Relationship	.016	1.016	.858	1.203
	Role	-.005	.995	.847	1.168
	Change	.108	1.114	.906	1.370

The reference category: 50-55yrs

The multinomial logit models shown in the Table 5.25, has six parts, labeled with outcome variable age group. They corresponds to six equations as shown below.

logp(age=20-25yrs)/p(age=50-55yrs)

=-5.864-0.497De-0.026Cl-0.181Ms-0.235Ps+0.426Re-0.510Rl

-0.403Ch ⟶ 5.3.4.1 (1)

Log p(age=25-30yrs)/p(age=50-55yrs) =

-6.905-0.254De-0.139Cl-0.489Ms+0.115Ps+0.734Re-0.363Rl

-0.330Ch ⟶ 5.3.4.1 (2)

Logp(age=30-35yrs)/p(age=50-55yrs)

= -7.232-0.151De-0.158Cl-0.137Ms+0.234Ps-0.015Re-0.045Rl-0.261Ch

⟶ 5.3.4.1 (3)

Logp(age=35-40yrs)/p(age=50-55yrs)

= -9.134-0.095De-0.097Cl-0.048Ms+0.111Ps+0.185Re+0.080Rl-0.056Ch

⟶ 5.3.4.1 (4)

Logp(age=40-45yrs)/p(age=50-55yrs)

= 3.288-0.039De-0.021Cl-0.111Ms-0.070Ps+0.041Re-0.164Rl+0.039Ch

⟶ 5.3.4.1.(5)

Log (p(age=45-50yrs)/p(age=50-55yrs)

=-1.496-0.075De-0.012Cl-0.093Ms-0.065Ps+0.016Re-0.005Rl+0.108Ch

5.3.4.1 6)

The above equations can be explained by means of the odds ratio

In the above model it is observed that ,one unit increase in the variable demand and control, the odds of improvement of in work stress is expected to decrease among all the age groups over the reference age group(OR<1), when all other predictor variables are held constant. Similar trend is noted for the variable 'control' for the different age groups under study.

The multinomial odds of improvement in work stress due to the variable –manager support , is expected to increase among 30-35yrs over the reference group by a factor 1.147. How ever a reverse trend is observed on this factor among all other age groups over the reference groupOR<1).

While analyzing the variable –peer support ,the odds of improvement in work stress is expected to decrease on 20-25yrs ,40-45yrs,45-50yrs over the reference groups by a factor 0.790,0.932and 0.937 respectively .How ever a reverse trend is observed on other groups over the reference group.(OR>1).

While analyzing the variable –relationship, the odds of improvement in work stress is expected to increase on 20-25yrs ,25-30yrs,35-40yrs, 40-45yrs and 45-50yrs by the factors 1.531 ,2.084,1.203, 1.041 and

1.016 respectively over the reference group. A reverse trend is noted for the age group 30-35yrs over the reference group(OR<1).

While examining the variable –role , the odds of improvement is expected to increase in 35-40yrs over the reference group by a factor 1.083. A reverse trend is found for this variable over the other age groups over the reference group (OR<1).

The multinomial odds of improvement in work stress due to unit increase in the variable –change is expected increase in 40-45 yrs and 45-50yrs age group over the reference group by the factors 1.040 and 1.114 respectively. A reverse trend is found for the other age groups over the reference group (OR<1).

5.3.4.2 For different designation levels of the employees in Heavy Engineering industries.

The model fitting information (Table 5.26), reveals that the initial log likelihood value obtained for the model with no independent variables (intercept only model) is 319.49The final log likelihood value obtained for the model by considering all independent variables is 293.61.The chi-square value obtained is 25.88.As the p-value obtained is below 0.05, it can be concluded that the final model is better than the intercept only model.

Table 5.26 Model fitting information of different designation levels for Heavy engineering industries.

Model	Model fitting criteria	Likelihood ratio test		
	2log[likelihood]	Chi-square	df	p-value
Intercept only	319.49	25.88	14	<0.001
Final	293.61			

The associations of the predictor variables was found for the different designation levels of the employees namely engineers and super visors in the heavy engineering industries. For this analysis ,we choose base category as workers .

Table 5.27 Parameter estimates of different designation levels in Heavy Engineering Industries

Designation		B	Exp(B)	95% Confidence Interval for Exp(B)	
				Lower Bound	Upper Bound
Engineer	Intercept	-8.037			
	Demand	-.005	.995	.879	1.150
	Control	.146	1.158	.995	1.346
	Manager Support	.082	1.085	.910	1.293
	Peer support	.025	1.025	.839	1.252
	Relationship	-.109	.897	.720	1.117
	Role	.182	1.200	.908	1.586
	Change	-.075	.928	.681	1.264
Supervisor	Intercept	-5.633			
	Demand	-.018	.982	.911	1.137
	Control	.051	1.052	.945	1.170
	Manager Support	.329	1.390	1.172	1.648
	Peer support	-.019	.981	.826	1.166
	Relationship	.034	1.034	.853	1.254
	Role	-.019	.981	.807	1.192
	Change	-.339	.713	.559	.909

The reference category: Worker.

The multinomial logit model shown in the Table 5.27 has two parts labeled with outcome variable designation .They corresponds to two equations as shown below

Logp(designation=engineers)/p(designation=workers)

=-8.037-0.005De+0.146Cl+0.082Ms+0.025Ps-0.109Re+0.182Rl-0.075Ch

→ 5.2.6.2 (1)

Log(p(designation=supervisors/p(designation=workers)=

-5.633-0.018De+0.051Cl+0.329Ms-0.019Ps+0.034Re-0.019Rl-0.339Ch

→ 5.2.6.2 (2)

The above models can be explained by means of odds ratio. One unit increase in the factor –demand , the multinomial odds of improvement is work stress is expected to decrease among engineers over workers by a factor 0.995and similar trend is noted for supervisors over the reference group (OR<1), when all other predictor variables are held constant.

The analysis of variable –control reveal that the multinomial odds of improvement in work stress is expected to increase for engineers over the reference group by a factor 1.158 and similar trend is noted for supervisors over the workers (OR>1).

