Maintaining TQM in a Nuclear Power Plant through Training

المحافظه على اداره شامله للجوده في محطة الطاقه النوويه من خلال التدريب

by

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Abstract

The main of the study used to identify the influence of training program outcome on the total quality management of the nuclear power plant in the UAE. Several sub-variables were identified to ease the process of reaching the research objective. For the purposes of this objective, a quantitative methodology was used. A five-point Likert Scale questionnaire was developed and distributed to the employees of Emirates Nuclear Energy Corporation (ENEC). The sample selection was done purposively with the questionnaire being distributed to five different levels of Management. Data analysis was carried out using the SPSS software. Results indicate that there is a general strong correlation between the training program outcome and the total quality management of the nuclear power plant in the UAE. Results for each of the sub-variable are presented and systematically discussed. Regression analysis was also carried out and a predictive model was developed for the relationship between the dependent and independent sub-variables. It was seen that almost all of the independent sub-variables had and influence on the dependent sub-variable, Knowledge Assets. Furthermore, One-Way ANOVA was carried out and the results of this test showed significant differences between the management groups.

البحث خلاصة

الهدف الرئيسي لهذه الدراسة هو تحديد الأثر أو الآثار لبرامج التدريب على إدارة الجودة في محطة الطاقة النووية في دولة الإمارات. تم تحديد بضعة من المتغيرات لأغراض هذا البحث. تم اللجوء إلى استخدام الطريقة الكمية في هذه الدراسة. كما تم القيام بإعداد استبيان طبقا لمقياس "لكرت" ذو الخمسة نقاط ومن ثم توزيعها على موظفي مؤسسة الإمارات للطاقة النووية. تم اختيار عينة الموظفين من خمسة مستويات مختلفة في الإدارة ووزع عليهم الاستبيان. تم القيام بتحليل النتائج باستخدام برنامج SPSS. تشير التحاليل إلى وجود علاقة قوية بين برامج التدريب وإدارة الجودة في محطة الطاقة النووية في الإمارات. تم استعراض النتائج المعنية بكل متغير ومناقشتها بتسلسل منظم. كما تم القيام بتحليل الانحدار وتطوير نموذج يربط بين المتغيرات الثابتة وغير الثابتة. تبين من خلال النتائج أن جميع المتغيرات الثابتة تقريبا لها تأثير على المتغيرات غير الثابتة. كما تم القيام باختبار One-way ANOVA وتشير النتائج إلى وجود فروقات محورية بين أقسام الإدارة.

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Introduction

1.1. Study Background and Research Context

According to INPO (2014), nuclear power plants are one of the most complex organisations in the world. They are also classified as high-reliability organisations because they have very few incidents relative to the nature of their work and the accidents that do occur cause harm on a wider scale. The splitting of uranium atoms is what generated nuclear energy. This method is also called fission. Fission produces a lot of heat to generate steam. This steam is used to power the turbine generator which in turn makes electricity. Due to the fact that nuclear power plants don't consume fuel, they don't produce greenhouse gas and hence supply clean and eco-friendly energy. A nuclear reactor can work for 24 hours a day, and supply energy to the population in a safe and reliable manner. This is the reason for it becoming one of the most in-demand energy solving needs. Additionally, because there are no carbon or greenhouse gas emissions, nuclear energy can change the future.

Barakah nuclear power plant is the UAE's first nuclear power station. The construction for this start ed in the year 2012, and it is set to begin operations in 2020. The world is changing its locus to get clean energy from a nuclear reactor to protect the environment and reduce the effects of Global Warming that are taking place. Today, there are 35 countries that have successfully established a nuclear energy industry in their country. However, while there are several benefits to nuclear energy, even a small failure in the nuclear power plant can cause devastating effects on the environment. This can be evident with the accidents like Chernobyl in 1986 and Fukushima in 2011 which caused economic, health and environmental is**sue**s as a result of radiation.

The harmful consequences of the breakdown of one nuclear power plant in Chernobyl can still be observed now. The region **enco**mpassing the plant remains to be an isolation region due to radiation levels which are very are high and make the area inhabitable. Further recently, the Fukushima incident that took place in 2011 in Japan, the nuclear meltdown happened due to an earthquake and the following Tsunami. This incident led to a huge relocation of 100,000 people and more who were residents in the area surrounding the plant (World Nuclear Association, 2017). Frank Von Hippel (2011) postulated that there would be in excess of 1,000 deathsWindscale from the radiation which was leaked after the power plant failure.

The radiation leak that happens does not cause issues only in the health but also can impact the environment and the economy of a country. Leadership and the general safety culture of the nuclear power plant plays an important role in the management of safety in a nuclear power plant.

However, there has been no identification of how a training program can influence the total quality management of a nuclear power plant to ensure that the operations of the plant are efficient. The role of every single employee is critical and more so in a high-risk organisation to ensure that the workforce is maintaining the total quality management in order to prevent any accidents or nuclear power plant failures. Overall, in a nuclear power plant, safety should be, and the workforce must be well acquainted in the skills, knowledge, and requirements.

1.2. Research Objectives and Questions

The primary research question that this study is trying to answer is whether there is an influence of training program outcome on the total quality management of a nuclear power plant. In order to elucidate the primary research question, the following are the research objectives:

- To identify the factors which influence the training program outcomes
- To identify the factors which influence the total quality management
- To develop a conceptual model for the relationship between the training program outcome and the total quality management
- To establish an empirical relationship between the training program outcome and the total quality management in UAE's nuclear power plant.

The following are the research questions that have guided the study:

1. What are the factors which influence the effectiveness of a training program?
2. What are the factors which define total quality management in a nuclear power plant?
3. Is there a relationship between the training program outcome and the total quality management of a nuclear power plant?

1.3. Research Rationale

The UAE’s nuclear power industry is only just emerging. The very first nuclear power plant is being developed in the country, and this serves as an impetus to ensure that there are no incidents that take place in the UAE. Incidents in the nuclear power industry are rare, but they can have devastating effects ranging to loss of millions in revenue, the instant death, radiation exposure and mass relocations. In essence, there is a strong motivation to prevent any incidents from happening in the first place. For this to be ensured, there needs to be total quality management in the organisation that manages and runs the nuclear power plant. In addition, according to the principles of Weick and Sutcliffe (2011), high-reliability organisations such as nuclear power plants are able to stay clear of accidents and incidents by having a preoccupation with safety. Thereby to ensure that there is a strong safety culture in the organisation and that there is sufficient development of robust total quality management in the nuclear power plant. Weick and Sutcliffe stated that there is an increased emphasis by high-reliability organisations in an effort to improve the overall resilience of the nuclear power plant's operations. In essence, there needs to be mindfulness created in the organisation. This also means that there needs to be a better creating of the workforce in the nuclear power plant who engage in continuous professional development, are mindful of the risks and benefits of harnessing nuclear power, and creating a conducive environment with a wide range of diverse workforce. Therefore, this study is driven by the need to establish a relationship between the training programs that are provided as a routine of working in a nuclear power plant and the total quality management of the organisation. In the absence of a similar study conducted before, this study has a novel nature.

1.4. Structure of the Dissertation

- ***Chapter 1:*** Introduction- This study is comprised of five chapters beginning with an introduction to the topic under study. This involves a brief about the nuclear power industry in the UAE.

- ***Chapter 2:*** Literature review- The second chapter gives a literature review of the various studies that have been conducted in the past with respect to the objectives that the study intends to establish. This chapter also allows the development of the conceptual model of what the research is guided by.
- ***Chapter 3:*** Research Methodology The chapter indicates the techniques that the researcher uses in the collection of data for the research process. In the case of this study, the investigator will use questionnaires in the collection of data
- ***Chapter 4:*** The chapters offers a summary of the obtained findings and interprets the findings in relation to existing literature outlined in chapter 2 of the study.
- ***Chapter 5:*** Conclusions, recommendations and limitations. The chapter details the general conclusion of the findings. The conclusions give way for the formulation of recommendations both practical and theoretical on areas for further studies development in the future. The limitations of this study are also addressed.

Literature Review

2.1. Introduction

This chapter explores the importance of safety training and the challenges that are faced in providing training to nuclear power plant personnel. In a nuclear power plant, traditional safety drills cannot be carried out due to the sensitive and radioactive nature of the operations. However, human factor has been identified as the primary issue in the escalation of accidents in the nuclear facilities like in the case of Fukushima Daiichi in Japan, the Three Mile Island in the USA and the Chernobyl incident in the Soviet. In such a scenario, imparting procedural knowledge is important, and hence, there needs to be a good training program that needs to be provided to the operators to avoid human errors as much as possible. This chapter also explores just what went wrong in the Fukushima Daiichi Power plant and provides an insight into what the post-Fukushima policy changes have been in Japan since then. This chapter also provides an overview of the factors which influence training program outcome and its resultant effects on the performance of the nuclear power plant.

2.2. Safety Training

The nature and complexity of tasks have been on the rise in the professional environment. Personnel training used to be focused on learning only the most important and necessary skills to complete the job; however, now the focus has shifted towards the improvement of team effectiveness and enhancement of individual capabilities (Noe, Clarke, & Klein, 2014). It was suggested by Salas and Cannon-Bowers (2001) that the transformation to more enhanced training means is due to the increasing understanding of organisational psychology, human factors, and exposure for better design and development techniques. The researchers also state that the transformation has also happened due to the increased development of new, interactive theoretical models and tools. According to Bell, Tannebaum, Ford, Noe, and Kraiger (2017), there is a long-standing assumption that the team or individual performance undergoes a change with new knowledge or skills. This improvement thereby affects the performance of the unit or the individual in the work environment.

Personnel training can also significantly improve the financial performance of the organisation as well as the rate of customer satisfaction (Kim & Ployhart, 2014). Safety training goes beyond that and ensures that there are no accidents and incidents which can also affect the financial performance of the organisation. However, nuclear safety training is vastly different from any other safety training (Joyce, 2018). Joyce also stated that this is due to the fact that nuclear safety is different from any other safety regime simply due to the fact that of the extremely low frequency of the incidents and the relatively larger impact of the incidents. The social upheaval and the economic cost of a nuclear accident will be far larger than any other sector even if the individual recorded incidents will be infinitesimally smaller. Training achieves a better financial performance of a nuclear power plant due to the fact that employees perform with greater efficiency, which leads to a lower downtime and reduced refuelling outages thereby enhancing the safety records (Leclair, 2013). According to Leclair, in addition to worker training, managerial training is also important due to the fact that the managers are consistently dealing with the day-to-day work issues as well as the management of a highly regulated nuclear organisation. In addition, there is also a need to provide appropriate safety training to the supplemental staff in addition to the plant personnel.

There are some notable nuclear accidents in the nature of the Chernobyl incident, the Three Mile Island incident, and the Fukushima incident. Wahlström (2018) argues that these accidents are caused by "simple misses and oversights in safety precautions". It was stated by Carroll (1998) that the low rate of organisational learning is an important contributor to the higher rate of incidents. In light of this, Drupsteen and Guldenmund (2014) have placed emphasis on how learning can be achieved from incidents and accidents. In learning from the Chernobyl and the Three Mile Island incidents, it was identified that human factors were the primary cause of the escalation of the incident into a disaster (IAEA, 1993).

According to Silva, Legey, and Mol (2018), training in the past used to happen with physical copies of the nuclear power plant control desks which had the same presentation and layout as the real ones. However, these physical copies were not practical, and hence there was a need for better training protocols.

2.1. Simulator Training

Simulator training is used in a number of industries and sectors from medical to aviation. In the nuclear energy sector, it is even more relevant due to the fact that almost none of the drills can be enacted in the traditional manner due to the sensitive nature of nuclear energy. In such a scenario, simulator training becomes essential for the operators to learn how to act in various emergency situations thereby increasing the emergency response and preparedness. IAEA (1993) identified the need for implementing the simulator training to increase safety and reliability in the face of the fact that most of the minor incidents escalated into major ones due to human errors. Incorrect maintenance procedure and erroneous practices have led to the trigger of several safety programs in the past. IAEA has identified several issues in the training of safety personnel that can be the root cause for a nuclear power plant shutdown and release of radioactive material into the environment. Inadequate initial training and continuing training of the nuclear personnel is the primary reason for the escalation of accidents. In addition to that, an insufficient safety culture is also to blame. Personnel overconfidence, technology interface issues, lack of appropriate management, leadership and procedures are also causes of a nuclear accident.

According to IAEA (1993), the simulator training needs to be provided to the Control Room Personnel, Assistants to Control Room Personnel, the Management Personnel, the technical and operations staff, and the vendor's commissioning staff. IAEA also identified that the person must be specially trained for stressful tasks, complicated tasks, sensitive or critical tasks, and infrequent tasks. In the case of a minor incident, there is a high likelihood that alarms will be blaring a number of instructions will be received by the personnel. It is, therefore, important to remember the sequence of steps that need to be taken in order to prevent a catastrophe. Such situations cause a lot of stress, and it can lead to erroneous practices. Hence, simulator training in this scenario can be really helpful. According to IAEA, there are several components of a nuclear power plant that requires complex knowledge and set of skills to impart that knowledge. In such a scenario also, simulator training is an essential tool.

As noted by Mol (2011), the importance of simulator training is also seen when the operators are trained in situations that would otherwise cause radioactive exposure and not be safe. Conducting a normal training drill in this scenario is not only unpractical but extremely dangerous. Here, the virtual reality or simulator technology can become an immersive tool that is interactive which provides a first-hand experience without the individual being present. According to Silva, Legey, and Mol (2018), virtual training is the only way to simulate the situations that are too dangerous to replicate in real life such as the presence of fire, smoke or radioactive substance in the nuclear power plant. Even an emergency shutdown and procedures relating to that can be simulated using virtual reality to gauge the emergency preparedness of the operations and other personnel.

There are several approaches, methods and technologies that are suggested by researchers. For example, the researchers Silva, Legey and Mol (2018) suggested that using a virtual reality simulation can provide a rather reliable way of counting the bubbles (bubbles are used for radiological detection and hence are very important).

IAEA (1993) has provided three major training objectives: skill-based, procedure-based, and knowledge-based. It has suggested that skill-based training is wrong and should not be carried out in responsible nuclear power plant operations. Providing the example of a stressful situation, IAEA suggested that there is an operator is reacting based on skill and not appropriate procedure, the containment of the incident can be difficult. If an operator is supposed to react in a responsible and more importantly, in an accurate manner, the operator must know the correct procedure to perform in stressful situations. The simulator training must be so extensive that the procedure becomes second nature to the operator and hence, regardless of the pressure, the operator must perform the write operations.

In terms of the procedure-based training, the entry, as well as the exit requirements, must be taught to the operator and other personnel. In essence, the operator should know what he is doing right and what he is doing wrong in order to allow for rectifications of his behaviour. In terms of knowledge-based training, certain complicated tasks or procedures can be too complex to be of any understanding to the operator. In such a case, repetition is the best way to achieve a complete memory imprint in the minds of the personnel. In essence, skill-based training is not only unhelpful but also can lead to escalations of the minor accident into a major one. Procedure-based training followed by knowledge-based training are the best objectives to strive for in nuclear power plant emergency preparedness training. Regardless of the type of task, the operator needs to be in a position of attention, concentration, calmness, and show clear judgment even in the case of infrequent tasks. Creating experience for the tasks is more important than creating knowledge or skill in order to limit human errors and contain the incident. Simulators come in handy due to the real nature of the simulation while being far removed from the actual hazardous conditions of a nuclear emergency situation. The following section will detail the types of simulations that are available and recommended for use by IAEA (1993).

2.2.Types of Simulations

IAEA recommended three types of simulators and their uses all of which were outlined by the need to have a high fidelity to the nuclear power plant being simulated. Every simulator needed to be customized and designed for use in a particular nuclear power plant as every nuclear power plant had a different interface.

