Bridging the Gaps in HSE Training

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Abstract

Proper training is a powerful tool to enhance the employee's performance in any required HSE-related job. The lack of HSE training has a direct effect on the adequacy expected from the employee to handle various situations that might lead to accidents, injuries, or losses if not dealt with properly. Hence, it is important to provide HSE training, which will enable the employees to become more aware and considerate of their safety by avoiding risks. In this study, a clear definition of knowledge, competency, and training will be presented, along with highlighting the significance of proper HSE training that will have a direct effect on minimizing possible accidents and promoting the performance of the organization from an HSE point of view. Moreover, this study also investigates the training methods approached globally for employees' training, and the drawbacks of the training programs offered in the present day. To gather the required data, two methods of data collection were utilized to gather the required data in order to address the research question, which are online surveys and interviews with subject matter experts. The results obtained from the data collection will be presented and discussed, along with a proposed solution for the existing drawbacks or shortcomings, and this will be further clarified through a case study scenario of activities carried out in confined spaces. The shortcomings that were identified through data analysis of the two methods will be resolved in the proposed training framework to fulfill the gaps.

Keywords
HSE training, On-the-job Training, Knowledge acquisition, Dynamic knowledge, Practical Training, Virtual reality training, and Confined space entry activity.

1. Introduction

Process safety integrity statistics revealed that 7% of major safety incidents root causes in different industries are caused by improper employee training. It was also ranked second to the highest rated cause which is not following the right procedure. There are several factors contributing to major process safety incidents' root causes, where 50% are personal factors, individual competency, and HSE culture (Sisyuk 2018). Furthermore, a previous study investigated several trainees' ability to react in safety-related scenarios and decision making, where the findings revealed that there is a clear difference in performing the task between the trainees who experienced proper on-job training and those who didn't (Chauvin 2009). The study performed by Holoviak (1982) states that the employee's performance within the company refers to the observable and measurable responses due to the learning experience obtained during the training period. This emphasizes the importance of providing HSE training, which will enable the employees to become more aware and considerate of their safety by recognizing and avoiding hazards.

Furthermore, normalizing HSE training at each step will make it a habit for the employees to consider health and safety in their work, which will create a positive HSE culture in the workplace (Chen et al. 2010). HSE training will also provide the employees a chance to act upon their sense of responsibility to cohere with their legal duties and protect others by first protecting themselves (North et al. 2018). Nowadays, there are some witnessed cases in several organizations where HSE training is not reaching the level of effectiveness of the HSE standards. This is clear through the many confirmations showing employees' poor HSE competence leading to the rising numbers of HSE incidents and increased risk severities with manifested losses in the expenditures, time and manpower (Vinesh 2014).

Training in an organization is one of the key indicators to measure the organization's performance and reduce the rate of incidents and injuries; hence organizations spend millions each year to obtain proper training for their employees. In that, the research question is "How to improve HSE Training in the organization?" In order to address this research question, thorough research was conducted to explore strategies and methods of improving HSE Training in the organization. The project is constrained by the objective of achieving zero costs when formulating a new training program/ framework, which requires the utilization of in-house resources and expertise.

1.1 Project Objectives

The main objective to be achieved here is to increase employees' training and competency to perform their jobs safely. Therefore, to achieve this goal, it is imperative to improve the training of employees as a way to enhance their competency. To meet the objectives, the following approach will be followed:

- Identify and assess the current state of the organization's training plans and programs.
- Study the impact of inadequate training and poor competence on the organization from an HSE perspective.
- Highlight the main concerns associated with existing training in the organization.
- Adapt best practices benchmarks to the organization's needs and requirements.
- Develop a plan/solution to improve the organization's training and proficiency levels.

2. Literature Review

Knowledge is the ability to apply information to specific functions and performance. It is gained through formal education, professional certifications, and training. Sisyuk (2018) defined knowledge as a combination of organized experience, information, values, and insights that can be utilized to evaluate new experiences and information. Since knowledge is mostly tacit and acquired through practice, different people have different levels of knowledge despite obtaining similar information and data (Sisyuk 2018).

In the process of learning, an individual acquires knowledge through dynamic models. According to one dynamic model, information and knowledge flow through the individual's knowledge acquisition, storage, and retrieval (Snyman et al. 2007). Knowledge acquisition is also part of the dynamic model that ensures a continuous process that spreads throughout an individual's lifetime. It involves gathering knowledge from various sources, including journals, textbooks, technical papers, and database reports, and maybe from experts in the field of interest. In other words, it involves adding new knowledge to a knowledge base and refining or improving existing knowledge. The information acquired consists of facts, concepts, rules, guidelines, procedures, statistics, relationships, or formulas. Figure 1 shows the different methods that are considered to acquire knowledge. Concerning training, the Acquisition of new and emerging knowledge sets serves as an active process for meeting the organization's short and long-term requirements. Additionally, researchers have identified multiple factors that influence individual learning processes and ultimately impact the knowledge acquisition efficiency in the organization. Hence, Training and education programs of high quality and/or programs with high relevance can lead to high acquisition efficiency (Chen et al. 2010).