For unit increase in the variable- manager support, the multinomial odds of improvement in work stress is expected to increase in engineers over the workers by a factor 1.085 and similar trend is noted for supervisors over the workers (OR>1).

The multinomial odds of improvement in the work stress due to variable relationship is expected to decrease among engineers over the reference group by a factor 0.897 and a reverse trend is observed supervisors over the reference group(OR >1).

The odds of improvement in work stress due to the variable -role is expected to increase among engineers over the reference group by a factor 1.200 and a reverse trend is noted for supervisors over the reference group.

One unit increase in the variable change ,the multinomial odds of improvement in work stress among engineers over the reference group is expected to decrease by a factor 0.928 and similar trend is observed for supervisors over workers

5.3.4.3 For the employees having different experience in Heavy Engineering Industries.

The model fitting information (Table 5.28), reveals that the initial log likelihood value obtained for the model with no independent variables (intercept only model) is 921.25. The final log likelihood value obtained for the model by considering all independent variables is 860.83 .The chi-square value obtained is `60.42 .As the p-value obtained is below 0.05, it can be concluded that the final model is better than the intercept only model.

Table 5.28 Model fitting information of different experience groups in Heavy Engineering industries.

Model	Model fitting criteria	Likelihood ratio test		
	-2log[likelihood]	Chi squre	df	p-value
Intercept only Final	921.25 860.83	60.42	42	0.033

The association of this predictor variable with difference experience groups is found, for this analysis new choose reference category as employees having experience 30yrs and above. The multinomial logit model is shown in the Table 5.29 has six parts, labeled with out come variable experience groups .They corresponds to six equations as shown in the Table 5.29.

Table 5.29 Parameter estimates of different experience group in Heavy Engineering industries

Experience Groups (Yrs)		B	Exp(B)	95% Confidence Interval for Exp(B)	
				Lower bound	Upper bound
up to 5 yrs	Intercept	-13.271			
	Demand	-.257	.773	.942	1.774
	Control	-.206	.814	.661	1.002
	Manager Support	-.033	.967	.663	1.412
	Peer support	.266	1.305	.767	2.220
	Relationship	.194	1.214	.640	2.301
	Role	.012	1.012	.589	1.736
	Change	-.143	.867	.471	1.595
5-10 yrs	Intercept	-7.307			
	Demand	-.128	.879	.889	1.454
	Control	-.152	.859	.710	1.040
	Manager Support	-.185	.831	.609	1.133
	Peer support	.095	1.099	.771	1.567
	Relationship	.406	1.500	.867	2.596
	Role	-.068	.934	.633	1.380
	Change	-.082	.921	.572	1.484
10-15 yrs	Intercept	-8.987			
	Demand	-.077	.925	.929	1.255
	Control	-.147	.863	.758	.982
	Manager Support	-.121	.886	.735	1.067
	Peer support	-.079	.924	.756	1.128
	Relationship	.222	1.249	.930	1.676
	Role	.297	1.346	.970	1.866
	Change	-.003	.998	.727	1.369
15-20 yrs	Intercept	.119			
	Demand	-.090	.993	.985	1.215
	Control	-.080	.923	.834	1.021
	Manager Support	-.096	.908	.794	1.039
	Peer support	.023	1.023	.877	1.194
	Relationship	.070	1.072	.892	1.288
	Role	-.073	.930	.788	1.098
	Change	-.007	.993	.790	1.247
20-25 yrs	Intercept	2.262			
	Demand	-.007	.913	.916	1.107
	Control	.013	1.013	.916	1.121
	Manager Support	-.080	.923	.811	1.050
	Peer support	-.123	.884	.770	1.016
	Relationship	.113	1.120	.931	1.348
	Role	-.089	.915	.780	1.073
	Change	.084	1.088	.877	1.349
25-30 years	Intercept	-2.925			
	Demand	-.046	.955	.946	1.159
	Control	-.038	.962	.872	1.063
	Manager Support	-.021	.979	.860	1.116
	Peer support	.162	1.176	1.003	1.380
	Relationship	-.018	.982	.825	1.170
	Role	-.010	.990	.830	1.181
	Change	.079	1.082	.864	1.356

Reference category 30yrs and above

Logp(experience=up to 5yrs)/ p(experience=30yrs and above)

= -13.271-0.257De-0.206Cl-0.033Ms+0.266Ps+0.194Re+0.012Rl-0.143Ch

⟶ 5.3.4.3 (1)

Logp(experience =5-10yrs / p(experience =30yrs and above)

=-7.307-0.128De-0.152Cl-0.185Ms+0.095Ps+0.406Re-0.068Rl-0.082Ch

⟶ 5.3.4.3 (2)

Logp(experience =10-15 yrs / p(experience =30yrs and above)

= -8.987-0.077De-0.147Cl-0.121Ms-0.079Ps+0.222Re+0.297Rl-0.003Ch

⟶ 5.3.4.3 (3)

Logp(experience =15-20 yrs / p(experience =30yrs and above)

= 0.119-0.090De-0.080Cl-0.096Ms+0.023Ps+0.070 Re-0.073 Rl-0.007Ch

⟶ 5.3.4.3 (4)

Logp(experience =20-25yrs / p(experience =30yrs and above)

=2.262-0.007De+0.013Cl-0.080Ms-0.123Ps+0.113Re-0.089Rl+0.084Ch

⟶ 5.3.4.3 (5)

Logp(experience =25-30yrss / p(experience =30yrs and above) =

-2.925-0.046De-0.038Co-0.021 Ms+0.162Ps-0.018Re-0.010Ro+0.079Ch

⟶ 5.3.4.3 (6)

The multinomial odds of improvement of work stress due to the unit increase variables demand, is expected to decrease among all the groups over the reference group, when all other predictor variables are held constant. Similar result is obtained for the unit increase in the variable control, and manger support for the different groups considered for the study over the reference group.

The multinomial odds of improvement in work stress due to unit increase in the variable – control is expected to increase in experience group 20-25 yrs over the reference group by a factor 1.013 and a reverse tend is noted among all other groups over the reference group (OR<1).