Full Scope Simulators

According to the IAEA guideline released in 1993, the full scope simulator is a simulator that replicates the main control room of the nuclear power plant and allows for a real time decision making process. Essentially, it simulates the nuclear steam supply as well as the balance of plant systems including nuclear, service, conventional, and safety. It needs to be based on a reference plant thereby allowing for a customized solution. Full scope simulators are to be used in the cases of highly developed nuclear technology for the preliminary as well as continuous training of technical staff and shift personnel.

According to IAEA (2004), full scope control room simulators are increasingly used in almost all nuclear plants during even the commissioning phase. These full scope simulators need to be plant specific to manage the negative impact of non-specific or generic nuclear power plant simulator. In recent times, full scope simulators are identified for their increased efficiency and are touted as the most realistic means to impart real time training and hands-on experience to the operators which would not be possible in conventional training methods or means. According to the IAEA, results of analysis in Ukraine and The Russian Federation revealed that there are operator errors which are contributing to operational risk. In light of this, the only way to safely and securely reduce such operator errors is using the full scope simulators. In addition, these full scope simulators have been accepted generally as the best tool there is to “dynamically validate” the correctness of symptom based emergency operating procedures. In addition, they are used to provide validation for testing the normal operating procedures, conducting engineering studies, and train other plant personnel. The report outlined that the three most important factors that improve the safety of the nuclear power plant are full scope simulators, safety parameter displays and symptom-based emergency operating procedures.

IAEA (1993) stressed on the importance of building a plant specific full scope control room replication as the familiarity with the control panel and the “mental picture” that is obtained during the training serve as real advantages in an emergency situation. In addition to simulating the control room, full scope simulators are also used for emergency control room simulations and local operation simulations (IAEA, 2004).

Basic Principle Simulator

According to IAEA (1993) report, the basic principle simulator is used for the demonstration of the basic underlying principles of the processes of the nuclear power plant. This simulator provides a primary understanding of the main operation modes. This simulator serves as an essential basic simulator to visualize the lessons learned in a classroom environment. Systems knowledge, for example, is provided via basic principle simulator and builds upon the knowledge gained in a conventional training method. IAEA (2004) has outlined the training objectives for basic principle simulator and they include: to allow personnel to self-study the concepts gained in the classroom environment, to identify the primary thermohydraulic principles and other physical occurrence or phenomenon, to develop sound theoretical concepts in order to save time during the full scope simulator training, and to provide an overall overview of the plant behavior and gain a basic understanding of the main operational modes.

Part Scope Simulator

This type of simulator provides real time and hands-on learning for a specific part of the nuclear power plant (IAEA, 1993). In the IAEA (2004) report, the part scope simulators are referred to as Other Than Full Scope Control Room Simulators that have the primary objective to help operators understand the plant dynamics and develop specific skills to test the emergency procedure in non-lethal or safe manner. In addition, this simulator is also used in providing essential skills to the learner with reference to a non-accident and regular operating procedure of a specific part of the plant process. Furthermore, the part scope simulators as well as the basic principle simulators are essential tools for the development of procedure awareness.

In addition to the above three simulators outlined in the IAEA (1993) report, the IAEA (2004) report provides another simulator called the Severe Accident Simulator. This simulator is used for training the technical support engineers, the Emergency Response team, the Accident Management Team as well as the MCR personnel. The objective of this training is to provide training on how to perform practical emergency exercises and to develop a comprehensive understanding of the physical occurrences and their impact on the nuclear power plant.

To conclude, the full scope simulators are in the use of essential importance in providing hand-on and real time training to the nuclear power plant operators of the control room and the emergency control room. In cases where the objective is to provide a preliminary awareness or understanding of the processes of the nuclear power plant procedure, the basic principle simulator and the part scope simulator can be used. In addition, the IAEA (2004) noted that the Line Managers are of paramount importance when it comes to the identification of the simulator training needs in the operators or their teams. The Line Managers are also involved in the training observation and overlook the performance of the staff. Simulator training is the most effective method in the nuclear power plant's arsenal to ensure that there is a reduced human factors intervention in the case of an accident. Simulator training is not only provided for the operators and technical staff, but also to the other non-technical personnel, managers, field operators, contractual personnel and technical support personnel. Nuclear power plant specific simulation is of utmost importance in the delivery of effective training and the building of essential skills in the trained personnel.

2.3. Factors Affecting Training

It has already been confirmed that there is an importance placed on training programs in a nuclear power plant as a way of producing a safety climate. However, there are several factors which affect the effectiveness of a training program. Some of the factors which were identified by Burke and Hitchins (2010) were motivation to learn or motivation for self-improvement, self-efficacy, and perceived utility, among others which had a strong influence on the training program outcome. Several other factors were also identified by the authors who had a moderate or weak impact on training program outcome included organisational commitment, extroversion of the individual, extrinsic motivation, and local of control.

2.3.1. Motivation for self-improvement

Several studies have recognised that there is a direct link between the motivation to learn or self-improve and positive training program outcome. Most notably, the study carried out by Chiaburu and Marinova (2005) found that the motivation to learn before the training program was undertaken led to a positive result after the training program was completed.

They also found that the intensity of the motivation also affected the training program outcome. In addition, Noe (1986) also found that there was a positive influence of motivation to learn to the training program's effectiveness. Another study Heine et al. (2001) found that in cultures where self-improvement was valued, the individuals displayed a better performance on the training program.

2.3.2. Self-Efficacy

Bandura (1982) defined self-efficacy as the measure of how well an individual thinks he/she can carry out an action that is required of him/her. The author also stated that a higher self-perception of efficacy leads to a better performance. In addition, it was found by Stajkovic and Luthans (1998) that people with higher perceptions of self-efficacy performed better at complex tasks and situations. Cheng and Ho (2001) stated that a higher perception of self-efficacy affects motivation to learn which in turn affects the training outcome. Burke and Hitchins (2010) also found a strong relationship between self-efficacy and positive training transfer. Quin˜ones (1997) showed a strong correlation between the training outcome, training motivation and the individual’s perception of self-efficacy.

However, Bandura (1982) also noted a negative effect of high self-perceptions of efficacy in learning environments as that meant that there was a lack of acceptance to new information that was provided in learning environments.

2.3.3. Training Framing or Awareness

Hicks and Klimoski (1987) had noted that the training program’s outcome was directly related to individuals understanding in clear terms the objectives and outcomes of the training being provided. In addition, Baldwin and Magjuka (1991) stated that the trainees, who were aware of the realistic outcomes and objectives of the training program before the training program began, were more motivated to learn as opposed to trainees who weren't provided with any such awareness. Tai (2004) also found empirical evidence that being aware of the training materials and intended outcomes of the training program, led the participants of the survey to be more motivated, have a higher perception of self-efficacy and thereby affect the training outcome positively.

Kahneman & Tversky (1979) carried out a study which found that the training framing had the effect of changing the training program outcome. For example, if the training framing and awareness were created about 'loss' of monetary outcomes, the participants also accounted for loss. This shows that training framing can also affect trainees' decision-making process.

2.3.4. Ethnic Diversity

The primary aspect of ethnic diversity can be found in language and cultural barriers. The language difficulty, however, is one of the major detrimental aspects of having a multinational workforce in an organisation (Forbes, 2011). According to Forbes, language barriers not only affect training program outcomes but also affect the general productivity levels of the organisation. A case study conducted in Kuwait with regards to e-learning by Ali and Magalhaes (2008) found that one of the major barriers to the efficient transfer of new information was a language barrier brought on by the diversity of the workforce in the organisation. The issue happened when the training was mostly in English while the workforce was a predominant Arabic speaker. This not only affected the training and learning outcome but also affected employee performance as effective skills and knowledge were not transferred.

It was noted by Tamimi and Sebastianelli (1998) that a lack of appropriate training was one of the key barriers to achieving TQM across the organisation.

2.4. Total Quality Management

According to Ross (1999), Total Quality Management (TQM) refers to the process of integrating all the processes and functions of that organisation to ensure that there is a consistent enhancement of the quality of the services provided by the organisation in an attempt to achieve maximum customer satisfaction. The author noted the findings of another prominent author in TQM, Juran, whose ten steps to building TQM are:

- Creating awareness
- Setting improvement goals
- Promoting the meeting of those goals
- Providing training
- Solving problems
- Progress reporting
- Providing recognition
- Communicating results
- Keeping score of the changes
- Maintaining the momentum

In addition to the above, Crosby (1979) also stated the importance of supervisor training or the development of knowledge assets an essential aspect of TQM. Gatchalian (1979) also stated that people empowerment, communication and social awareness are key aspects of achieving success in

2.5. Fukushima, Japan: A Case Study

Japan is a nation that is prone to earthquakes and resultant tsunamis. According to data provided by the World Nuclear Agency (2018), Japan needs to import around 90%of its energy requirements from the outside world. The first commercial nuclear power plant was established in 1966, and since then Japan has placed an important focus on furthering the energy output from nuclear energy. However, the first research into Nuclear energy for Japan started in 1954, and the Japanese Atomic Energy Commission (JAEC) was established after two years. Due to the lack of minerals and oil in Japan, nuclear energy and industrialisation is a huge aspect of its history and future.

There are with reference to 42 reactors in Japan which can be operated with only 5 power plants with 8 reactors operational (JAIF, 2018). The first nuclear power plant of Japan to provide electricity was operational during 1963-1976 which was a boiling water reactor. According to the World Nuclear Agency (2018), this plant provided a large amount of information with reference to the operational and decommissioning requirements of a nuclear power plant.

2.4.1 The Fukushima Daiichi Disaster

During early 2011, the Tohoku earthquake caused the emergency shutdown of the Fukushima Daiichi nuclear power plant according to the incident analysis report released by TEPCO (2012). While the earthquake caused the shutdown and the loss of power in the areas where electricity was supplied by Fukushima units, the real damage to the nuclear power plant was caused by the tsunami that was caused by the earthquake. The report released by TEPCO states that the water entered Fukushima Daiichi and started the chain of events that eventually led to the radioactive substance being released into the atmosphere and prompted the mass evacuation.

After an in-depth analysis of the accident, the report released by TEPCO (2012) seems to suggest that the accident was surely started by two natural disasters, but escalated due to human factors. Even though it's a well-known fact that Japan has a high seismic activity, the plant was not designed to be earthquake or tsunami safe. However, more than that, the report points towards an insufficient training and development of the nuclear power plant personnel. This was seen in the lack of preparedness and creative ideas that the personnel used to try and subvert the disaster. In addition, the safety culture was not established to the maximum where the decision making did not follow a clear hierarchy as it should especially in the case of an emergency. Due to the lack of anticipation of such a calamity occurring, the training of the personnel was not sufficient and up to the standards as it should have been. The human factors contributed to making the disaster a scale 7 nuclear emergency and created mass hysteria regarding nuclear power. In addition, the Fukushima plant did not have a training simulator, and the training was provided in a generalised manner and not specific to an accident occurring. Here, it can be stipulated that there was a general lack of appropriate training that was provided and which is the primary reason apart from the natural disaster that the Fukushima Daiichi nuclear plant failed and caused a massive release of a radioactive substance into the surrounding areas.

2.5.1. Post-Fukushima Changes

In 2012, Japan established the Japan Nuclear Safety Institute (JANSI) with the sole aim to prevent any further nuclear disasters in the nature of the Fukushima Daiichi Plant. The organisation is not affiliated to any nuclear plant operator and stands alone while providing training and safety in an effort to build capability in the nuclear power plant. There are several programs that JANSI offers in an effort to achieve its aim: the Safety system improvement program, the Nuclear facility peer review program, the OE information utilisation program, the human resource development program, the integrated assessment system program for the nuclear power station, the Support program, and the Infrastructure strengthening program. Each of the program and sub-program related to safety culture and training will be discussed in the following sections (JANSI, n.d.):

Safety System Implementation Program

In this program, the primary focus is on the development of risk management expertise and human resource development. It first assesses the safety measures of the nuclear power plant and then suggests improvement of the safety measures. In addition, this program entails the personal ability reinforcement and risk information utilisation. The primary objective of this program is the development of a culture of continuous, voluntary pursuit of excellence.

Nuclear facility peer review program

In addition to examining the operations of nuclear power plants and reactors, this program also examines the soundness of the safety culture and recommends improvements. Several specific areas are reviewed by the team such as Organization and Administration, Operating Excellence, Operations, Emergency Preparedness, Maintenance, Training and Qualification, Radiation Protection, Chemistry, Fire Protection, and Engineering Support.

Human Resource Development Program

In this program, there are two sub-specialities: Leadership training and Operation Supervisor qualification system. In the Leadership training, due to the major issues in the lack of efficient leadership apparent at the Fukushima plant, there are trainings provided at every rung of the management. The training is achieved via seminars and trainings that are designed to provide skills on responsibility, risk management, and administration issues.

In the Operations Supervisor qualification system, it assesses the qualifications of the operations supervisor and manages the skill certification system.

Integrated Assessment System Program for Nuclear Power Station

This program provides incentives to the nuclear power plant personnel when they undertake voluntary skill enhancement training. This program provides support to the operator's improvement initiatives and activities. The aim of this program is to encourage the operators to seek further advancements in their skills and expertise. The incentives provided are moral in terms of awards and honours, as well as fiscal in nature in the nature of the reward. Negative incentives are also a part of this to further motivate the personnel to undergo training in the nature of embarrassment and fiscal penalty.

Support Program

There are several subprograms in this program in the nature of support for nuclear facilities, support for independent maintenance activities, fostering safety culture, and assisting in the nuclear disaster prevention and emergency response.

In the first subprogram, it provides a contact point which is often a senior JANSI representative for the enhancement of the safety activities of the nuclear plant. Creating a collaborative culture of coordination and information sharing, this program aims to develop a strong safety culture. The second subprogram, the support for independent maintenance activities is designed to provide support to the nuclear power plant to enhance its human performance and augment its quality management system. There are several trainings and support that this program provides to the nuclear power plant which directly enhances the human factors.

The fostering safety subprogram provides seminars, lectures and other programs for the training of personnel. It provides e-learning and traditional learning educational material to enhance passive knowledge on a number of safety-related issues and leadership development.

The final subprogram of this program is the assisting nuclear disaster prevention and emergency response. In addition to providing simulator training, several other efforts are undertaken to develop an effective emergency response. It also provides support for the designing and implementation of specialised emergency trainings. Furthermore, it encourages and provides support to operators seeking to increase their emergency response as part of voluntary training. They also arrange visits to other operators in various nuclear facilities to provide an observatory learning experience and an opportunity to analyse their own internal training effectiveness.

Despite all of the above efforts, recently, the Japan Times (2016) reported that a review by IAEA (International Atomic Energy Agency) stated that while the safety measures had become more stringent in Japan, there was still a significant room for improvement. The inspection frequency and depth also needed to be increased. The report stated that Japan's inspectors need to be trained in the USA. The report also stated that the IAEA asked Japan to develop better training programs and develop safety research and collaboration in the country as well as gain data from outside the country. Two alarming finds of the review were that there are only 150 safety inspectors in Japan as opposed to 1,000 inspectors in the USA and that the Japanese inspectors receive only a two-week training course where the USA inspectors are trained for 2 years.

Since the review, there has been an increase in the training and development activities in Japan (IAEA, 2017). IAEA has established an IAES Capacity Building Centre in Japan which provides training courses that focus on enhancing the emergency preparedness and response.

To conclude, despite the negative effects of nuclear in the history of Japan (in the nature of the destruction of Hiroshima and Nagasaki using atomic bombs) and the 2011

Fukushima Daiichi nuclear disaster, there is a drive in Japan to increase the emergency preparedness and response to prevent such an accident from occurring again. It has established JANSI which provides a range of support services and help to the nuclear facilities so that they may operate without any disasters taking place. Japan is a place of higher seismic activity which leads to earthquakes and tsunamis. In light of this, Japan's safety training program needs to be further bolstered so that a human factors error cannot cause another calamity in Japan.