Competence consists of a combination of related capabilities, knowledge, and skills that enables a person or organization to perform effectively in a given situation or job (Sisyuk 2018). Similarly, North and Kumta (2010) defined competency

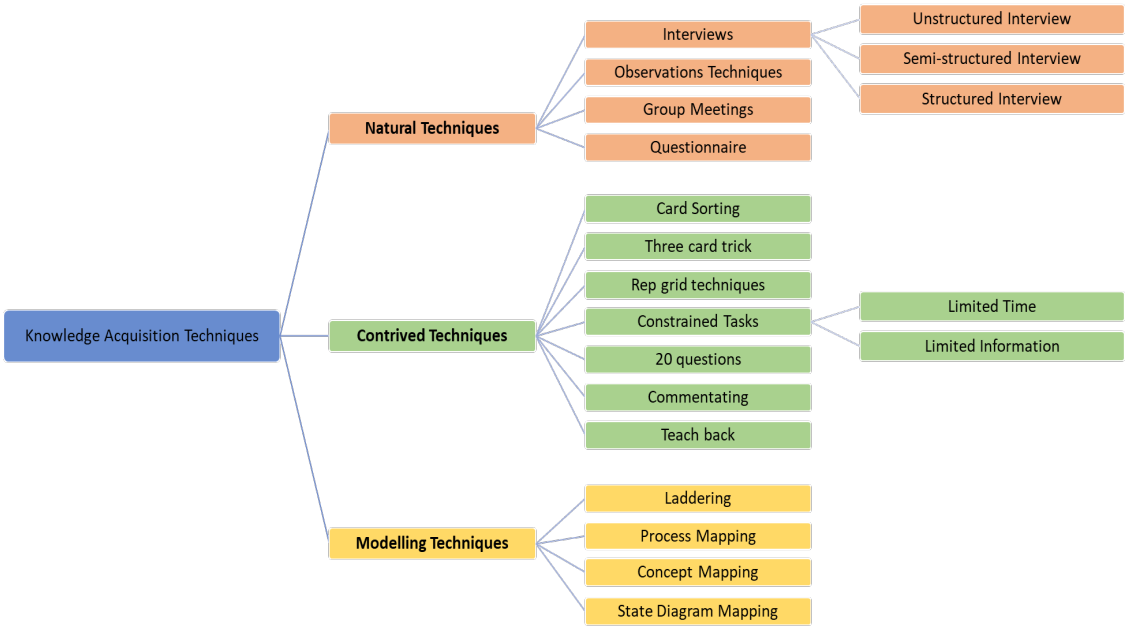

Figure 1. Knowledge Acquisition Techniques (Milton, 2007)

as the relationship between a person's or group's task assignments and their capability and potential to accomplish that task. It is implied by these definitions that competencies are described in ways that are observables, measurables, and based on performance (Sisyuk 2018).

Institution of Occupational Safety and Health (IOSH) established a competency framework that consists of professional standards for safety and health at work to build capability and keep pace with rapid change in the workplace. The framework focused on three main competencies which are technical, core, and behavioral competencies, which reflect best practices in occupational safety and health that help employees and employers to maximize performance and minimize the risk. Technical competencies include the collection of the OSH technical proficiencies that reinforce advisory capability **(**Milton 2007**).** On the other hand, core competencies are the necessary skills that support proper decision-making, and finally, behavioral competencies support the building of successful working relationships. Figure 2 displays the areas in each type of competency.

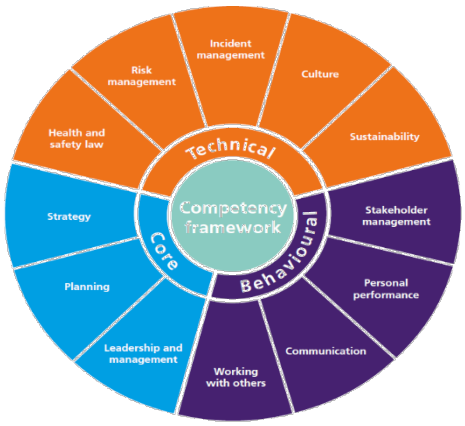

Figure 2. IOSH's Competency Framework

From another perspective, Gabriel Albino (2018) associated competency with performance as the performance evaluation is used as an essential tool for employees' compensation, training, and development (Albino, 2018). Two types of management models were adapted to support this comparison. In the Position-based management model, employees' performance was evaluated solely based on the tasks required for the task at hand. However, in the competency-based management model, employees are expected to have dynamic capabilities to enhance operation resilience. Table 1 summarizes the differences between both models.