The multinomial odds of improvement of work stress due to unit increase of the variable - peer support is expected to increase among the groups having experience up to 5yrs,5-10yrs,,15-20yrs and 25-30yrs,over the reference group by the factors 1.035,1.099,1.023and 1.176 and a reverse trend is observed for the other groups over the reference group.

The analysis of variable–relationship, shows that the multinomial odds of improvement in work stress due to unit increase in this variable is expected to increase among the groups those who have experience up to 5yrs, 5-10yrs ,10-15yrs,15-20yrs,20-25yrs over the reference group by the factors 1.214, 1.500, 1.249, 1.072 and 1.120 respectively and a reverse trend is observed among the employees having experience of 25-30yrs over the reference group (OR<1).

The analysis of the variable - role on different experience groups shows that, the multinomial odds of improvement in work stress is expected to increase by the factors 1.012 and 1.346 for the group having

experience up to 5yrs and 10-15yrs respectively over the reference group and reverse trend is observed for the remaining groups.

The analysis of variable –change shows that, the multinomial odds of improvement in work stress due to unit increase in the variable is expected to increase by the factors 1.088 and 1.082 for the group having experience 20-25yrs and 25-30yrs respectively over the reference groups. A reverse trend is observed on other groups over the reference groups(OR<1) .

5.4 Summary of findings

In this chapter an attempt is made to develop number of stress models by using the seven factors identified for the evaluation of work stress. These variables are demand, control, and manager support, peer support, relationship, role and change. Three different methods of modelling the work stress is developed by using these factors they are 1) factor modelling 2) structural equation modelling 3) multinomial logistic regression modeling.

In factor modelling alpha method of factor analysis was used for developing the model of work stress in all the five industries selected for the study. This study is further extended to chemical and heavy engineering industries. The alpha factoring of the factors/variables in these industries yielded two factor structure for the stress model, stress- Personnel and Stress-team, where Stress-personnel (Stress-P), model includes two factors/ variables namely demand and control, meanwhile stress-team (Stress-T),have the rest of the factors/variables namely, manager support, peer support, relationship, role and change .The above models can be effectively used for evaluation of work stress.

The structural equation models were developed initially for all the selected industries and then models are developed for chemical and heavy engineering industries. These models were tested statistically to examine whether the data collected through the survey fit the model very well.

Multinomial logistic regression models were developed for the different age groups, designation levels and experience levels using the seven factors .The models are developed for all the selected industries and further it is extended to chemical and heavy engineering industries .The multinomial odds of improvement in work stress due to unit increase in each of the variable is studied .

The multinomial odds of improvement in work stress due to unit increase in the factor /variable –demand is expected to

i) Increase among engineers and supervisors over the reference group in chemical industries (OR>1),and reverse trend is noticed in heavy engineering industries.

ii) Decrease in general for all the age groups over the reference group in all the selected five industries (OR <1).

iii) Increase among 40-45 yrs age group and 15-20 yrs experience group in chemical industries and reverse trend is noticed in heavy engineering industries.

The multinomial odds of improvement in work stress due to unit increase in the factor /variable –control is expected to

i) Increase among 40-45yrs age group over the reference group in chemical industries and a reverse trend is observed in heavy engineering industries.

ii) Increase among the employees having experience 20-25yrs over the reference group in heavy engineering industries and a reverse trend is noticed in chemical industries .

iii) increase among engineers and supervisors over the reference group in all categories of industries.

The multinomial odds of improvement in work stress due to unit increase in the factor /variable –manager support is expected to

i) Increase among 30-35yrs age group in all categories of industries.

ii) Increase among all the groups having different experience considered for the study over the reference group in chemical industries ,but a reverse trend is noticed for heavy engineering industries .

iii) Increase among engineers and supervisors over the reference groups in chemical as well as heavy engineering industries .

The multinomial odds of improvement in work stress due to unit increase in the factor /variable –peer support is expected to

i) Increase among 20-25yrs age group in chemical industries and among the age groups 30-35yrs and 35-40yrs in heavy engineering industries.

ii) Increase among the engineers over the reference group in chemical as well as heavy engineering industries . Similar result was obtained for the supervisors over the workers in chemical industries ,but a reverse trend is noticed in heavy engineering industries.

The multinomial odds of improvement in work stress due to unit increase in the factor /variable –relationship is expected to

i) Increase among age groups 40-45yrs over the reference groups in all categories of industries.

ii) Increase among the employees having experience 15-20yrs in all categories of industries.

iii) Increase among supervisors over the reference group in chemical as well as heavy engineering industries ,however a reverse trend is noted for the engineers over the reference groups.

The multinomial odds of improvement in work stress due to unit increase in the factor/variable –role is expected to

- Increase among engineers over workers in chemical as well as heavy engineering industries.

The multinomial odds of improvement in work stress due to unit increase in the factor –change is expected to

i. Increase among age groups 40-45yrs over the reference group in chemical as well as heavy engineering industries.

ii. Increase among the experience groups 15-20yrs in over the reference group among chemical industries but a reverse trend is noticed in heavy engineering industries.

Chapter - 6

SUMMARY AND CONCLUSIONS

Heath and safety of the employees is becoming an important aspect in industries all over the world. Even though there are several reports indicating the existence of work related stress among the industry professionals in India but only little work has been done for the evaluation of work stress. As part of the present study seven factors have been identified for evaluating the work stress and these factors are demand, control, manager support, peer support, relationship, role and change.

Further an instrument to measure the work stress (questionnaire) was developed, based on the above seven factors. The final draft of the questionnaire had 35 items and this was prepared in two languages, English and the local language. All the questions were Likert type with five fixed alternatives .Before the analysis of the result, the questionnaire was refined and validated .During this process, five items in the questionnaire were removed and the final refined scale had only 30 items .Confirmatory factor analysis was used for the scale refinement .The values of CFI and TLI and Cronbach alpha showed that the refined scale has good validity, and unidimensionality in addition to reliability. All the analysis were performed by using the software SPSS-15

The analysis shows that ,no significant correlation exists between the variables and hence the above factors can be treated as independent factors for the purpose of research.