2.6. Chapter Conclusion

The Fukushima Daiichi accident was a disaster on a scale similar to the Chernobyl incident. It is well known that the Chernobyl accident was in part due to poor design and in part due to human factors. While the Fukushima Daiichi accident was started due to a natural calamity -- and the plant was not well build to counter such a calamity even in the known fact that Japan is prone to earthquakes and tsunamis -- it was escalated to a level 7 nuclear emergency due to insufficient internal action to contain the nuclear radiation. Due to the Japanese culture of team decision making rather than singular decision making, there was no clear chain of command during the incident. When the seawater breached the wall and came in, there was a lot of creative thinking that was used by the operators to maintain control of the plant as was reported by the incident analysis report released by the plant operator TEPCO.

Post-Fukushima, Japan's nuclear scene did see the application of better training and leadership policies as is seen with the establishment of the JANSI which provides specialised training and support to the nuclear facilities located across the country. The amount of nuclear accidents is far less compared to safety accidents in say, the construction industry. However, in other industries the incidents are limited to a select few individuals, in nuclear, the scale of the accidents are large and span hundreds of thousands of kilometres. No doubt this can have a detrimental effect on the health of the mass population due to radiation poisoning as well as cause strain on a country's economic condition as well. There can be no nuclear power plant that is fully automated with the technology we have now. Humans, in the form of nuclear power plant personnel, in various positions will be present for a long time to come. In light of this, the training needs to be robust enough that there is no discrepancy in the actions of the personnel in what to do and when so that future nuclear calamities can be prevented. The several factors that affect training need to be taken into account when developing a training program.

For example, some of the factors identified in the above discussion are motivated to learn and improve the skills, perception of self-efficacy, training framing, and ethnic diversity. It is important to consider that the above factors are not mutually exclusive and are interdependent on one another. It was found that there is a strong relation of training motivation on the training program's outcome. In turn, training motivation is affected by high self-perceptions of self-efficacy as well as training framing or awareness. The perceived utility or value of the training program is an essential aspect of the training framing and can lead to increased motivation as well as increased self-efficacy which can increase training knowledge transfer. In addition, language barriers are seen to influence the training program outcomes in a multinational organisation negatively. Finally, these factors which affect training program outcome can also be seen to influence the performance of the company measured as TQM. Training is one of the core elements of a successful TQM process and when applied to the nuclear industry context, focuses on creating environmental awareness, social awareness, and building good technological and knowledge-based capabilities in the personnel.

Research Methodology

This chapter provides an overview of the strategies and methods that a researcher can use to ensure that the research objectives of the study are met. Firstly, the various approaches that are available for a researcher to use are discussed in this chapter. Then, the reliability and validity of the research instrument are also discussed. Ethical considerations, which form a major part of the research, are also touched upon in this chapter briefly. This chapter also provides a basis for data collection and analysis as well as in-depth discussion on the various research methodologies is provided in this chapter.

3.1. Research Philosophy

The Research Philosophy is a set of assumptions that help the researcher in the development of a concept concerning a specific topic (Creswell, 2013). The benefit of ascribing to a research philosophy is to render the research process scientific. There are various types of philosophies that are used in research. However, the most prominent ones are pragmatism, interpretivism, relativism, realism, and positivism.

In the context of this study, the most suitable research philosophical approach is positivism. The aim of this research is to understand how TQM is maintained in a nuclear power plant in the UAE through training. For the purposes of the objective of this research, the best method would be positivist philosophy. The key feature of this philosophy is that it allows the researcher to act in an unbiased and highly objective manner, which means that, the researcher collects data in the form of objective, quantifiable data. In this type of research methodology, the researcher is not involved with the participants in particular.

3.2. Research Strategy

Research Strategy is defined by Saunders (2012) as the manner in which the investigator searches for the answer to his or her research question. According to Denzin and Lincoln (2011), the two primary means of data collection are through qualitative and quantitative means.

3.3. Data Collection

This study employs both the primary and the secondary data sources in the course of establishing the relationship between training program outcome and TQM of the NUCLEAR POWER PLANT in UAE. Saunders (2012) defines primary data sources for the data that is collected for the first time, and the primary purpose of the data is to be used in the research process. On the contrary, secondary data is collected by different people, and the data serves different purposes rather than answering the research questions that are being investigated. Secondary data mostly are found in the form of journals, books, and articles, and they can be reused in answering different research questions.

In this study, both the primary and the secondary sources are used in the collection of data for the study. This has an advantage for the study since it helps in overcoming the challenges that come along as a result of the use of a source of data. Furthermore, in a research process, the two sources of data serve as a compliment for each other. The secondary data in this study are used in the identification of the factors that affect the dependent variable of this study which is the TQM of the Nuclear Power Plant. Thus, the secondary data will be used for purposes of developing the argument that the researcher aims at investigating. (Saunders 2012).

Questionnaires are used for purposes of collection of primary data in this study. The data obtained through this means is quantitative in nature as it makes uses of statistical procedures. Quantitative data is mainly used so as to be able to determine the relationship that exists between the various aspects of the topic under study. This is done by performing correlations and the regressions of the independent and the dependent variables. The distribution of the questionnaires is one of the most challenging aspects of data collection. This is due to the time that is taken in the distribution and the eventual collection of the questionnaires. The risk of a low response rate is an equally high challenge. Consequently, the study sued the available technology platforms to distribute its questionnaire. This was through the Survey Monkey platform. In this regard, the questionnaire was uploaded online and the URL link sent out to all the potential respondents under the defined sample base. As such, this allowed for the ease of distribution as the researcher was able to send out questionnaires to a majority of the respondents within a short period of time. Equally, due to the online filling convenience, and the allowance to fill in parts and saving drafts, the respondents were able to fill the entire questionnaire. This ensured that although the questionnaire had a significant number of questions, all of them were responded to within the offered response period.

3.4. Data Sources

The primary sources of data used in the collection of data are secondary and the primary data sources. Such sources increase on the reliability that the results obtained from the field and literature may have in a given situation (Bamberger 2008). In this study, the secondary sources of data used are both offline and online. The sources used in the collection of data on the factors affecting TQM of the Nuclear Power Plant in the UAE are highly reputable sources. Questionnaires are used in the collection of primary data by use of participants that are employed with the nuclear power plant and undergo continuous training as part of the work. Therefore, these people served as the best source of primary data.

The use of questionnaires in this study led to various pro to the researcher such as investigator being able to deliver them to all the respondents under study. In addition, the use of questionnaires is more economical as compared to other sources of collection of primary data as they save on both times that is spent in the field interviewing people and money. The questionnaires were made up of closed-ended questions. This type of questionnaires was adopted as a way of conservation of time that the researcher was required to spend on the field. In this case, was made of a five-point Likert scale.

3.5. Data Validity and Reliability

According to Creswell (2013) reliability is defined as the act of one coming up with results are same under similar conditions. However, validity refers to the credibility that is involved in the entire research process and the data collected for the study.

On the other hand, reliability is seen as the consistency that is needed in any measure that is used in either psychometrics or statistics. If a measure results in similar results under circumstances that are the same then reliability is termed as being high (Bhattacherjee, 2012). In this study, the reliability of the data that is used in the determination of average correlation and the internal consistency is measured by use of the Cronbach's alpha that ranges between figures 1 and 0. If the values of the coefficient are higher, it gives an implication that the consistency that occurs among the items in the group is at a high level also. According to Greener (2008), if the value of Cronbach's alpha that is obtained in a study is above 0.7, then the data will be acceptable, and if it is below the figure, then there will be need of questioning the data and the data collection instrument.

3.6. Data Analysis

First, the researcher will be required to convert the data into statistical forms as the study incorporates quantitative data. This will be done so that the researcher is able to grasp the various implications of the data that is obtained. The scrutiny of the data collected will be done with the help of the SPSS version 25 software. Muijs (2004) posit that the use of SPSS software assists in the process of analysis of the data collected by the use of questionnaires. Presentation of the data will be done by the use of graphs, charts, and tables. The main aim of using this form of presentation is to make it easier for one to interpret the data.

Furthermore, the data is represented in an arithmetical manner with the aim of making them be easy for the conversion of the figures into statistical forms. The process entails both describing and making a summary of the data obtained from the research process. In addition, the relationship that exists between the independent and the dependent variable of this study will be established through performing of a correlation. Furthermore, the multiple regression analysis will be conducted. One-Way ANOVA will also be conducted for the data and the sample groups.

3.7. Limitations of the Methodology

The primary study limitation is its use of closed-ended questionnaires. In this regard, although the questions allow for response uniformity, they do not provide for the expression of additional opinions. In this case, the respondents are required to fill in their responses based on the offered study question responses. On the other hand, the use of open-ended questions would have allowed the involved experts to contribute by offering their own opinions and experiences effectively. In order to mitigate this limitation, the study uses the five-point Likert scale. This is a scale that provides an opportunity for the respondents to gauge which response level fits their opinions, instead of the traditional yes or no questions.

3.8. Ethical Issues

The researcher started by introducing the topic, objectives and the instructions that the study involved the participants via the questionnaire. This was done with the primary purpose of ensuring that no deception was present in the process of data collection but also in the entire process of carrying out the study (Kimmel 2009). As a result, the conclusions that are drawn from the data are credible in nature.

The respondents were asked not to indicate their names on the questionnaires as there was a need for protection of the identity of the respondents and there was a need for maintenance of confidentiality in the entire study. The study had no harm to the respondents, and hence the researcher was not supposed to give the respondents any physical protection. In relation to the secondary data obtained, the researcher ensured that there was proper referencing of the data so as to avoid the use of inaccurate information.

Chapter 4: Findings and Analysis

The questionnaire was administered to a purposive sample group of 6o individuals consisting of Directors, Senior Managers, Section Heads, Engineers and Management Executives. The sample size for each of the individuals is provided below:

Table 1: Sample Group

Group	Sample Size (N)
Directors	10
Senior Managers	10
Section Heads	10
Engineers	20
Management Executives	10
Total	**60**

The study identified four sub-independent variables for the primary independent variable Training Program Outcome and four sub-dependent variables for the primary dependent variable TQM of Nuclear Power Plant.

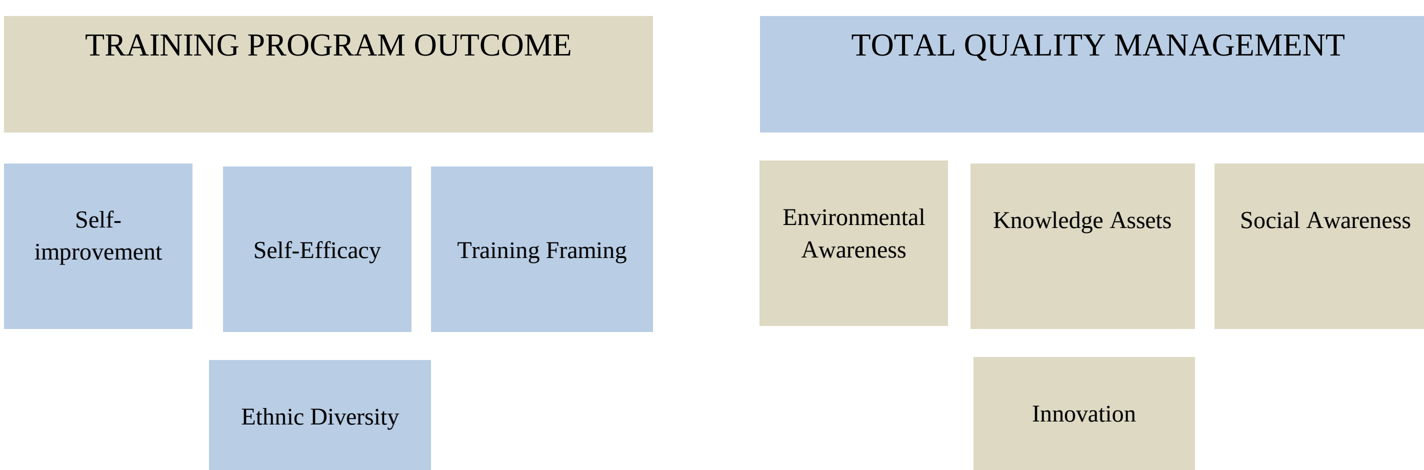

Figure 1: Conceptual Model

The results were collected for the above sample using the online software Survey Monkey, and the results were analysed using the software SPSS. The following sections outline the tests conducted and the results obtained.

4.1. Reliability Testing

Internal consistency is an important measure in any research instrument. It is also known as reliability. Reliability is important because it helps us understand if an item on a questionnaire or a scale measures the same thing. The most common instrument to measure the reliability of internal consistency is the Cronbach's Alpha. The ideal Cronbach's Alpha value is supposed to be above 70%. However, a value between 60 or 70% is also accepted.

To judge the reliability of the research instrument, Cronbach's Alpha test was conducted. The Cronbach's Alpha value was 0.76, which is well at the ideal level and hence, the instrument was considered valid.

Moving forward, the following tests were conducted: Correlation, Regression and ANOVA. The following section outlines the results gained from these tests.

4.2. Correlation

Correlation test is an important measure of the relationship between any two variables. There are two types of correlation: Pearson and spearman

The most common test, however, is the Pearson's correlation. Every correlation test is measured using the statistical significance of $p = 0.05$. The significance value less than standard p is considered to be statistically significant. If a value is greater than $p = 0.05$, then the correlation is considered to be non-significant. The significance can be measured using one tailed or two tailed tests. The one-tailed test is the measure of correlation between two variables in one direction. On the other hand, the two-tailed test measures of correlation in both directions. The correlation is always measured in a linear fashion between any two given variables.

Thus in accordance with the above, Pearson's 2-tailed correlation was conducted on the variables, and the results are tabulated below:

Table 2: Pearson's Correlations for the dependent and independent variables

		Environmental_Awareness	Knowledge_Assets	Social_Awareness	Innovation
Self_Improvement	Pearson Correlation	.216	.370**	.318*	.121
	Sig. (2-tailed)	.097	.004	.013	.356
	N	60	60	60	60
Self_Efficacy	Pearson Correlation	-.258*	-.318*	-.134	-.163
	Sig. (2-tailed)	.046	.013	.308	.212
	N	60	60	60	60
Training_Framing	Pearson Correlation	.463**	.516**	.095	.072

	Sig. (2-tailed)	.000	.000	.471	.583
	N	60	60	60	60
Ethnic_Diversity	Pearson Correlation	-.153	-.322*	-.227	.091
	Sig. (2-tailed)	.242	.012	.080	.491
	N	60	60	60	60

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

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

As can be seen from the above table 2, independent sub-variable, Self-improvement has a significant correlation with the dependent sub-variable, Knowledge Assets. The significance is strong at p = 0.004. As was noted by Noe, Clarke, & Klein, (2014) that in order to maintain safety consideration in a nuclear power plant, the focus has shifted from having only the necessary skills to gaining a wider knowledge base and improving one's capabilities. Salas and Cannon-Bowers (2001) stated that due to advancements in our understanding of organisational philosophy and human factors that impact safety in a nuclear power plant there is an increased focus on increasing the capabilities of the employees. Results of the study suggest that the increased focus on self-improvement can lead to better knowledge assets creation in a nuclear power plant. Therefore it can be said that when individuals have a higher self-improvement drive, they can accumulate knowledge faster and in a better way. This can have positive effects on a nuclear power plant setting. In addition, if an individual wants to improve himself, then they might come out of the training program having learnt and gathered essential knowledge as well as professional development.

Self-Improvement also has a significant correlation with Social Awareness with p = 0.013. The nuclear power industry in the UAE is an emerging field. Thus, there is no local talent or expertise in this area. Therefore it is important for a nuclear power plant in the UAE to bring in knowledge and other assets from International sources. More specifically the nuclear power plant of U A E comprises of a diverse workforce that has International roots. In order to create a collaborative environment communication that flows through is very important. In the presence of various languages and attitudes having a high Social awareness become important. The results show a positive correlation between self-improvement and social awareness which means that with an increase in self-improvement drive of an individual that can be improvements in his interaction with other multicultural individuals.