Five profit making public sector industries in Kerala were selected for the study. These industries were classified in to two types –namely chemical and heavy engineering, based on the type of product manufactured, for further analysis .The total number of participants in the study was 830. For the purpose of analysis the age of the employees were grouped in to seven categories namely 20-25yrs, 25-30yrs, 30-35yrs, 35-40yrs, 40-45yrs, 45-50yrs and 50-55yrs. Only three designation levels of the employees are considered,viz, engineers,supervisors and workers. Also a study is conducted by dividing the employees in to seven categories based on their experience. The different categories were having experience up to 5yrs,5-10yrs,10-15yrs,20-25yrs,25-30yrs and 30yrs and above .The effect of the factors identified were analyzed in the above groups.

Among the industries selected, three were in the chemical sector and two in the heavy engineering sector.

The analysis of mean score of the various factors on different age groups shows the existence of work stress among all age groups .Relatively higher amount of demand, low control and low manager support were observed among the 40-45yrs age group .This points out that this age group is subjected to higher work stress than other age groups. The demand –control/support model (Karasek and Theorell, 1990) suits the age group 40-45yrs.

The analysis of the mean score at various designation levels, shows that the factors leading to work stress exist at all levels. Further it is noted that lack of control exists among the workers compared to engineers and supervisors.

Analysis of mean score of the factors at different experience groups, show that, factors leading to work stress exist in all the groups .Further higher job control is noted among groups having relatively longer experience. In general it is observed that employees of 15-20 yrs of experience groups have relatively higher 'demand', low 'control' and low 'manger support', irrespective of the type of industries

The analysis of the factors was further carried out by considering the three chemical industries as one category and the two heavy engineering industries as another category. The total number of participants in the chemical industries were 554 .The sample size of engineers, supervisors and workers in the chemical industries were 48 ,77 and 429 respectively. The total number of participants in the heavy engineering industries were 276 .The sample size of the engineers, supervisors and workers in these industries were 19,29 and 228 respectively.

The analysis of factors among two categories of industries show the existence of work stress in these two categories of industries .Relatively higher amount of demand, low control and low manger support were observed among the 40-45yrs age group compared to other age groups. Lack of control was noted among lower designation levels namely workers compared to engineers and supervisors. The group with 15-20yrs of experience had relatively higher amount of work demand, low job control and low manager support at work.

Further an analysis of factors was done among the three chemical industries as well as among the two heavy engineering industries. Significant difference in the means score of the factors was observed among the chemical industries as well as among heavy engineering

industries. .The mean score of the factors point out the existence of work stress due to these factors in these industries. A comparative study between the chemical and heavy engineering industries using the same factors showed no significant difference in mean score of the factors between the two categories of industries.

Three different types of modelling of work stress was carried out.These are i) Factor modelling ii) Structural equation modelling and iii) Multinomial logistic regression modeling.

Factor modelling of work stress was carried out by means of the seven factors .Alpha method of factor analysis was used This yielded a two factor structure for work stress namely stress-personnel (Stress-P),and stress-team (Stress-T).This method of modeling is further extended to chemical and heavy engineering industries. The software used for this analysis was SPSS-15

Structural equation modelling of work stress was done by using the seven factors for the entire data collected from all the industries selected for study by means of confirmatory factor analysis .This yielded two components for the work stress namely stress-personnel (Stress-P),and stress-team (Stress-T). Further separate structural equation models were developed for chemical and heavy engineering industries.

The above structural equation models were tested statistically by using, the following goodness of fit indices to assess the degree of fit, between the model and sample.

i) Normed χ^2 (between 1 and 3) (Hair et al., 1998)

ii) Normed Fit Index (NFI > 0.90 excellent)

(Byrne, 2001; Hair et al., 1998).

iii) Tucker Lewis Index (TLI > 0.90 acceptable, > 0.95 excellent) (Tucker and Lewis, 1973)

iv) Comparative Fit Index (CFI >0.90 acceptable,>0.95 excellent) (Benter , 1990; Bentler and Bonnet, 1980)

v) Root Mean Square Error of Approximation (RMSEA<0.08 acceptable, <0.05 excellent) (Brown and Cudeck, 1998)

vi) Standard Root Mean Square Residual (SRMR <0.05 excellent) Hu and Bentler, 1995)

The values obtained for NFI, CFI, and TLI, Normed χ^2, RMSEA, SRMR were found to be well with in the acceptable limit. Hence it can be concluded that the structural equation models are equally good in representing the work stress. The modelling was done by using AMOS-7 (Arbuckle, 2006).

Multinomial logistic regression models were developed for the different age groups, designation levels and experience levels using the seven factors.The models were developed for all the selected industries and further it is extended to chemical and heavy engineering industries separately.The multinomial odds of improvement in work stress due to unit increase in each of the variable is studied .

The multinomial odds of improvement in work stress due to unit increase in the factor /variable –demand is expected to

i) Increase among engineers and supervisors over the reference group in chemical industries (OR>1),and reverse trend is noticed in heavy engineering industries.

ii) Decrease in general for all the age groups over the reference group in all the selected five industries (OR <1).

iii) Increase among 40-45 yrs age group and 15-20 yrs experience group in chemical industries and reverse trend is noticed in heavy engineering industries.

The multinomial odds of improvement in work stress due to unit increase in the factor /variable –control is expected to

i) Increase among 40-45yrs age group over the reference group in chemical industries, and a reverse trend is observed in heavy engineering industries.

ii) Increase among the employees having experience 20-25yrs over the reference group in heavy engineering industries and a reverse trend is noticed in chemical industries

iii) Increase among engineers and supervisors over the reference group in all categories of industries

The multinomial odds of improvement in work stress due to unit increase in the factor /variable –manager support is expected to

i) Increase among 30-35yrs age group in all categories of industries

ii) Increase among all the groups having different experience levels considered for the study over the reference group in chemical industries, but a reverse trend is noticed for heavy engineering industries.

iii) Increase among engineers and supervisors over the reference groups in chemical as well as heavy engineering industries

The multinomial odds of improvement in work stress due to unit increase in the factor /variable –peer support is expected to

i) Increase among 20-25yrs age group in chemical industries and among the age groups 30-35yrs and 35-40yrs in heavy engineering industries

ii) Increase among the engineers over the reference group in chemical as well as heavy engineering industries . Similar result was obtained for the supervisors over the workers in chemical industries ,but a reverse trend is noticed in heavy engineering industries.

The multinomial odds of improvement in work stress due to unit increase in the factor /variable –relationship is expected to

i) Increase among age group 40-45yrs over the reference groups in all categories of industries

ii) Increase among the employees having experience 15-20yrs in all categories of industries .

iii) Increase among supervisors over the reference group in chemical as well as heavy engineering industries , however a reverse trend is noted for the engineers over the reference groups.

The multinomial odd of improvement in work stress due to unit increase in the factor/variable – role is expected to

- Increase among engineers over workers in chemical as well as heavy engineering industries .

The multinomial odds of improvement in work stress due to unit increase in the factor –change is expected to

i. Increase among age group 40-45yrs over the reference group in chemical as well as heavy engineering industries

ii. Increase among the experience group 15-20yrs over the reference group among chemical industries but a reverse trend is noticed in heavy engineering industries.

The following conclusions are drawn from the present study:

- The results of the present study indicate that work stress exists among the employees in the public sector industries in Kerala.
- The instrument developed for the evaluation of work stress by using the variables /standards, namely demand, control, manager support, peer support, relationship, role and change has validity, unidimensionality and reliability and this instrument can be effectively used for the evaluation of work stress in different types of industries.
- Relatively higher amount of demand, low control and low manager support were observed among the 40-45yrs age group , irrespective of the nature and type of industry. The demand -control/support model (Karasek and Theorell 1990), suits the age group 40-45yrs.
- It is observed that employees having 15-20 yrs of experience have relatively higher 'demand', low 'control' and low 'manger support', irrespective of the nature and type of industries. The demand –control/

support model (Karasek and Theorell 1990) suits the above experience groups.

- Lack of control was observed among lower designation levels particularly at the workers level compared to engineers and supervisors.
- The factor modelling yielded two factor structure namely stress-personnel (Stress-P) and stress - team (Stress – T) for work stress.
- The structural equation models proposed are equally good in representing the work stress in industries.
- Multinomial logistic regression models developed are also found equally good in predicting the work stress in industries.

6.1 Scope for further research

The present analysis of work stress was carried out among the employees in the public sector industries in Kerala, which leaves enough scope for further research.

i. The factors identified for the analysis of work stress can be used to analyze the work stress among male and female employees in the organization.

ii. The study can be extended further among the employees in the service sector by using the same factors identified for the evaluation of work stress.

iii. The present study is limited to selected public sector industries in Kerala, and the same factors can be used to analyze the work stress among the employees working in similar units in other states of India.

iv. The study can be extended to the private sector industries by using the same factors for the analysis of work stress.

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APPENDIX

Questionnaire to evaluate work related stress

Name of the Industry : Date :

Type of Industry :

Name of Employee :

Male ☐ Female ☐

Designation :

Department :

Age :

Experience :

Educational Qualification :

Please tick ☑ against only one appropriate answer each question in the box provided

1. I am unable to do all the work demanded by different groups

   Always ☐ Often ☐ Some times ☐

   Rarely ☐ Never ☐

2. I am unable to meet work dead lines

   Always ☐ Often ☐ Some times ☐

   Rarely ☐ Never ☐

3. I am unable to complete the jobs without putting intensive effort

   Always ☐ Often ☐ Some times ☐

   Rarely ☐ Never ☐

4. I am unable to complete the task without eliminating any, at times

   When I am loaded heavily

   Always ☐ Often ☐ Some times ☐

   Rarely ☐ Never ☐

5. I am unable to avail sufficient breaks during the work

   Always ☐ Often ☐ Some times ☐

   Rarely ☐ Never ☐

6. I am unable to do the work in a normal way when I am pressurized to work for long hours?

   Always ☐ Often ☐ Some times ☐

   Rarely ☐ Never ☐

7. I am unable to complete all the works at normal speed

   Always ☐ Often ☐ Some times ☐

   Rarely ☐ Never ☐

8. I am unable to complete the work when Iam put in unrealistic time pressures

Always ☐ Often ☐ Some times ☐

Rarely ☐ Never ☐

9. Can you decide when to take break according to your requirements?

Always ☐ Often ☐ Some times ☐

Rarely ☐ Never ☐

10. Do you have say in your own work speed?

Always ☐ Often ☐ Some times ☐

Rarely ☐ Never ☐

11. Have you got a choice in deciding how to do the work?

Always ☐ Often ☐ Some times ☐

Rarely ☐ Never ☐

12. Do you have a choice in deciding what to do the work?

Always ☐ Often ☐ Some times ☐

Rarely ☐ Never ☐

13. Do you have some say over the way you work?

Always ☐ Often ☐ Some times ☐

Rarely ☐ Never ☐

14. Do you have freedom to opt your shift duty?

Always ☐ Often ☐ Some times ☐

Rarely ☐ Never ☐

15. Do you get supportive feed back from superiors on the work you are doing?

Always ☐ Often ☐ Some times ☐

Rarely ☐ Never ☐

16. Can you rely on your superiors to help you out with a work problem?

Always ☐ Often ☐ Some times ☐

Rarely ☐ Never ☐

17. Can you communicate to superiors about some thing that has upset or annoyed you about work?

Always ☐ Often ☐ Some times ☐

Rarely ☐ Never ☐

18. Are you getting emotional support at work from superiors?

Always ☐ Often ☐ Some times ☐

Rarely ☐ Never ☐

19. Does your superior encourage you at work?

Always ☐ Often ☐ Some times ☐

Rarely ☐ Never ☐

20. Do you get help from colleagues, when the work gets difficult?

Always ☐ Often ☐ Some times ☐

Rarely ☐ Never ☐

21. Do you get always required support from colleagues?

Always ☐ Often ☐ Some times ☐

Rarely ☐ Never ☐

22. Do you receive the respect at work which you deserve from colleagues?

Always ☐ Often ☐ Some times ☐

Rarely ☐ Never ☐

23. Does your colleagues willing to listen to your work related problem?

Always ☐ Often ☐ Some times ☐

Rarely ☐ Never ☐

24. Are you able to do the work without the challenges of personal harassment in the form of unkind words or behaviour from the superiors?