However, there is a non-significant correlation between self-improvement and Environmental Awareness as well as Innovation. Non-significant correlation between self-improvement and environmental awareness can be explained by the fact that environmental awareness is almost a second nature to the employees of a nuclear power plant. This could be because of the nature of the power plant itself as well as the benefit it aims to create. For example the positive impact of a nuclear power plant is widely known to general society even if they are not employees of a nuclear power plant. The same could be said about the negative impacts of the nuclear power plant in terms of safety incidents. In terms of innovation, the lack of correlation between Innovation and self-improvement can be explained by the fact that a nuclear power plant follows strict protocols. Therefore there really is no scope for innovative problem solving or creativity. INPO (2014) has stated that a nuclear power plant is a very complex organisation. This complexity is what ensures that the energy of the atom is harnessed in a safe and reliable manner. Having an innovative atmosphere, he is not conducive to a nuclear power plant. Therefore these results or not only justified but also expected.

With respect to the independent sub-variable Self-Efficacy, there is a significant correlation of $p = 0.046$ with Environmental Awareness and of $p = 0.013$ with Knowledge Assets. There was a non-significant correlation of Self-Efficacy with Social Awareness as well as with Innovation. In the study self-efficacy is essentially the self-perception of an individual’s capabilities. The results showed a positive correlation between self-efficacy and environmental awareness. This could suggest that based on the self-perception of an individual's self-efficacy, he/she may have a higher or lower environmental awareness. However, more interesting is the positive correlation between self-efficacy and knowledge assets. What the result depicts is that with a possible increase in the perception of self-efficacy of an individual, acquisition of knowledge and skills might increase. These results are in accordance with the study that was conducted by Bandura (1982) who stated that higher self-perception of self-efficacy created a better performance in an individual. In addition, it was also found by Stajkovic and Luthans (1998) that a greater self-perception of efficacy helps and individually perform better in a highly complicated environment and jobs. The amount of self-efficacy also leads to far higher motivation to learn which in turn can increase the acquisition of knowledge.

Training Framing or being aware of the goals and objectives of a training program showed a highly significant and strong correlation to Environmental Awareness and Knowledge Assets at the value of $\alpha = 0.000$ for both the dependent sub-variables. There was a non-significant correlation between Training Framing and Social Awareness as well as Innovation. The positive correlation of training framing on environmental awareness can be explained by the fact that being aware of the training is going to provide insight into the impact of a nuclear power plant on the environment, then the individual undergoing the training program will learn more about environmental awareness and related issues. In addition, the strong correlation between training framing and knowledge assets is of particular interest. In essence, being aware of what is going to be taught or learnt in the training program increases knowledge acquisition. Baldwin and Magjuka (1991) stated that individuals who are aware of the objectives of the training program outcome motivated to learn and gain knowledge. Therefore it can also be stated that training framing leads to better motivation to learn which in turn enhances the knowledge acquisition of an individual. Tai (2004) also found the same results where training framing leads to positive training outcome.

Finally, the fourth independent sub-variable, Ethnic Diversity, only has a significant correlation with Knowledge Assets and had a non-significant correlation with the other three dependent sub-variables. Ethnic diversity has a strong positive correlation with knowledge assets. Reason for this could be that the organisational culture creates an atmosphere of learning and professional development due to a competitive international workforce.

While the correlation analysis provided some great insight into the data collected, there are limitations to this method. Correlation only provides a relationship between the two variables, but it does not represent the cause. In other words, it can be said that change in any two variables subsequently could be related, but that does not mean that a change in one certainly causes a change in the other. Even if two variables behave similarly, it cannot be conclusively argued that the dependent variable is causing the change in the independent variable. Therefore to establish the nature of the relationship between the two variables the study needs to go beyond correlation analysis and onto regression analysis conducting a regression analysis will lend robustness to the study and analysis. With the above results in mind, a Multiple Regression Analysis was carried, and the results are presented below.

4.3. Multiple Regression Analysis

The multiple regression analysis he is a crucial test which allows us to determine the nature of the relationship between the independent and the dependent variables. Essentially, regression analysis will help us understand how much change is caused in the dependent variable, that is, how much is the dependent variable influenced by a unit change in the independent variable. It is essential to note that in the case of a non-significant correlation the regression also will be non-significant. Therefore correlation analysis and regression analysis go hand in hand. For the study since most of the correlations was significant regression analysis was carried out on the variables. Multiple Regression Analysis was carried out to conclude if changes in the independent variable produced a significant change in the dependent variable. This test was conducted by keeping every sub-dependent variable fixed per the test.

Dependent Sub-Variable: Environmental Awareness

The first Multiple Regression Test was carried out for the fixed dependent sub-variable of Environmental Awareness with the fixed independent sub-variables of Self-Improvement, Self-Efficacy, Training Framing and Ethnic Diversity. The results are presented below.

Table 3: Model Summary of Regression Analysis for Environmental Awareness

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics: R Square Change	F Change	df1	df2	Sig. F Change
1	.506[a]	.256	.202	.22476	.256	4.726		5	.002

a. Predictors: (Constant), Ethnic_Diversity, Self_Efficacy, Training_Framing, Self_Improvement

The above table shows and the value of R = 50.6% which suggests a moderate relationship between the variables. Since this value suggests the strength of the relationship between the variables, we can assume that the model developed in this study is a relatively good predictor of the outcome. Furthermore, the R^2 = 25.6% suggests that only 25.6%of the variances can be explained by the predictors of this model.

The next Analysis of Variance table provides more insight into the significance of our results.

Table 4: Analysis of Variance Table for Environmental Awareness

ANOVA[a]

Model	Sum of Squares	df	Mean Square	F	Sig.
Regression	.955	4	.239	4.726	.002[b]
Residual	2.778	55	.051		
Total	3.733	59			

a. Dependent Variable: Environmental_Awareness

b. Predictors: (Constant), Ethnic_Diversity, Self_Efficacy, Training_Framing, Self_Improvement

From the above table, it can be seen that the regression model is significant with an $\alpha = 0.02$ which is less than the desired 0.05. Therefore, it can be said the regression model significantly predicts Environmental Awareness, $F(4, 55) = 4.726$, $p = 0.002$.

Table 5: Beta Coefficients Table for Environmental Awareness

Coefficients[a]

Model	Unstandardized Coefficients		Standardized Coefficients		
	B	Std. Error	Beta	T	Sig.
(Constant)	2.662	.295		9.014	.000
Self_Improvement	.022	.035	.086	.642	.524
Self_Efficacy	-.025	.022	-.150	-1.137	.261
Training_Framing	.139	.041	.413	3.354	.001
Ethnic_Diversity	-.013	.034	-.045	-.369	.714

a. Dependent Variable: Environmental_Awareness

While the overall regression model shows a significant result, Training Framing significantly contributes to the model (B = 0.139, p = 0.001) while the other predictors do not. Following the above table, a statistic model of regression for the dependent sub-variable Environmental Awareness is represented by the below equation:

Environmental Awareness = 2.662 + (0.22) * Self-Improvement + (-0.25) * Self-Efficacy + (0.139) * Training Framing + (-0.013) * Ethnic Diversity

The regression model presented above clearly depicts a positive relationship between self-improvement, self-efficacy, training framing, and environmental awareness. This equation also shows what's the value of environmental awareness will be, that is, how much influence will self-improvement, self-efficacy, training framing and ethnic diversity will have on environmental awareness. For example, for every unit increase in self-improvement, there will be an increase in environmental awareness by a factor of 0.22.

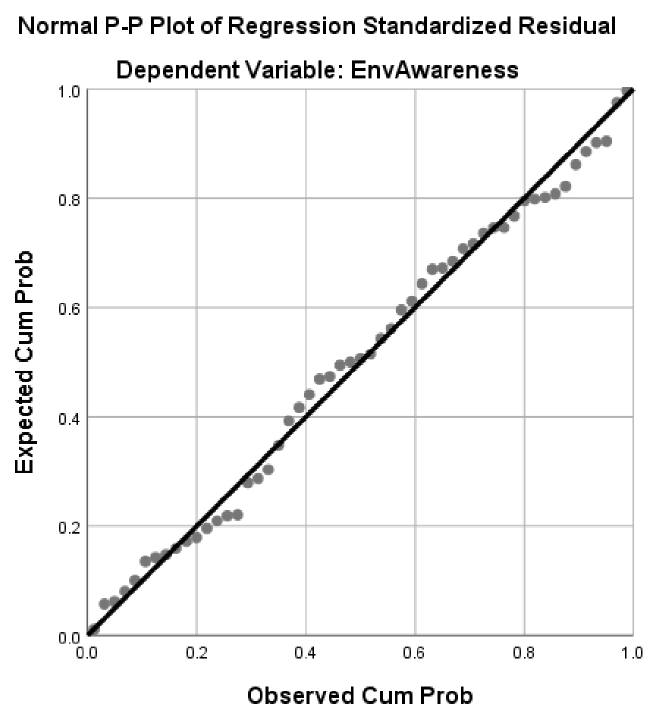

Figure 2: Normal P-P Plot of Regression Standardized Residual for Environmental Awareness

The above figure 1 shows that the data generally follows the straight line. The linear relationship is thus satisfied, and the normality of the data can be accepted. In addition, this also means that the above developed regression model is accurate and can be accepted as reliable.

Dependent Sub-Variable: Knowledge Assets

Moving on, the nest regression analysis was carried out for the dependent sub-variable, Knowledge Assets with the following predictors: Self-Improvement, Self-Efficacy, Training Framing, and Ethnic Diversity.

Table 6: Model Summary for Regression with Knowledge Assets

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	.648[a]	.420	.378	.67210	.420	9.965		5	.000

a. Predictors: (Constant), Ethnic_Diversity, Self_Efficacy, Training_Framing, Self_Improvement

The above table depicts the value of R = 64.8% which suggests a strong relationship between the dependent sub-variable and the predictors. Furthermore, the R^2 = 42.0% suggests that 42% of the variances in the value of Knowledge Assets can be explained via this regression model. The Analysis of Variance table below shows a highly significant regression model for this variable.

Table 7: Analysis of Variance Table for Knowledge Assets

ANOVA[a]

Model	Sum of Squares	df	Mean Square	F	Sig.
Regression	18.006	4	4.501	9.965	.000[b]
Residual	24.844	55	.452		
Total	42.850	59			

a. Dependent Variable: Knowledge_Assets

b. Predictors: (Constant), Ethnic_Diversity, Self_Efficacy, Training_Framing, Self_Improvement

From the above table, it can be seen that the regression model is highly significant with a p = 0.000 which is less than the desired 0.05. Therefore, it can be said the regression model significantly predicts Knowledge Assets, F (4, 55) = 9.965, p = 0.000.

Table 8: Beta Coefficients Table for Knowledge Assets

Coefficients[a]

Model	Unstandardized Coefficients B	Unstandardized Coefficients Std. Error	Standardised Coefficients Beta	T	Sig.
(Constant)	2.233	.883		2.529	.014
Self_Improvement	.250	.103	.286	2.413	.019
Self_Efficacy	-.061	.066	-.109	-.933	.355
Training_Framing	.443	.124	.389	3.575	.001
Ethnic_Diversity	-.231	.102	-.246	-2.266	.027

a. Dependent Variable: Knowledge_Assets

The above table represents a detailed view of which predictor affects Knowledge Assets. It can be seen that Self-Improvement (B = 0.25, p = 0.019), Training Framing (B = 0.443, p = 0.001) and Ethnic Diversity (B = -0.231, p = 0.027) all have significant contributions to the regression model. On the other hand, Self-Efficacy has a non-significant influence on the regression model (B = -0.061, p = 0.355). In accordance with the above results, the following predictive model for Knowledge Assets is developed:

Knowledge Assets: 2.233 + (0.25) * Self-Improvement + (-0.61) * Self-Efficacy + (0.443) * Training Framing + (0.231) * Ethnic Diversity

The above predictive model for knowledge effects shows the impact of self-improvement, self-efficacy, training framing and ethnic diversity on Knowledge assets. For example, with a unit increase in self-improvement, there will be an increase in knowledge assets by a factor of 0.25. Similarly, a unit increase in training framing will call an increase in knowledge assets by 0.443. A unit increase in ethnic diversity, on the other hand, will increase knowledge assets by 0.231.

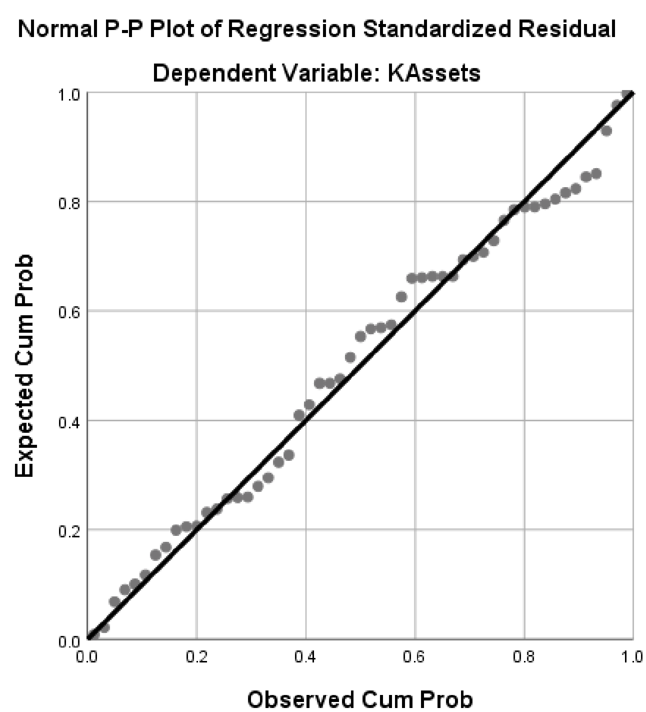

Figure 3: Normal P - P Plotof Regression Standardized Residual for Knowledge Assets

The above figure 2 depicts the data following a generally straight line which means that the linear relationship and the normality can be assumed. Thereafter, the regression model can be accepted as reliable and valid.

Dependent Sub-Variable: Social Awareness

Multiple Regression Analysis was carried out for the dependent sub-variable Social Awareness and the standard predictors. The R = 0.419, shows that there is a moderate relationship between the variable and the predictors. The low R^2 = 17.5 shows that only 17.5% of the variance in Social Awareness can be explained by the predictors of this model.

Table 9: Model Summary of Regression for Social Awareness

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	.419[a]	.175	.116	.93032	.175	2.927		5	.029

a. Predictors: (Constant), Ethnic_Diversity, Self_Efficacy, Training_Framing, Self_Improvement

The following Analysis of Variance table shows that the regression model is a significant predictor of the dependent sub-variable Social Awareness F (4, 55) = 2.927, p = 0.029.

Table 10: Analysis of Variance Table for Social Awareness

ANOVA[a]

Model	Sum of Squares	df	Mean Square	F	Sig.
Regression	10.131	4	2.533	2.927	.029[b]
Residual	47.602	55	.865		
Total	57.733	59			

a. Dependent Variable: Social_Awareness

b. Predictors: (Constant), Ethnic_Diversity, Self_Efficacy, Training_Framing, Self_Improvement

The following coefficients table shows that while the overall regression model is significant, only predictors Self-improvement (B = 0.386, p = 0.009) and Ethnic Diversity (B

= -0.308, p = 0.033) significantly predict the variable Social Awareness. The other two predictors have a non-significant result.

Table 11: Coefficients Table for Social Awareness

Coefficients[a]

Model	Unstandardized Coefficients		Standardised Coefficients		
	B	Std. Error	Beta	t	Sig.
(Constant)	4.897	1.222		4.007	.000
Self_Improvement	.386	.143	.381	2.699	.009
Self_Efficacy	.035	.091	.054	.389	.699
Training_Framing	-.042	.172	-.032	-.247	.806
Ethnic_Diversity	-.308	.141	-.283	-2.189	.033

a. Dependent Variable: Social_Awareness

In line with the above, the below predictive model is representative of the relationship between Social Awareness and Self-Improvement, Self-Efficacy, Training Framing, and Ethnic Diversity:

Social Awareness = 4.897 + (0.386) * Self-Improvement + (0.035) * Self-Efficacy + (-0.042) * Training Framing + (-0.308) * Ethnic Diversity

The predictive model for social awareness shows that for a unit increase in self-improvement, there will be an increase in social awareness by a factor of 0.386. Similarly, a unit increase in self-efficacy will increase Social awareness by a factor of 0.035.