Always ☐ Often ☐ Some times ☐

Rarely ☐ Never ☐

25. Are you able to do the work without friction or anger between the Colleagues

Always ☐ Often ☐ Some times ☐

Rarely ☐ Never ☐

26. Are you able to do the work without bullying from superiors?

Always ☐ Often ☐ Some times ☐

Rarely ☐ Never ☐

27. Are you able to maintain good relationship with superiors at work?

Always ☐ Often ☐ Some times ☐

Rarely ☐ Never ☐

28. Are you clear what is expected from you at work?

Always ☐ Often ☐ Some times ☐

Rarely ☐ Never ☐

29. Do you know how to go about getting your job done?

Always ☐ Often ☐ Some times ☐

Rarely ☐ Never ☐

30. Are you clear about your duties and responsibilities?

Always ☐ Often ☐ Some times ☐

Rarely ☐ Never ☐

31. Are you clear about the goals and objectives of the department?

Always ☐ Often ☐ Some times ☐

Rarely ☐ Never ☐

32. Does your work helps in achieving the overall aim of the organization?

Always ☐ Often ☐ Some times ☐

Rarely ☐ Never ☐

33. Do you have enough opportunities to lodge complaints against the changes at work?

Always ☐ Often ☐ Some times ☐

Rarely ☐ Never ☐

34. Does the staff members are consulted by the authorities about change at work?

Always ☐ Often ☐ Some times ☐

Rarely ☐ Never ☐

35. When changes are made at work, are you clear how they will work out in practice?

Always ☐ Often ☐ Some times ☐

Rarely ☐ Never ☐

Signature

Thank you for completing the questionnaire

Questionnaire to evaluate work related stress

Name of the Industry : Date :

Type of Industry :

Name of Employee :

Male ☐ Female ☐

Designation :

Department :

Age :

Experience :

Educational Qualification :

ഓരോ ചോദ്യത്തിനും താങ്കൾക്ക് ശരി എന്ന് തോന്നുന്ന ഉത്തരം മാത്രം ☑ചെയ്യുക.

1. എന്റെ സ്ഥാപനത്തിലെ വിവിധ വർക്ക് ഗ്രൂപ്പുകൾ ആവശ്യപ്പെടുന്ന എല്ലാ ജോലികളും ചെയ്തു കൊടുക്കാൻ സാധിക്കുന്നില്ല.

   എപ്പോഴും ☐ മിക്കവാറും ☐ ചിലപ്പോൾ ☐

   അപൂർവ്വമായി ☐ ഒരിക്കലുമില്ല ☐

2. എന്നെ ഏൽപിച്ചിട്ടുള്ള ജോലികൾ എല്ലാം പൂർത്തീകരിക്കാൻ സാധിക്കുന്നില്ല

   എപ്പോഴും ☐ മിക്കവാറും ☐ ചിലപ്പോൾ ☐

   അപൂർവ്വമായി ☐ ഒരിക്കലുമില്ല ☐

3. എല്ലാ ജോലികളും കഠിനമായ ശ്രമം ഇല്ലാതെ ചെയ്ത് തീർക്കാൻ കഴിയുന്നില്ല

   എപ്പോഴും ☐ മിക്കവാറും ☐ ചിലപ്പോൾ ☐

   അപൂർവ്വമായി ☐ ഒരിക്കലുമില്ല ☐

4. കൂടുതൽ ജോലി ഭാരം ഉ ാകുന്ന അവസരങ്ങളിൽ ഒന്നുപോലും ഒഴിവാക്കാതെ ചെയ്യാൻ കഴിയുന്നില്ല.

   എപ്പോഴും ☐ മിക്കവാറും ☐ ചിലപ്പോൾ ☐

   അപൂർവ്വമായി ☐ ഒരിക്കലുമില്ല ☐

5. ജോലിയിൽ ആവശ്യമായ വിശ്രമം എടുക്കാൻ സാധിക്കുന്നില്ല.

   എപ്പോഴും ☐ മിക്കവാറും ☐ ചിലപ്പോൾ ☐

   അപൂർവ്വമായി ☐ ഒരിക്കലുമില്ല ☐

6. കൂടുതൽ സമയം ജോലി ചെയ്യാൻ നിർബന്ധിക്കപ്പെടുന്ന അവസരങ്ങളിൽ എനിക്ക് അത് ശരിയായ രീതിയിൽ ചെയ്യാൻ സാധിക്കുന്നില്ല

   എപ്പോഴും ☐ മിക്കവാറും ☐ ചിലപ്പോൾ ☐

   അപൂർവ്വമായി ☐ ഒരിക്കലുമില്ല ☐

7 എല്ലാ ജോലികളും സാധാരണ വേഗതയിൽ ചെയ്ത് തീർക്കാൻ കഴിയുന്നവയല്ല

   എപ്പോഴും ☐ മിക്കവാറും ☐ ചിലപ്പോൾ ☐

   അപൂർവ്വമായി ☐ ഒരിക്കലുമില്ല ☐

8. വളരെ കുറഞ്ഞ സമയത്തിനുള്ളിൽ ജോലി പൂർത്തീകരിച്ച് കൊടുക്കാൻ ആവശ്യപ്പെടുമ്പോൾ അതിന് സാധിക്കുന്നില്ല.

   എപ്പോഴും ☐ മിക്കവാറും ☐ ചിലപ്പോൾ ☐

   അപൂർവ്വമായി ☐ ഒരിക്കലുമില്ല ☐

9. ജോലിയിൽ ആവശ്യമനുസ്സരിച്ച് വിശ്രമം എടുക്കാൻ സ്വാതന്ത്രം ഉ ാ?

   എപ്പോഴും ☐ മിക്കവാറും ☐ ചിലപ്പോൾ ☐

   അപൂർവ്വമായി ☐ ഒരിക്കലുമില്ല ☐

10. താങ്കൾ ചെയ്യുന്ന ജോലിയുടെ വേഗത താങ്കൾക്ക് തന്നെ നിശ്ചയിക്കാൻ സ്വാതന്ത്ര്യം ഉ ാ?