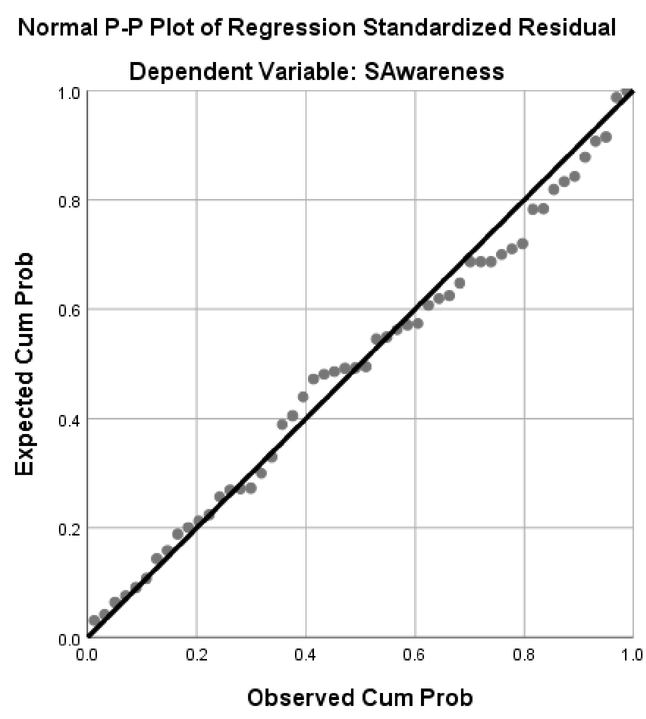

Figure 4: Normal P -P Plot of Regression Standardized Residual for Social Awareness

The above graph in Figure 3 depicts that there is an overall linearity and normality of the data and hence, the regression model that has been developed above can be accepted as being acceptable.

Dependent Sub-Variable: Innovation

The below table shows that the value of R = 20.8% is low and the R^2 = 4.3% shows that only a very low 4.3% of the variance in Innovation can be explained by this regression model.

Table 12: Model Summary of Regression Analysis for Innovation

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	.208[a]	.043	-.026	1.33462	.043	.622		5	.649

a. Predictors: (Constant), Ethnic_Diversity, Self_Efficacy, Training_Framing, Self_Improvement

Furthermore, the below Analysis of Variance table indicates that this regression model is non-significant with p = 0.679 which is greater than the desired 0.05.

Table 13: Analysis of Variance for Innovation

ANOVA[a]

Model	Sum of Squares	df	Mean Square	F	Sig.
Regression	4.434	4	1.108	.622	.649[b]
Residual	97.966	55	1.781		
Total	102.400	59			

a. Dependent Variable: Innovation

b. Predictors: (Constant), Ethnic_Diversity, Self_Efficacy, Training_Framing, Self_Improvement

The non-significant regression of innovation and the independent variable is expected as there was no correlation as well. As has been stated above, nuclear power plant does not have the scope for Innovation and innovative practices. Therefore it can be stated that a lack of significant regression is a positive result when it comes to the dependent variable innovation in the context of a nuclear power plant.

4.4. One-Way ANOVA

One way ANOVA is an important tool to test the differences between the responses of the two groups and determine if the difference is statistically significant. This test turns measures if there is a difference in the mean between the groups for the dependent variable. The study was carried out on a sample of employees from UAE's Nuclear power plant that consisted of five management groups: Directors, Senior Managers, Section Heads, Engineers, and Officers.

One-Way ANOVA was carried out to test if there was a significant difference between the various sample groups. The following result was generated:

Table 14: One-Way ANOVA for Multiple Groups Comparison

ANOVA

		Sum of Squares	f	Mean Square	F	Sig.
Environmental_Awareness	Between Groups	1.333		.333	7.639	.000
	Within Groups	2.400	5	.044		
	Total	3.733	9			
Knowledge_Assets	Between Groups	37.064		9.266	88.073	.000

	Within Groups	5.786	5	.105		
	Total	42.850	9			
Social_Awareness	Between Groups	15.416		3.854	5.009	.002
	Within Groups	42.318	5	.769		
	Total	57.733	9			
Innovation	Between Groups	91.755		22.939	118.513	.000
	Within Groups	10.645	5	.194		
	Total	102.400	9			

As can be seen from the table, the variation between the groups is highly significant as all the values for the dependent sub-variables are below p = 0.005. Following these results, the Tukey’s post hoc test was conducted, and the following results were generated:

Table 15: Tukey's Test

Multiple Comparisons

Tukey HSD

Dependent Variable	(I) Group	(J) Group	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
Environmental_Awareness	Directors	Senior Managers	.00000	.09598	1.000	-.2707	.2707
		Section Heads	.00000	.09389	1.000	-.2648	.2648
		Engineers	.00000	.08385	1.000	-.2365	.2365
		Management Exec	-.40000*	.09598	.001	-.6707	-.1293
	Senior Managers	Directors	.00000	.09598	1.000	-.2707	.2707
		Section Heads	.00000	.09127	1.000	-.2574	.2574
		Engineers	.00000	.08090	1.000	-.2282	.2282
		Management Exec	-.40000*	.09342	.001	-.6635	-.1365
	Section Heads	Directors	.00000	.09389	1.000	-.2648	.2648
		Senior Managers	.00000	.09127	1.000	-.2574	.2574
		Engineers	.00000	.07841	1.000	-.2212	.2212
		Management Exec	-.40000*	.09127	.000	-.6574	-.1426

	Engineers	Directors	.00000	.08385	1.000	-.2365	.2365
		Senior Managers	.00000	.08090	1.000	-.2282	.2282
		Section Heads	.00000	.07841	1.000	-.2212	.2212
		Management Exec	-.40000*	.08090	.000	-.6282	-.1718
	Management Exec	Directors	.40000*	.09598	.001	.1293	.6707
		Senior Managers	.40000*	.09342	.001	.1365	.6635
		Section Heads	.40000*	.09127	.000	.1426	.6574
		Engineers	.40000*	.08090	.000	.1718	.6282
Knowledge_Assets	Directors	Senior Managers	-.20000	.14903	.667	-.6203	.2203
		Section Heads	-.18182	.14579	.724	-.5930	.2293
		Engineers	-.05000	.13019	.995	-.4172	.3172
		Management Exec	-2.20000*	.14903	.000	-2.6203	-1.7797
	Senior Managers	Directors	.20000	.14903	.667	-.2203	.6203
		Section Heads	.01818	.14172	1.000	-.3815	.4179

		Engineers	.15000	.12562	.755	-.2043	.5043
		Management Exec	-2.00000*	.14506	.000	-2.4091	-1.5909
	Section Heads	Directors	.18182	.14579	.724	-.2293	.5930
		Senior Managers	-.01818	.14172	1.000	-.4179	.3815
		Engineers	.13182	.12176	.815	-.2116	.4752
		Management Exec	-2.01818*	.14172	.000	-2.4179	-1.6185
	Engineers	Directors	.05000	.13019	.995	-.3172	.4172
		Senior Managers	-.15000	.12562	.755	-.5043	.2043
		Section Heads	-.13182	.12176	.815	-.4752	.2116
		Management Exec	-2.15000*	.12562	.000	-2.5043	-1.7957
	Management Exec	Directors	2.20000*	.14903	.000	1.7797	2.6203
		Senior Managers	2.00000*	.14506	.000	1.5909	2.4091
		Section Heads	2.01818*	.14172	.000	1.6185	2.4179

		Engineers	2.15000*	.12562	.000	1.7957	2.5043
Social_Awareness	Directors	Senior Managers	-.74444	.40303	.358	-1.8811	.3922
		Section Heads	.19192	.39425	.988	-.9200	1.3038
		Engineers	-.59444	.35208	.449	-1.5874	.3985
		Management Exec	-1.34444*	.40303	.013	-2.4811	-.2078
	Senior Managers	Directors	.74444	.40303	.358	-.3922	1.8811
		Section Heads	.93636	.38326	.119	-.1446	2.0173
		Engineers	.15000	.33972	.992	-.8081	1.1081
		Management Exec	-.60000	.39228	.548	-1.7064	.5064
	Section Heads	Directors	-.19192	.39425	.988	-1.3038	.9200
		Senior Managers	-.93636	.38326	.119	-2.0173	.1446
		Engineers	-.78636	.32927	.134	-1.7150	.1423
		Management Exec	-1.53636*	.38326	.002	-2.6173	-.4554

	Engineers	Directors	.59444	.35208	.449	-.3985	1.5874
		Senior Managers	-.15000	.33972	.992	-1.1081	.8081
		Section Heads	.78636	.32927	.134	-.1423	1.7150
		Management Exec	-.75000	.33972	.192	-1.7081	.2081
	Management Exec	Directors	1.34444*	.40303	.013	.2078	2.4811
		Senior Managers	.60000	.39228	.548	-.5064	1.7064
		Section Heads	1.53636*	.38326	.002	.4554	2.6173
		Engineers	.75000	.33972	.192	-.2081	1.7081
Innovation	Directors	Senior Managers	.13333	.20214	.964	-.4368	.7034
		Section Heads	-2.03030*	.19774	.000	-2.5880	-1.4726
		Engineers	-2.66667*	.17659	.000	-3.1647	-2.1686
		Management Exec	-.16667	.20214	.922	-.7368	.4034
	Senior Managers	Directors	-.13333	.20214	.964	-.7034	.4368

		Section Heads	-2.16364*	.19223	.000	-2.7058	-1.6215
		Engineers	-2.80000*	.17039	.000	-3.2806	-2.3194
		Management Exec	-.30000	.19675	.551	-.8549	.2549
	Section Heads	Directors	2.03030*	.19774	.000	1.4726	2.5880
		Senior Managers	2.16364*	.19223	.000	1.6215	2.7058
		Engineers	-.63636*	.16515	.003	-1.1021	-.1706
		Management Exec	1.86364*	.19223	.000	1.3215	2.4058
	Engineers	Directors	2.66667*	.17659	.000	2.1686	3.1647
		Senior Managers	2.80000*	.17039	.000	2.3194	3.2806
		Section Heads	.63636*	.16515	.003	.1706	1.1021
		Management Exec	2.50000*	.17039	.000	2.0194	2.9806
	Management Exec	Directors	.16667	.20214	.922	-.4034	.7368
		Senior Managers	.30000	.19675	.551	-.2549	.8549

	Section Heads	-1.86364*	.19223	.000	-2.4058	-1.3215
	Engineers	-2.50000*	.17039	.000	-2.9806	-2.0194

*. The mean difference is significant at the 0.05 level.

We can see from the above table that there is a statistically significant ($p < 0.05$) difference between the Senior Management versus Management Executives, between the Senior Managers and the Management Executives, between the Section Heads and the Officers and Engineers and the Management Executives for the dependent sub-variable Environmental Awareness. However, there was no statistically significant result found in the comparison between any combination of the other groups. That is, the Management Executives group had the difference in the mean with every other sample group. It's important to note that the other sample groups have work that affects the working of the nuclear power plant.

For the dependent sub-variable Knowledge Assets, there was a similar result observed as above with statistically significant ($p < 0.05$) differences between the Management Executives and the other groups but there was a non-significant difference observed between the other groups.

For Social Awareness, there was a statistically significant difference ($p < 0.05$) between Directors and the Management Executives and the Section Heads and the

Management Executives. For the other groups, there was a non-significant difference between the groups.

With respect to the final dependent sub-variable Innovation, there was a statistically significant difference between the Directors and the Section Heads (p = 0.000) and between the Directors and Engineers (p = 0.000). In addition, there was also a statistically significant difference between the Senior Managers and Section Heads and the Senior Managers and the Engineers (p = .000 in both cases). Management Executives differed significantly from both Section Heads and Engineers (p = 0.000 for both cases).