    എപ്പോഴും ☐ മിക്കവാറും ☐ ചിലപ്പോൾ ☐

    അപൂർവ്വമായി ☐ ഒരിക്കലുമില്ല ☐

11. ഒരു ജോലി ഒന്നിലധികം വിധത്തിൽ ചെയ്ത് തീർക്കാനുള്ള സംവിധാനം ഉ ങ്കിൽ അത് ഏത് വിധത്തിൽ ചെയ്യണമെന്ന് തീരുമാനിക്കാൻ താങ്കൾക്ക് സ്വാതന്ത്ര്യം ഉ ാ?

    എപ്പോഴും ☐ മിക്കവാറും ☐ ചിലപ്പോൾ ☐

    അപൂർവ്വമായി ☐ ഒരിക്കലുമില്ല ☐

12. ഒന്നിലധികം ജോലി താങ്കൾക്ക് ഉ ങ്കിൽ അതിൽ ഏതുജോലി എപ്പോൾ ചെയ്യണം എന്ന് തീരുമാനിക്കാൻ സ്വാതന്ത്യം ഉ ാ?

    എപ്പോഴും ☐ മിക്കവാറും ☐ ചിലപ്പോൾ ☐

    അപൂർവ്വമായി ☐ ഒരിക്കലുമില്ല ☐

13. താങ്കളുടെ ജോലി താങ്കളുടേതായ രീതിയിൽ ചെയ്ത് തീർക്കാൻ സ്വാതന്ത്ര്യം ഉ ാ?

    എപ്പോഴും ☐ മിക്കവാറും ☐ ചിലപ്പോൾ ☐

    അപൂർവ്വമായി ☐ ഒരിക്കലുമില്ല ☐

14. താങ്കൽക്ക് ഇഷ്ടമുള്ള ഷിഫ്റ്റിൽ ജോലി ചെയ്യാനുള്ള സ്വാതന്ത്ര്യം ഉ ാ?

    എപ്പോഴും ☐ മിക്കവാറും ☐ ചിലപ്പോൾ ☐

    അപൂർവ്വമായി ☐ ഒരിക്കലുമില്ല ☐

15. താങ്കൾ ചെയ്ത് കൊ ിരിക്കുന്ന ജോലിയ്ക്ക് ആനുകൂല പ്രതികരണം മേലുദ്യോഗസ്ഥരിൽ നിന്നും ലഭിക്കുന്നുേ ാ ?

എപ്പോഴും ☐ മിക്കവാറും ☐ ചിലപ്പോൾ ☐

അപൂർവ്വമായി ☐ ഒരിക്കലുമില്ല ☐

16. ജോലിയിൽ ബുദ്ധിമുട്ട് ഉ ാകുമ്പോൾ മേലുദ്യോഗസ്ഥരെ ആശ്രയിക്കാമോ ?

എപ്പോഴും ☐ മിക്കവാറും ☐ ചിലപ്പോൾ ☐

അപൂർവ്വമായി ☐ ഒരിക്കലുമില്ല ☐

17. ജോലിയെക്കുറിച്ചുള്ള ഉത്കണ്ഠകളും വിഷമങ്ങളും മേലുദ്യോഗസ്ഥരുമായി സംസാരിക്കാമോ ?

എപ്പോഴും ☐ മിക്കവാറും ☐ ചിലപ്പോൾ ☐

അപൂർവ്വമായി ☐ ഒരിക്കലുമില്ല ☐

18. വൈകാരികമായ പിന്തുണ ജോലിയിൽ മേലുദ്യോഗസ്ഥരിൽ നിന്നും ലഭിക്കാറുേ ാ?

എപ്പോഴും ☐ മിക്കവാറും ☐ ചിലപ്പോൾ ☐

അപൂർവ്വമായി ☐ ഒരിക്കലുമില്ല ☐

19. മേലുദ്യോഗസ്ഥരുടെ പ്രോത്സാഹനം താങ്കൾക്ക് ജോലിയിൽ ലഭിക്കുന്നുേ ാ?

എപ്പോഴും ☐ മിക്കവാറും ☐ ചിലപ്പോൾ ☐

അപൂർവ്വമായി ☐ ഒരിക്കലുമില്ല ☐

20. ജോലിയിൽ പ്രയാസം അനുഭവപ്പെടുമ്പോൾ സഹപ്രവർത്തകർ സഹായിക്കുന്നുേ ാ?

എപ്പോഴും ☐ മിക്കവാറും ☐ ചിലപ്പോൾ ☐

അപൂർവ്വമായി ☐ ഒരിക്കലുമില്ല ☐

21. സഹപ്രവർത്തകരിൽ നിന്നും എപ്പോഴും ആവശ്യമായ സഹായം ലഭിക്കുന്നുേ ാ?

എപ്പോഴും ☐ മിക്കവാറും ☐ ചിലപ്പോൾ ☐

അപൂർവ്വമായി ☐ ഒരിക്കലുമില്ല ☐

22. ജോലിയിൽ അർഹിക്കുന്ന ബഹുമാനം / അംഗീകാരം സഹപ്രവർത്തകരിൽ നിന്നും ലഭിക്കുന്നുേ ാ?

എപ്പോഴും ☐ മിക്കവാറും ☐ ചിലപ്പോൾ ☐

അപൂർവ്വമായി ☐ ഒരിക്കലുമില്ല ☐

23. താങ്കളുടെ ജോലി ജോലി സംബന്ധമായ പ്രശ്നങ്ങൾ സഹപ്രവർത്തകർ ശ്രദ്ധയോടെ കേൾക്കുന്നുേ ാ?

എപ്പോഴും ☐ മിക്കവാറും ☐ ചിലപ്പോൾ ☐

അപൂർവ്വമായി ☐ ഒരിക്കലുമില്ല ☐

24. മേലുദ്യോഗസ്ഥരിൽ നിന്ന് വ്യക്തിപരമായ അധിക്ഷേപങ്ങളും, പീഡനങ്ങളും ഇല്ലാതെ ജോലി ചെയ്യാൻ സാധിക്കുന്നുേ ാ ?