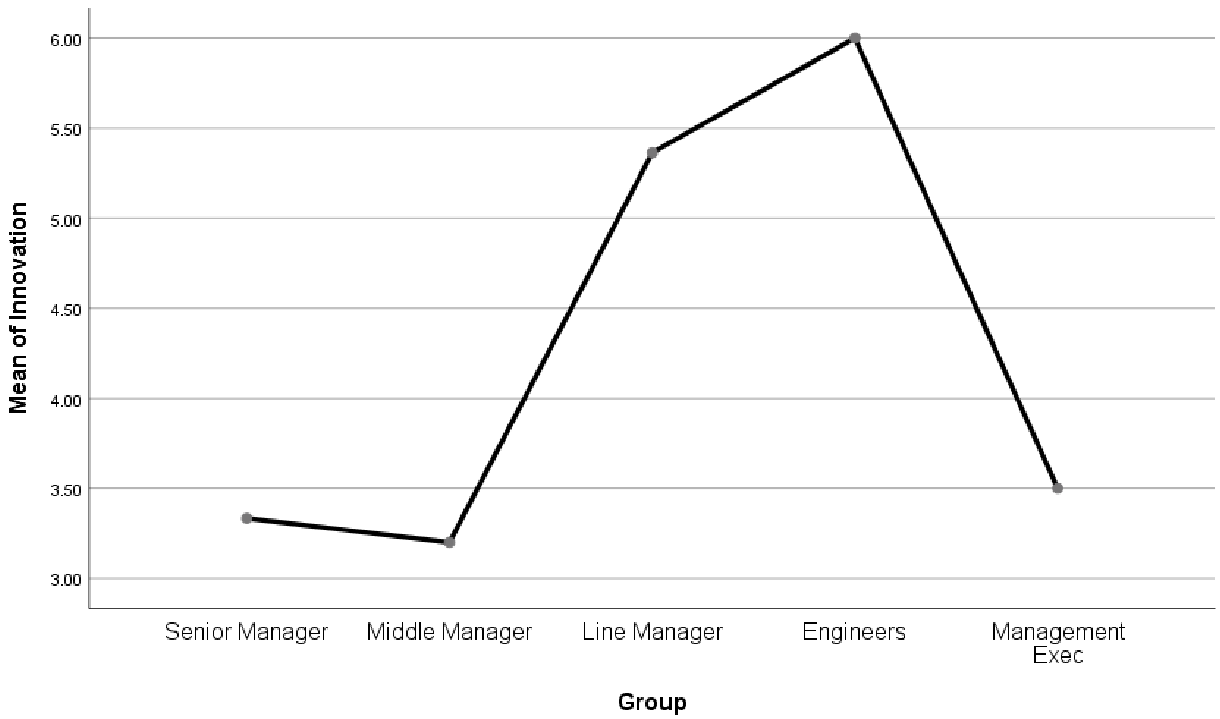

Figure 5: Means Plot of Innovation

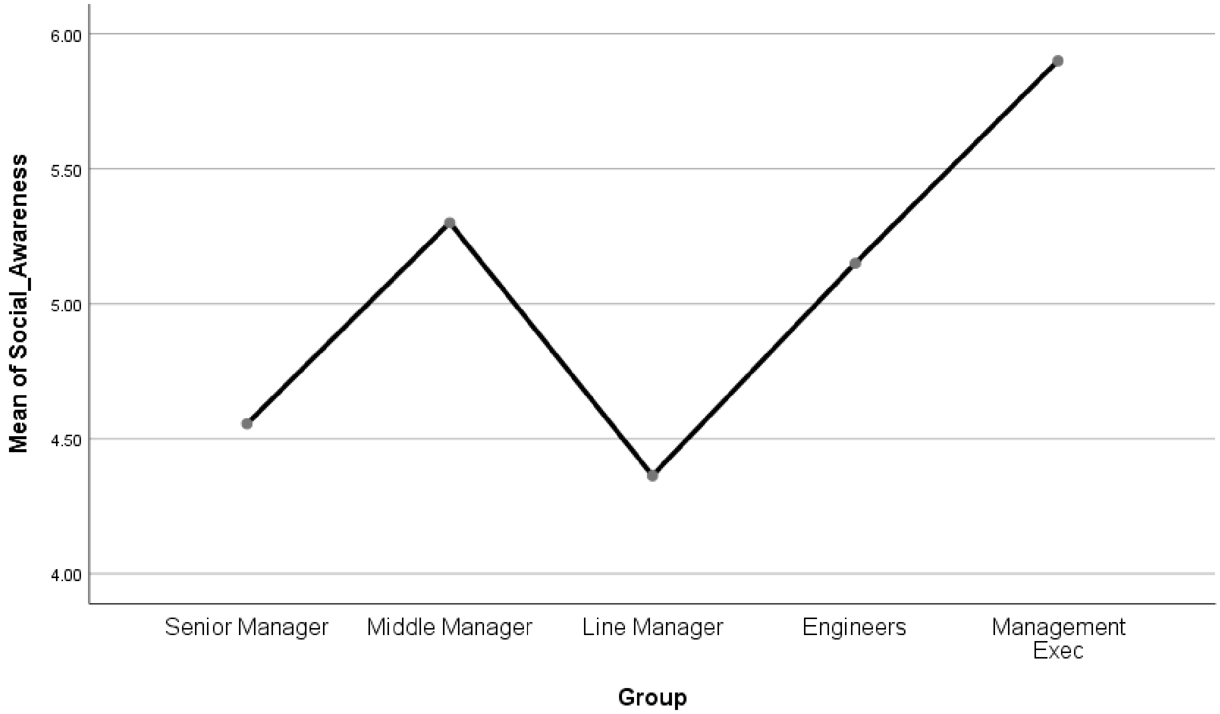

Figure 6: Means Plot of Social Awareness

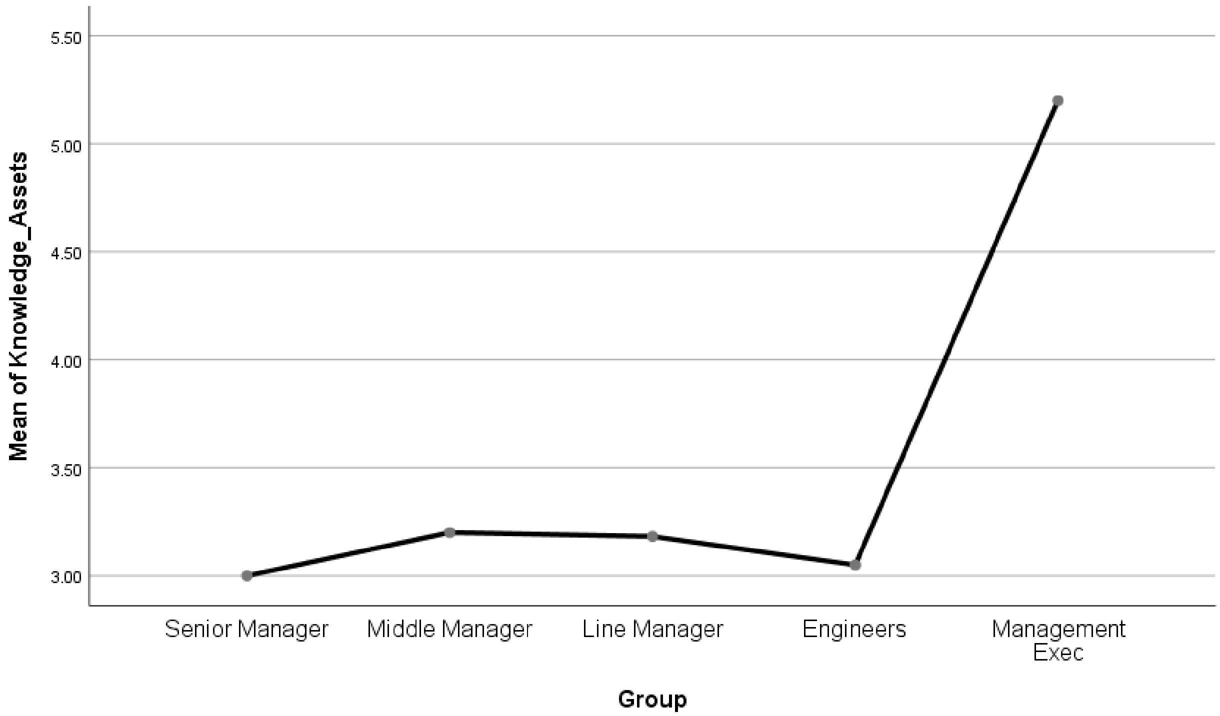

Figure 7: Means Plot of Knowledge Assets

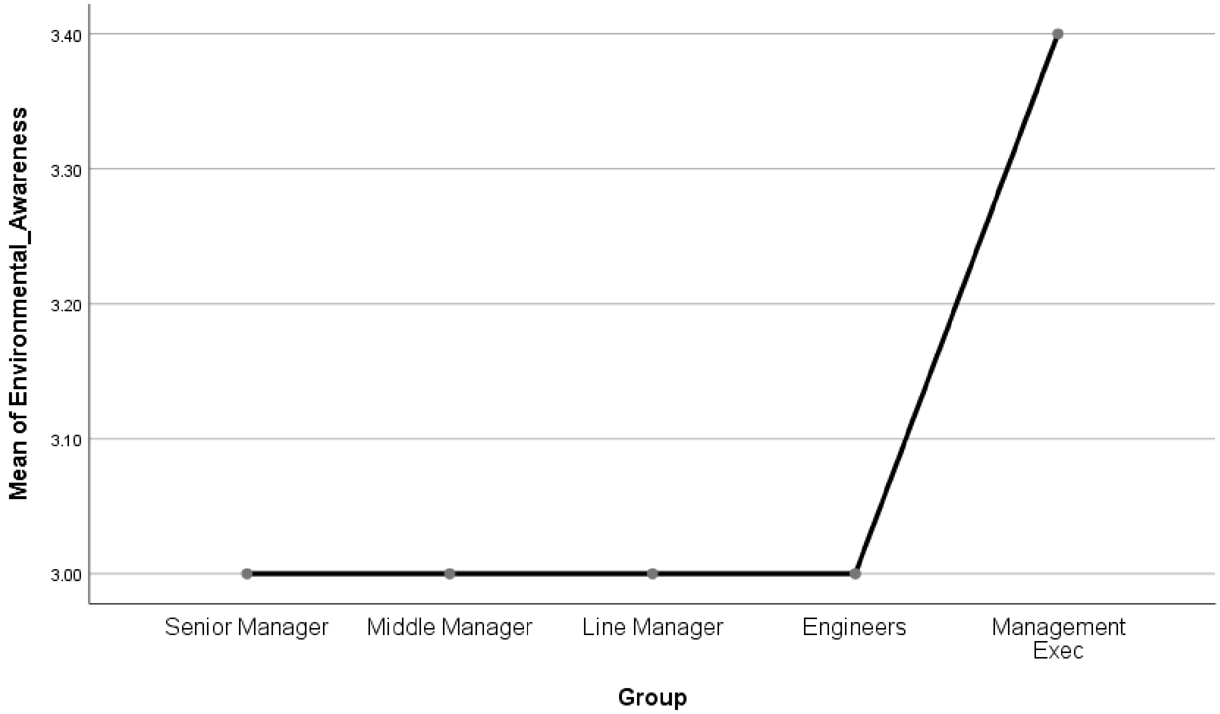

Figure 8: Means Plot of Environmental Awareness

Conclusion, Recommendation and Limitation

5.1. Conclusion

The primary purpose of this study was to identify and determine the nature of the relationship between training program outcome and total quality management in a nuclear power plant. This study was conducted because it is important to understand how total quality management can be applied to a nuclear power plant by way of creating environmental awareness, increasing the knowledge assets, enhancing the Social awareness, and innovation. The nuclear industry of UAE is an emerging industry because there is only one reactor site in the UAE today. Safety is an important feature in a nuclear power plant which is also considered to be a high-reliability organisation. The rationale behind the study was to identify how internal quality can be improved in a nuclear power plant through effective training. To reach the studies objectives, the best approach identified was a quantitative methodology. As part of this methodology, first secondary analysis was conducted on available literature resources. This allows us to determine through literature what were the possible some variables that were present for the primary variables. The primary variables are total quality management which is the dependent variable and training program outcome which is the independent variable.

For the primary independent variable, four sub-variables were identified: Self-improvement, self-efficacy, training framing, and ethnic diversity. Self improvement is an individual drive to engage in activities that improve his or her knowledge. Self efficacy is the perception that an individual has regarding his or her efficacy in a given situation. Meaning framing is the Awareness of the goals and objectives of the training program before the training begins. Ethnic diversity simply refers to the multinational work who's that is present as part of the nuclear power plant in the UAE.

Similarly who dependent some variables the total quality management. 20 word in the context of a nuclear power plant environmental awareness, social awareness, knowledge assets, innovation. Using the above variables and sub variables, conceptual model was developed. For the move using the the literature review a detailed questionnaire was developed in accordance with the conceptual model. This questionnaire was distributed to selected sample of individuals all employed in the nuclear power plant. Sample selection was carried out on the basis of the fact that this study you wanted to quantify best practices in a nuclear power plant with regards to training program outcome and total quality management therefore sample population needed to be well versed with the topic at hand. Once the questionnaire was developed, it was distributed to the is sample population using the online software called Survey Monkey.

The question is carried explanations regarding the purpose of the study to ensure that the participants are aware of the research objective and aims.

The questionnaire was distributed to a sample size of 60 people and the questionnaire received a 100% response rate.

Responses that were collected were tested using the SPSS software. The first test that was carried out was reliability testing. It is important to identify if they work internal consistency can the questionnaire and if the question is valid. Consistency value of 0.76 once identified which is above 0.7 and hence the questionnaire was rendered to be valid. Once validity was established, attention was turned towards conducting the Pearson's correlation test using two tailed significance.

The results indicated that there was a strong positive correlation between self-improvement and knowledge assets as well as social awareness. This implies that with an increased value of self-improvement drive in an individual it is possible that individuals knowledge acquisition and skill development will increase. In addition, the self-improvement drive can also lead to an increase in the Social awareness of the individual. This has great implications as understanding the psychology of an individual with regards to training can allow us to create better skill development in the organisation as a whole. Relationship between self-improvement and social awareness is also important as the nuclear power plant in the UAE comprises of various multinational individuals. Therefore in order to avoid conflict and maintained smooth communication across all levels is crucial to the safety and efficient running of the nuclear power plant. Therefore creating a culture of self-improvement can lead to better skills and knowledge development as well as increased efficiency in communication across various people of international backgrounds.

The perception of self-efficacy of an individual has been shown to have a positive correlation with environmental awareness. This indicates that with a highest test perception of efficacy in an individual, they will be more cognizant of the positive and negative impacts of a nuclear power plant. In addition self-efficacy has shown a strong positive correlation with knowledge assets. This implies the fact that with a higher self-perception of an individual he or she can develop better skills and acquire more knowledge over given course of time. This has implications for the organisation to increase the self-perception of an individual. What this means is that confidence building activities and a culture of positive feedback can influence the acquisition of knowledge and professional development of an individual.

Training framing, or being aware of the goals and objectives of the training program before the training begins, strongly influences environmental awareness as well as knowledge assets. In simple terms that can be stated that when an individual is aware of training outcomes and requirements, he or she will pay more attention to the training program and as a result come out with a better understanding of the environmental issues surrounding the nuclear power plant. This means that an individual who is aware of objectives the training program can better understand what is expected of him or her and hence this can lead to a better knowledge acquisition and professional development in the nuclear power plant. These results are in accordance with the findings of the literature review that is presented in Chapter 2.

With regards to ethnic diversity, only strong correlation it had was with knowledge assets. It appears that a diverse atmosphere in a nuclear power plant influences the acquisition of knowledge. This could be due to organisational diversity climate which is known to increase the performance of an individual. Furthermore, a greater ethnic diversity we can bring about complex ideas from a wide variety of perspectives. This increases not only the interest in learning and professional development but also enhance is retention of information.

It is worth noting that none of the independent sub-variables any influence on innovation as a sub different variable. This could be explained by the fact that most of the sample size consisting of Engineers, senior engineers and section heads. Taking the case of Engineers for example, innovation is not advocated because a nuclear power plant is a highly Complex organisation and attach requires a very strict adherence to protocol. To put this in perspective, one of the primary causes of escalation of the Fukushima Daiichi nuclear power plant incident was the fact that the engineers tried to use innovative and Creative Solutions for solving problems during the crisis. While there were several other primary causes for the escalation of the incident, focus on innovation can be counterproductive as was seen in this case. Aftermath of the incident, the nuclear Association of Japan, made several changes to the training programs. In addition to placing an increase emphasis on simulator training to allow operators to be aware of the procedures during an incident in a virtually simulated space, emphasis was placed on following strict protocol and following a strict chain of command. Thus, it can be stated that lack of correlation between any of the independent some variables are a positive response in terms of safety measurement in the nuclear power plant.

Once the correlation results were identified, attention was turned towards quantification of the relationship between the independent sub-variables and the dependent sub-variables. Multiple regression analysis was carried out by keeping each of the dependent sub-variables fixed against the independent sub-variables.

For the dependent sub-variable, Environmental Awareness, the following predictive model was developed: **Environmental Awareness = 2.662 + (0.22) * Self-Improvement + (-0.25) * Self-Efficacy + (0.139) * Training Framing + (-0.013) * Ethnic Diversity;** with a 50.6% goodness of fit. This equation shows that there can be increases in the Environmental awareness of the individual through training by a factor of 0.22 if there is a unit increase in the self-improvement. Furthermore, it also depicts that that there can be an increase in the Environmental Awareness by a factor of 0.139 when there is an increase in one unit in the training framing. Self-efficacy and Ethnic diversity did not have statistically significant correlations with respect to the Environmental Awareness.

For the dependent sub-variable, Knowledge Assets, the following predictive model was developed: **Knowledge Assets: 2.233 + (0.25) * Self-Improvement + (-0.61) * Self-Efficacy + (0.443) * Training Framing + (0.231) * Ethnic Diversity;** with a 64.8% goodness of fit. This regression model shows that to see an increase in the Knowledge Assets by a factor of 0.25, one unit increase in self-improvement can be carried out. Training Framing can lead to an increase in the Knowledge Assets by an estimated factor of 0.443 and ethnic diversity can increase the Knowledge Assets by a factor of 0.231. Self-efficacy had a non-significant regression to Knowledge Assets. This can also be explained by saying that if an individual has an unusually high self-perception of efficacy, then he or she will be less inclined to engage in a positive professional development program due to the belief of it being ineffective in the face of self-efficacy. The negative sign of the regression also seeks to support this argument.

In terms of the dependent sub-variable, Social Awareness, the following predictive model was developed: **Social Awareness = 4.897 + (0.386) * Self-Improvement + (0.035) * Self-Efficacy + (-0.042) * Training Framing + (-0.308) * Ethnic Diversity**; with a 41.9% goodness of fit. Reading the equation, one can concur that a unit increase in self-improvement can lead to an increase in the Social Awareness by a factor of 0.386 and a unit increase in self-efficacy can lead to an increase in the Social Awareness by a factor of 0.035. The regression model for self-efficacy and ethnic diversity was statistically non-significant.

Once the regression analysis was completed, the attention was turned towards conducting the One-Way ANOVA.

Results of the One-Way ANOVA reveal that there is a statistically significant difference between the groups of the dependent variable environmental awareness. The primary difference is found between the mean of directors versus management executives. Difference in the mean can suggest that because directors make decisions regarding the operations of the nuclear power plant they have to be more aware of the positive and negative impact of the decision as well as on environment. The lack of difference between directors and senior managers, directors and section heads, directors and engineer, can be explained by the fact that engineers, section head and senior managers mostly follow strict protocols of operation in a nuclear power plant to maintain the safety requirements. Therefore, senior manager, section heads, and engineers need to have a certain degree of environmental awareness in order to perform their job correctly and follow strict protocol.