എപ്പോഴും ☐ മിക്കവാറും ☐ ചിലപ്പോൾ ☐

അപൂർവ്വമായി ☐ ഒരിക്കലുമില്ല ☐

25. സഹപ്രവർത്തകരോട് സംഘർഷവും ദേഷ്യവും ഇല്ലാതെ ജോലി ചെയ്യാൻ സാധിക്കുന്നുേ ാ?

എപ്പോഴും ☐ മിക്കവാറും ☐ ചിലപ്പോൾ ☐

അപൂർവ്വമായി ☐ ഒരിക്കലുമില്ല ☐

26. അധികാരികളുടെ ഭീഷണിയില്ലാതെ തന്നെ താങ്കൾക്ക് ജോലി ചെയ്യാൻ സാധിക്കുന്നുേ ാ?

എപ്പോഴും ☐ മിക്കവാറും ☐ ചിലപ്പോൾ ☐

അപൂർവ്വമായി ☐ ഒരിക്കലുമില്ല ☐

27. ജോലിയിൽ മേലുദ്യോഗസ്ഥരുമായി നല്ല വ്യക്തിബന്ധം പുലർത്താൻ സാധിക്കുന്നുേ ാ?

എപ്പോഴും ☐ മിക്കവാറും ☐ ചിലപ്പോൾ ☐

അപൂർവ്വമായി ☐ ഒരിക്കലുമില്ല ☐

28. താങ്കളുടെ ജോലിയിൽ നിന്ന് എന്താണ് മേലധികാരികൾ പ്രതീക്ഷിക്കുന്നത് എന്ന് വ്യക്തതയുേ ാ?

എപ്പോഴും ☐ മിക്കവാറും ☐ ചിലപ്പോൾ ☐

അപൂർവ്വമായി ☐ ഒരിക്കലുമില്ല ☐

29. താങ്കളുടെ ജോലി തീർക്കുന്നതിന് എന്ത് സമീപനമാണ് സ്വീകരിക്കേ ത് എന്ന് താങ്കൾക്ക് അറിയാമോ?

എപ്പോഴും ☐ മിക്കവാറും ☐ ചിലപ്പോൾ ☐

അപൂർവ്വമായി ☐ ഒരിക്കലുമില്ല ☐

30. താങ്കളുടെ കടമകളേയും ഉത്തരവാദിത്വങ്ങളെയും കുറിച്ച് വ്യക്തമായ ധാരണയുേ ാ?

എപ്പോഴും ☐ മിക്കവാറും ☐ ചിലപ്പോൾ ☐

അപൂർവ്വമായി ☐ ഒരിക്കലുമില്ല ☐

31. താങ്കളുടെ വകുപ്പിന്റെ ഉദ്ദേശലക്ഷ്യം താങ്കൾക്ക് അറിയാമോ?

എപ്പോഴും ☐ മിക്കവാറും ☐ ചിലപ്പോൾ ☐

അപൂർവ്വമായി ☐ ഒരിക്കലുമില്ല ☐

32. സ്ഥാപനത്തിന്റെ പൊതുവായ ഉദ്ദേശലക്ഷ്യങ്ങൾ കൈവരിക്കുന്നതിന് താങ്കളുടെ പ്രവർത്തി എങ്ങനെ സഹായിക്കുന്നു എന്ന് താങ്കൾക്ക് അറിയാമോ?

എപ്പോഴും ☐ മിക്കവാറും ☐ ചിലപ്പോൾ ☐

അപൂർവ്വമായി ☐ ഒരിക്കലുമില്ല ☐

33. താങ്കളുടെ ജോലിയിൽ മാറ്റങ്ങൾ വരുത്തിയാൽ അതിനെക്കുറിച്ച് അധികാരികളോട് പരാതിപ്പെടാൻ അവസരങ്ങൾ ഉ ാ?

എപ്പോഴും ☐ മിക്കവാറും ☐ ചിലപ്പോൾ ☐

അപൂർവ്വമായി ☐ ഒരിക്കലുമില്ല ☐

34. ജോലിയിൽ മാറ്റങ്ങൾ വരുത്തുന്നത് അധികാരികൾ ജീവനക്കാരുമായി ചർച്ച ചെയ്തിട്ടാണോ?

എപ്പോഴും ☐ മിക്കവാറും ☐ ചിലപ്പോൾ ☐

അപൂർവ്വമായി ☐ ഒരിക്കലുമില്ല ☐

35. ജോലിയിൽ മാറ്റങ്ങൾ വരുത്തിയാൽ അത് എങ്ങനെ ചെയ്യാം എന്നതിനെകുറിച്ച് അറിയാമോ?

എപ്പോഴും ☐ മിക്കവാറും ☐ ചിലപ്പോൾ ☐

അപൂർവ്വമായി ☐ ഒരിക്കലുമില്ല ☐

ഒപ്പ്

ഈ ചോദ്യാവലിയുമായി സഹകരിച്ചതിന് നന്ദി

CURRICULUM VITAE

Satheeh Kumar.K was born in Neyyattinkara, Thiruvanthapuram district of Kerala, India in 1963. He obtained BE degree in Mechanical Engineering from Karnataka University in 1989 and completed ME degree in Production Engineering from Faculty of Engineering and Technology , Annamalai University in 1993. He has about 20years of experience in teaching. Since 2003, he is working in Federal Institute of Science and Technology (FISAT), Angamaly, Kerala as Assistant Professor - Senior grade in the Department of Mechanical Engineering. His areas of interest include Ergonomics, Quality Management Systems, Environment Management Systems, Reliability Engineering and Quantitative techniques.

LIST OF PUBLICATIONS

1. Work Related Stress in Public Sector Industries in Kerala, India: A Factor Analysis. Communicated to Human Factors and Ergonomics in Manufacturing

2. Presented a paper entitled "Work Related Stress Causes and Effects" in the National conference on *Advanced Challenges in Mechanical Engineering* held at Erode Shengunther Engineering College, Erode, Tamil Nadu on 25-26 March 2010.

3. Presented a paper entitled "Structural Equation Modelling of Work Related Stress Factor in Selected Industries in Kerala, India" in the National seminar on *Health Safety and Environment* held at Government Engineering College, Thrissur, Kerala on 9-10 March 2010.