Turning over attention to knowledge assets management executive showed a statistical difference between the responses in comparison to directors, senior managers, section heads, and engineers. In essence, they depicted a relatively smaller propensity for knowledge asset development and professional development in comparison to the other groups. Seeing as much of the operations of the nuclear power plant depends on the Directors, Senior Managers, Section Heads, and Engineers, the lack of significant difference between the two points to the fact that there is a good knowledge assets development in these four management levels. In keeping with the objective of the study, it seems that there is good knowledge, skills and professional development in these four management groups which are at the center of the operations of the nuclear power plant.

When looking at the results of Social Awareness across the various management groups, there was only a statistically significant difference found in the responses of Directors in comparison to the responses of the Management Executives and the Section Heads. This can also be attributed to the fact that the Directors are involved in crucial decision making and hence, need to be more aware of the diversity climate of the organization. They also need to ensure that proper decision making is carried out and hence, need to take into account the diverse climate of the organization.

Talking about Innovation, the final dependent sub-variable, a statistically significant difference was found in the comparison between Section Heads versus Directors and Engineers versus Directors. It has been stated throughout this study that innovation cannot be carried out by the operators and the engineers of the nuclear power plant. However, there is a provision for Directors to be innovative in solving management problems and creating a culture of collaboration across the multinational work force of the organization. Therefore, it can be stated that Directors can engage in innovative problem solving when it comes to the management issues. The same cannot be said about the engineers and the section heads as they need to adhere to strict protocol.

5.2. Limitations

No study is without limitations. Thus, this study has several limitations. First, the sample size of the data collection was small and limited. The small scale nature of this study can make the generalizations of this research difficult. As such, this research can only be applied to the UAE's nuclear power plant. In addition, nuclear power plant in question is UAE's first nuclear power plant and is not yet operational. Therefore, a study conducted in an operating nuclear power plant can yield different results than a non-operating power plant. Finally, this study is the first of its kind in the UAE's nuclear sector and hence, can be subjected to limitations such as lack of benchmark available through other researches in the same area.

5.3.Recommendations

The results of this study indicate that steps can be taken to improve the total quality management in the nuclear power plant. For one, a culture can be created whereby the motivation can be provided to the individual to self-improve. When there is a higher self-improvement, better knowledge assets can be created and hence, the over TQM of the organization can be enhanced. In addition, the study can be applied towards increasing the social engagement with multicultural people in an effort to increase the knowledge sharing and productive collaboration. There is, however, a greater impact of training framing that can be applied practically in the nuclear power plant in the UAE. The training programs that are carried out in the nuclear power plant can be accompanied with a prior session explaining what the training program will cover and how it might help the employees perform better at their jobs. This can lead to a better rate of skills development and acquisition and hence, can create a more conducive environment in the nuclear power plant. The maintenance of total quality management in a nuclear power plant is of utmost importance as there is a precedent where the prevention of an incident is the prime responsibility because in the absence of appropriate total quality management in a nuclear power plant, there can be devastating results for the environment as a whole.

In terms of recommendations for the research, to our knowledge, this study has been the first of its kind in the UAE's nuclear sector that is examining the impact of training program outcome on the total quality management in the UAE. In the future, studies can be conducted with an inductive approach into understanding why training program outcomes influence the total quality management in the nuclear power plant. The safety implications of this research can also be identified and carried out further to understand how much training framing, for example, can influence the safety outcomes in the nuclear power plant. Furthermore, policies can be developed for mandating certain practices in the nuclear power plant that can increase the effectiveness of the training program and hence, increase the total quality management. Finally, an international collaborative research can be conducted across two or more different nuclear power plants in an effort to understand the difference between two nuclear power plants that are separated by geographical boundaries.

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Appendix A - Questionnaire

Maintaining TQM of the Nuclear Power Plant through Training

This research is testing the effect of the training program outcome on the TQM of the organization. Several independent and dependent variables have been identified.

Independent variables influence the dependent variables. The primary independent variable is Training Program Outcome. In this study, the following independent sub-variables were identified: Self-Improvement, Self-Efficacy, Training Framing, and Ethnic Diversity.

Self-Improvement

The motivation for self-improvement means the drive of the trainees to develop new skills and better their workplace performance.

1. Self-improvement leads you to pay more attention to the training program provided?
    a. Strongly Agree
    b. Agree
    c. Neutral
    d. Disagree
    e. Strongly Disagree
2. Do you think that the stronger your self-improvement drive, the better your training program outcome is?

a. Strongly Agree
b. Agree
c. Neutral
d. Disagree
e. Strongly Disagree

3. Self-improvement is focused on in the material and knowledge provided in the training programs?
   a. Strongly Agree
   b. Agree
   c. Neutral
   d. Disagree
   e. Strongly Disagree

Self-efficacy

Bandura (1982) defined self-efficacy as the measure of how well an individual thinks he/she can carry out an action that is required of him/her.

4. Do you think that your perceived self-efficacy affects your training program outcome?
   a. Strongly Agree
   b. Agree
   c. Neutral
   d. Disagree
   e. Strongly Disagree

5. If you have a higher perception of self-efficacy, this will positively increase your training program outcome?
    a. Strongly Agree
    b. Agree
    c. Neutral
    d. Disagree
    e. Strongly Disagree
6. Having an increased self-efficacy perception increases your motivation to learn?
    a. Strongly Agree
    b. Agree
    c. Neutral
    d. Disagree
    e. Strongly Disagree

Awareness or Training Framing

Awareness or training framing refers to understanding what the training program will teach and how the lack of training can affect performance in a realistic manner (Hicks and Klimoski, 1987).

7. Training program goals and objective awareness is an important motivator for positive training program outcome?
    a. Strongly Agree
    b. Agree
    c. Neutral

d. Disagree

e. Strongly Disagree

8. If the trainee knows the harm that lack of training will bring, he/she can have a positive training program outcome?

a. Strongly Agree

b. Agree

c. Neutral

d. Disagree

e. Strongly Disagree

9. Awareness of the positive factors of training can lead to positive training program outcomes?

a. Strongly Agree

b. Agree

c. Neutral

d. Disagree

e. Strongly Disagree

Ethnic Diversity

This refers to the multi-national nature of the work force.

10. The personal culture of the trainee will affect the training program outcome?

a. Strongly Agree

b. Agree

c. Neutral

d. Disagree

e. Strongly Disagree

11. The greater the diversity in a training program, the more effective the training program is.
    a. Strongly Agree
    b. Agree
    c. Neutral
    d. Disagree
    e. Strongly Disagree
12. Language difficulties can affect the training program outcomes negatively?
    a. Strongly Agree
    b. Agree
    c. Neutral
    d. Disagree
    e. Strongly Disagree

The Dependent variables are influenced by changes in the Independent variables. The primary dependent variable is Total Quality Management (TQM). In this study, the following dependent sub-variables were identified: Environmental Awareness, Knowledge Assets, Social Awareness, and Innovation.

Environmental Awareness

This refers to the awareness of the environmental impact of the training program or lack of it.

13. Safety training program in the Nuclear power plants creates effective awareness of environmental impact of training.

    a. Strongly Agree

    b. Agree

    c. Neutral

    d. Disagree

    e. Strongly Disagree

14. You are well aware of what are negative and positive impacts of Nuclear power plants?

    a. Strongly Agree

    b. Agree

    c. Neutral

    d. Disagree

    e. Strongly Disagree

15. You understand the positive & negative environmental impact of the Nuclear Power Plant as a result of the training program?

    a. Strongly Agree

    b. Agree

    c. Neutral

    d. Disagree

    e. Strongly Disagree

Knowledge Assets

Knowledge assets are in the intellectual resources with respect to its human capital of the organization.

16. Training program provided to you has created significant improvements in your knowledge of procedures at the NUCLEAR POWER PLANT?
    a. Strongly Agree
    b. Agree
    c. Neutral
    d. Disagree
    e. Strongly Disagree
17. You are provided sufficient training programs to ensure your performance is enhanced?
    a. Strongly Agree
    b. Agree
    c. Neutral
    d. Disagree
    e. Strongly Disagree
18. You have gained significant leadership, communication, and other skills through training programs.
    a. Strongly Agree
    b. Agree
    c. Neutral
    d. Disagree
    e. Strongly Disagree

Social Awareness

Social awareness refers to the awareness of the various differences between the different ethnicities.

19. Communication with other multicultural people is the one of the focus of general training programs
    a. Strongly Agree
    b. Agree
    c. Neutral
    d. Disagree
    e. Strongly Disagree
20. Training program is a good chance to gain social awareness about other people and situations.
    a. Strongly Agree
    b. Agree
    c. Neutral
    d. Disagree
    e. Strongly Disagree
21. Training provided at the Nuclear Power Plant helps in interacting with other multicultural people.
    a. Strongly Agree
    b. Agree
    c. Neutral
    d. Disagree

e. Strongly Disagree

Innovation

Innovation refers to the development of the new and improved methods or practices.

22. Training program at the Nuclear Power Plant enables you to develop innovative solutions to work problems
    a. Strongly Agree
    b. Agree
    c. Neutral
    d. Disagree
    e. Strongly Disagree
23. You learn new and innovative ideas at the Nuclear Power Plant through training programs.
    a. Strongly Agree
    b. Agree
    c. Neutral
    d. Disagree
    e. Strongly Disagree
24. The training program encourage you to think innovatively
    a. Strongly Agree
    b. Agree
    c. Neutral
    d. Disagree
    e. Strongly Disagree

Appendix B - Survey Monkey results

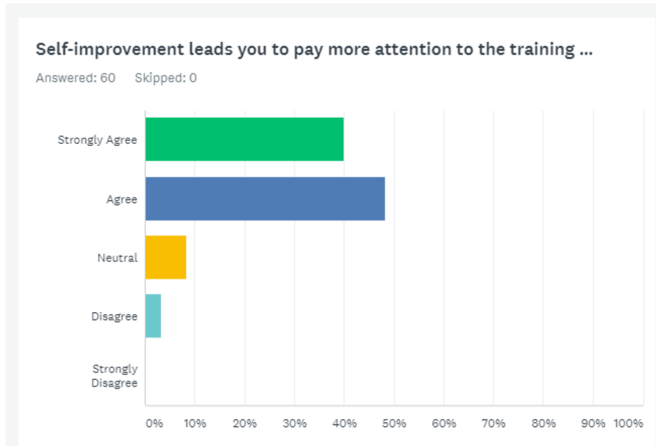

Figure 9: Self-improvement leads you to pay more attention to the training program provided?

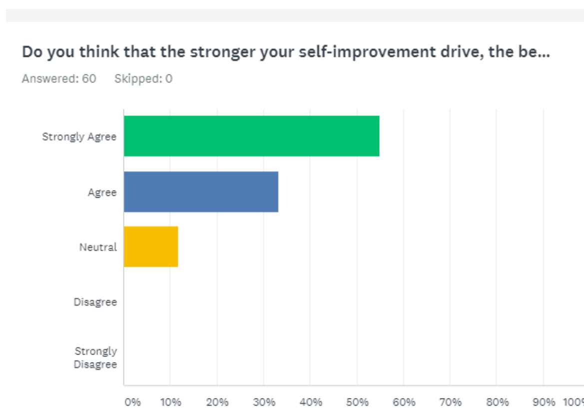

Figure 10: Do you think that the stronger your self-improvement drive, the better your training program outcome is

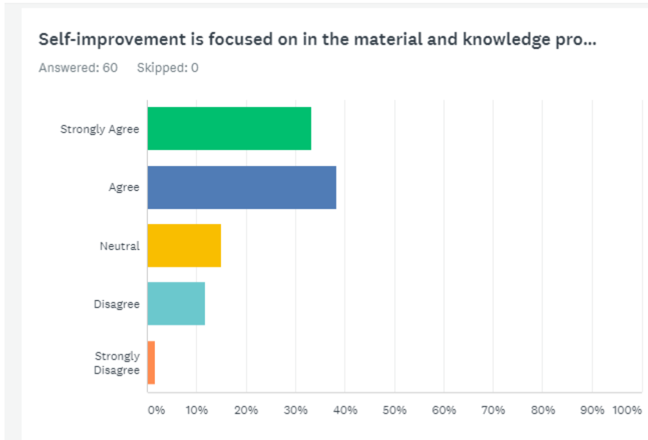

Figure 11: Self-improvement is focused on in the material and knowledge provided in the training programs

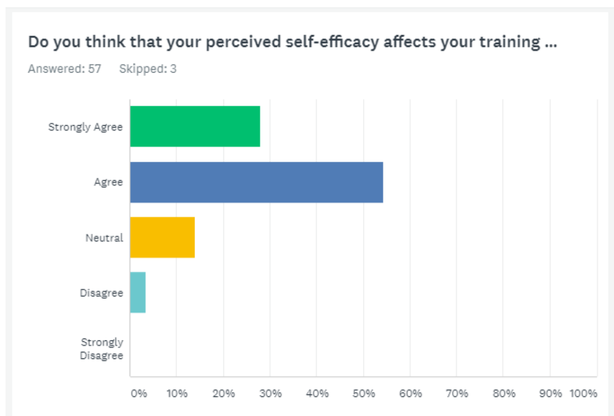

Figure 12: Do you think that your perceived self-efficacy affects your training program outcome?

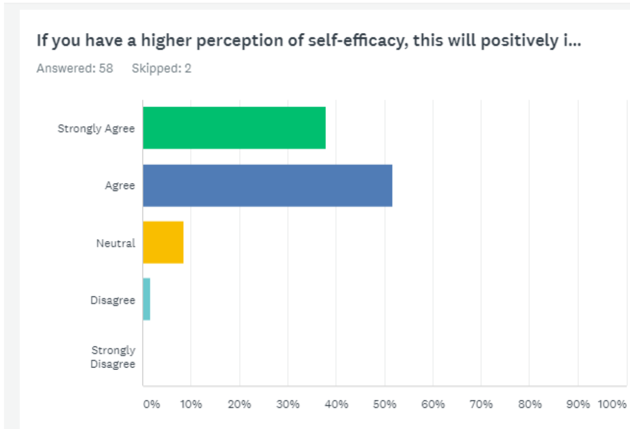

Figure 13: If you have a higher perception of self-efficacy, this will positively increase your training program outcome?

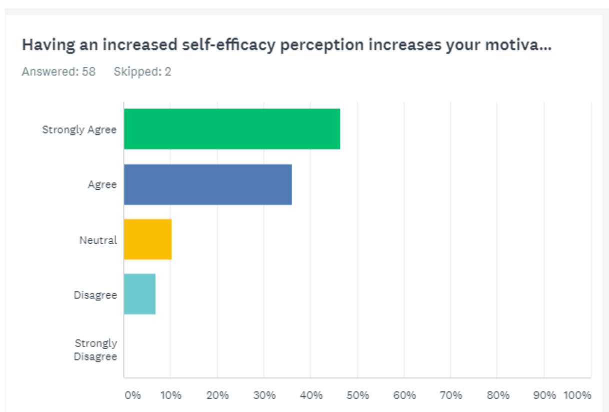

Figure 14: Having an increased self-efficacy perception increases your motivation to learn?

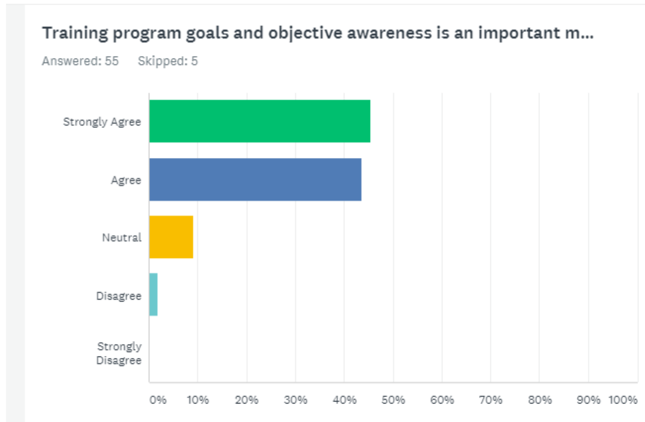

Figure 15: Training program goals and objective awareness is an important motivator for positive training program outcome?

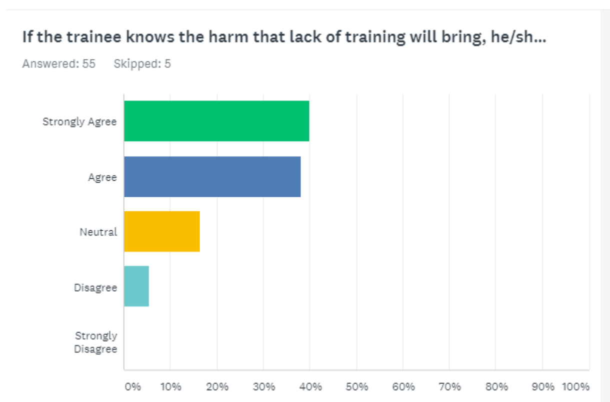

Figure 16: If the trainee knows the harm that lack of training will bring, he/she can have a positive training program outcome?

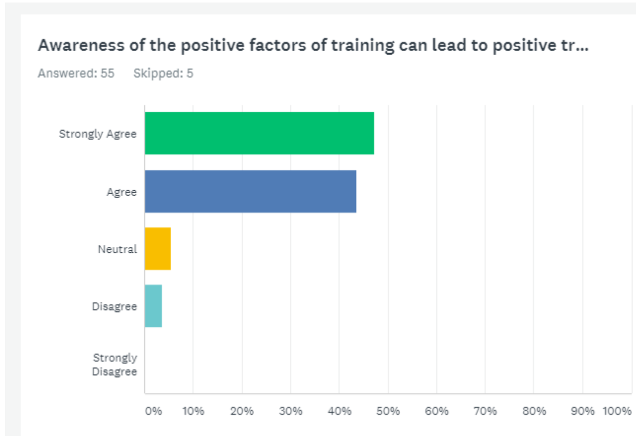

Figure 17: Awareness of the positive factors of training can lead to positive training program outcomes?

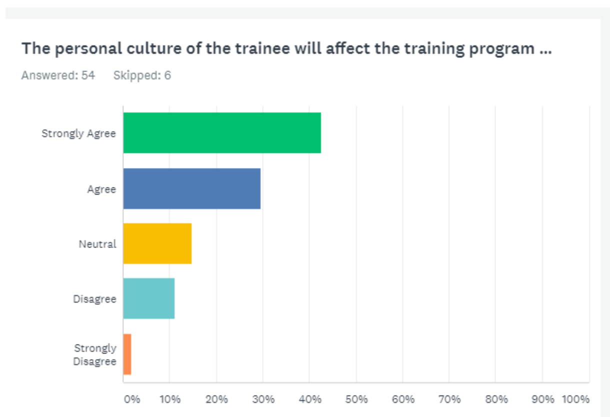

Figure 18: The personal culture of the trainee will affect the training program outcome?

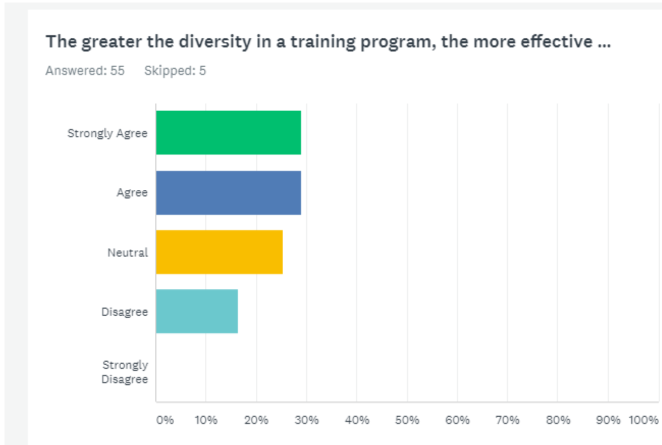

Figure 19: The greater the diversity in a training program, the more effective the training program is

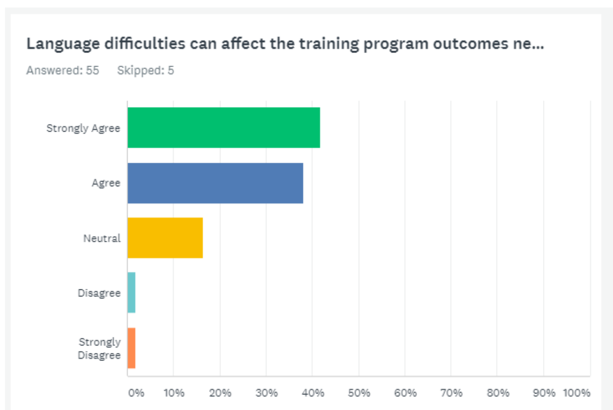

Figure 20: Language difficulties can affect the training program outcomes negatively?

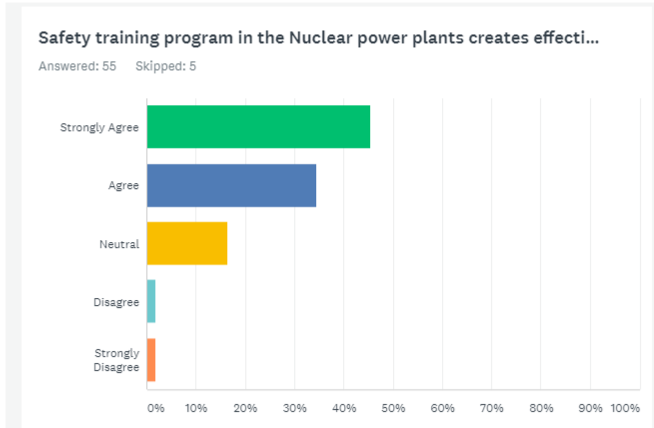

Figure 21: Safety training program in the Nuclear power plants creates effective awareness of environmental impact of training

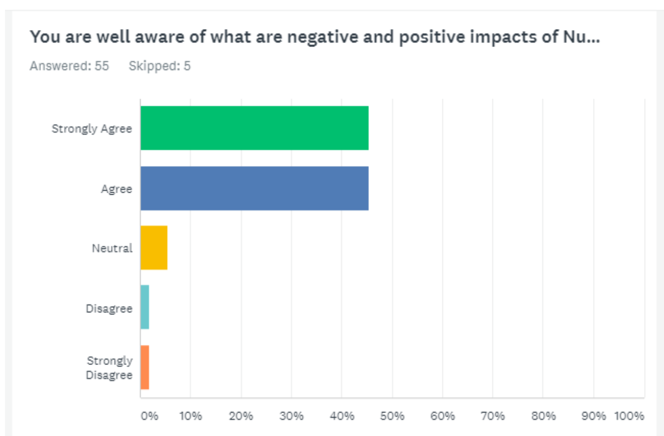

Figure 22: You are well aware of what are negative and positive impacts of Nuclear power plants

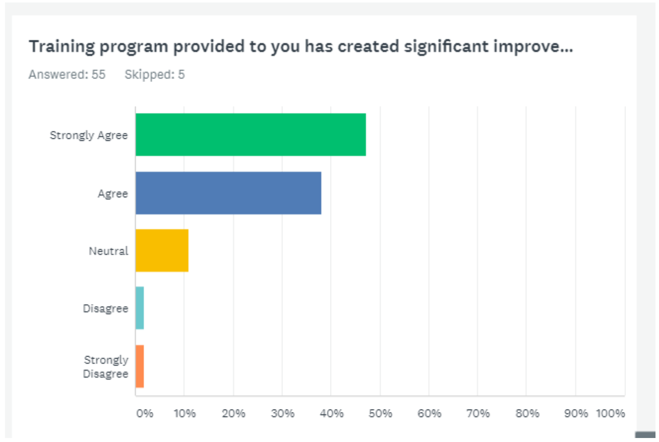

Figure 23: Training program provided to you has created significant improvements in your knowledge of procedures at the NPP?

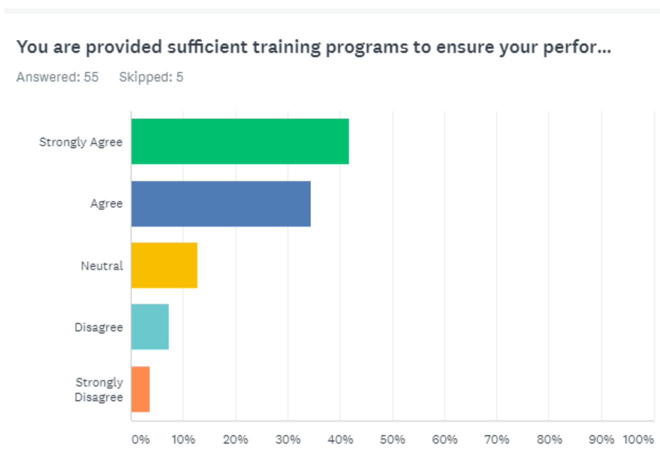

Figure 24: You are provided sufficient training programs to ensure your performance is enhanced?

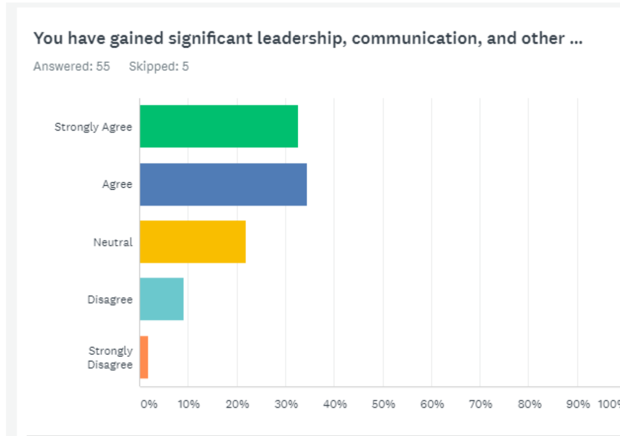

Figure 25: You have gained significant leadership, communication, and other skills through training programs

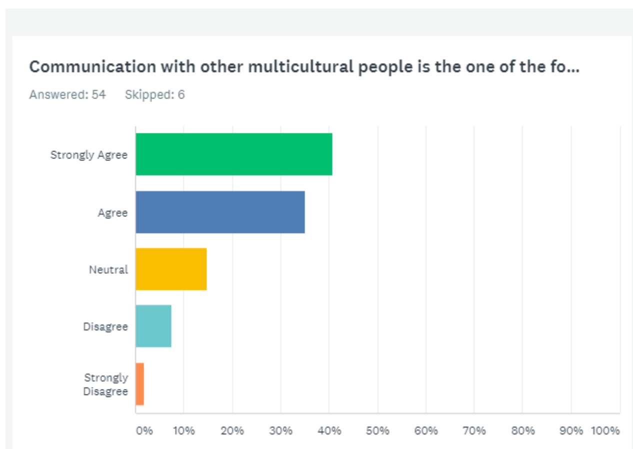

Figure 26: Communication with other multicultural people is the one of the focus of general training programs

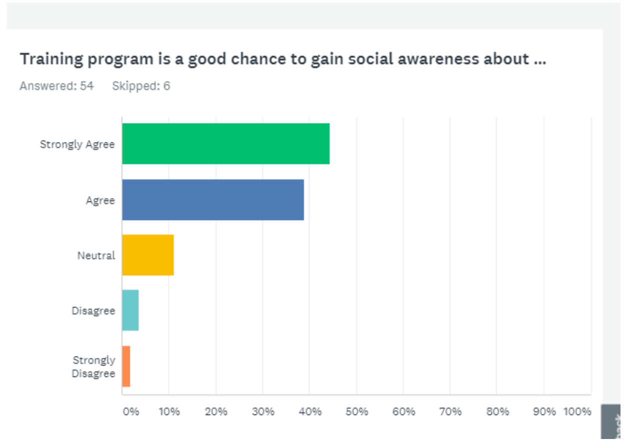

Figure 27: Training program is a good chance to gain social awareness about other people and situations.

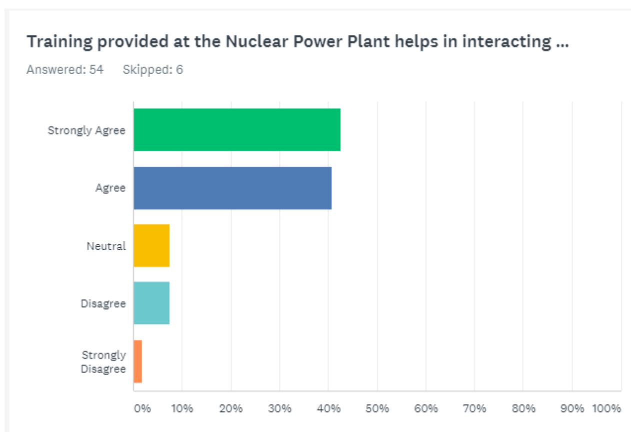

Figure 28: Training provided at the Nuclear Power Plant helps in interacting with other multicultural people.

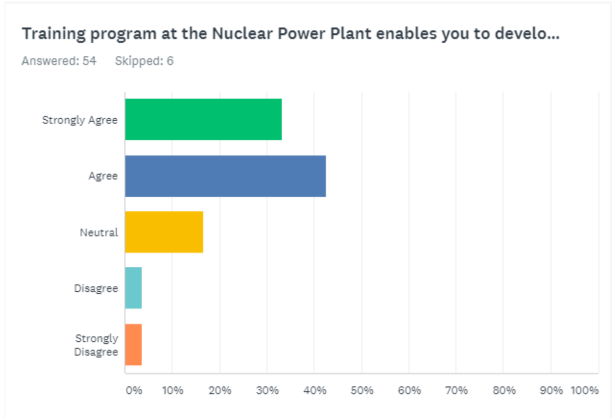

Figure 29: Training program at the Nuclear Power Plant enables you to develop innovative solutions to work problems

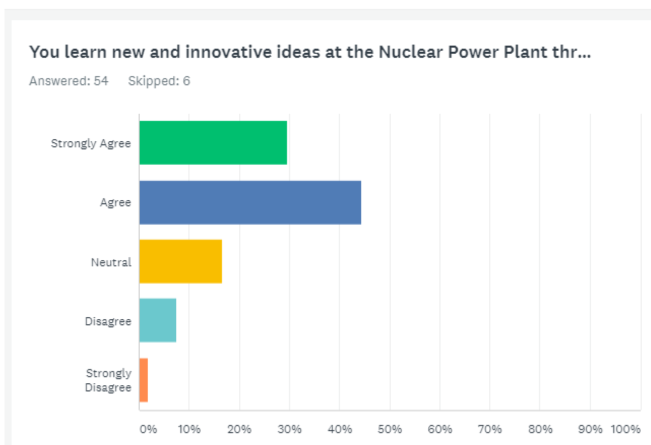

Figure 30: You learn new and innovative ideas at the Nuclear Power Plant through training programs

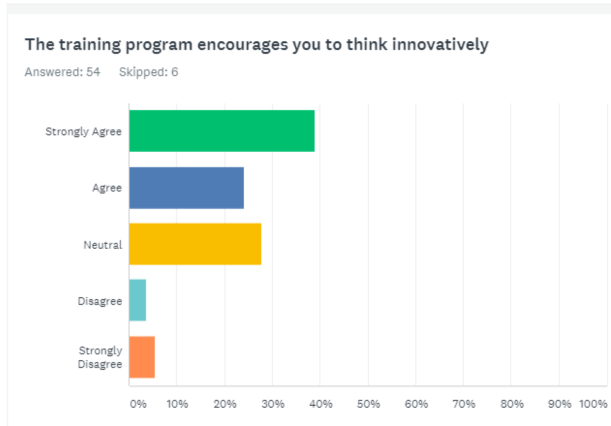

Figure 31: The training program encourage you to think innovatively