Table 1. Position-based and Competency-based Management Models (Milton N.R. 2007 ; Albino G. 2018)

Position-based management model	Competency-based management model
Inflexible	Flexible
Hinders the development of staff and the movement of initiatives	Incentivizes the development of staff and the movement of initiatives
The mobility of the organizational setting is slow	The mobility of organizational setting is fast
Hierarchical positions are perceived as career moves	Hierarchical positions are only part of career moves

Performance standards can be established, which is good for objectivity	An employee's actions are not limited to performance standards

In relation to knowledge acquisition, Noe et al. (2013) define Training as the efforts needed to help the employees acquire knowledge, abilities, behaviors, and skills to set and follow objectives. In addition, with competency development, scholars highlighted that the objective of the training is to ensure that all employees are competent to perform the assigned tasks (Campbell et al. 2015).

Campbell and Wiernik (2015) defined performance as the people's actions that fulfill the organization's objectives. The organization's performance is measured by many factors or variables which depend on the working field industry. For example, in the oil and gas industry, operational aspects, people, leadership, and finances are the key indicators for measuring the performance of the organization. Furthermore, the organization's HSE data and statistics are one of the key indicators and variables to measure the organization's performance (Qiu et al. 2017). Hence, the importance of the individual's competency in HSE comes to affect performance.

In the oil and gas industry, hazards and risks associated with the operation and maintenance activities are countless. In order to diminish these risks, HSE training plays a significant role in individual competency. Hazards awareness and knowledge will enable the employee to recognize the hazard in the activity and consequently he will be able to evaluate and control the hazard. By this, we will be able to manage the HSE performance by managing the illness, injury, and incidents statistics. Concluding that there is a direct relationship between training, knowledge, competency, and individual and organization's performance. Emphasizing the importance of the HSE Training, the Occupational Safety and Health Act of 1970 (OSHA) established a publication on training requirements in OSHA Standards (Qiu et al. 2017). The main purpose is to guarantee the workers' safety from injuries, illnesses, and deaths by setting and upholding standards. For example, OSHA standards are recognized for preventing countless workplace disasters by inducing standardized HSE training for the workers (OSHA 2022).

All global organizations are increasingly seeking the help of learning and development to increase the competency of their employees. In order to do that, various methods of training delivery are adopted. However, choosing a training delivery method depends on several considerations such as budget, size, and type of workforce, location, goal, and time frame (Richey 1999). In addition, the organization's training is an integral part of an employee development program for enhancing skills and competencies over time. A combination of on-the-job and off-the-job training aims to maximize the development of their potential and structure of their competencies based on their personal and professional experiences (Maršíková et al. 2015). Table 2 summarizes the training methods/ type and their characteristics, along with the commonly used forms/ delivery methods in each method (Raheja 2015].

Table 2. Training Types and their delivery forms

Method	Characteristics	Used forms of training
On-the-job Training	Utilized in everyday practice as part of a training program (tailored)	Apprenticeship, demonstration, coaching, job instruction Technology, job rotation, counseling, mentoring, workshops, assisting, understudy.
Off-the-job Training	Used in traditional education institutions as a training tool.	Method of discovery, lectures, discussions, assessment centers, workshops, role-playing, simulation exercises, team building, case studies, brainstorming, seminars, and learning within games.

On-the-job Training and Off-the-job Training	Combination of the above-mentioned ways.	E-learning, briefings, the study recommended literature, questions, and answers, task delegation, learning events, multimedia education, and interactive videos.

An effective training program addresses requirements and delivers in accordance with training objectives. A study was conducted in 2009 to survey employees' opinions about their perceptions of the effectiveness of training and development (Devi et al. 2020). Training and developmental practices had a positive impact on preparing the employees to be more effective with the tasks at hand, and increase their technical abilities, interpersonal abilities, teamwork, job confidence, and work motivation. Overall, Training and development are effective when the training outcomes match the training objectives. Training effectiveness is determined by how closely the outcome matches the objective. Evaluation is crucial to determining the effectiveness of training. However, other factors such as the delivery method of learning, trainer's ability to deliver the training, trainees' ability to absorb the information, the ability of the institute and trainers to identify trainee needs appropriately, and the matching of training packages to trainee need also contribute to determining training effectiveness (Devi et al. 2020). Figure 3 demonstrates a new model for evaluating the training effectiveness, which is called the "Four-stage cyclic model to measure training effectiveness".

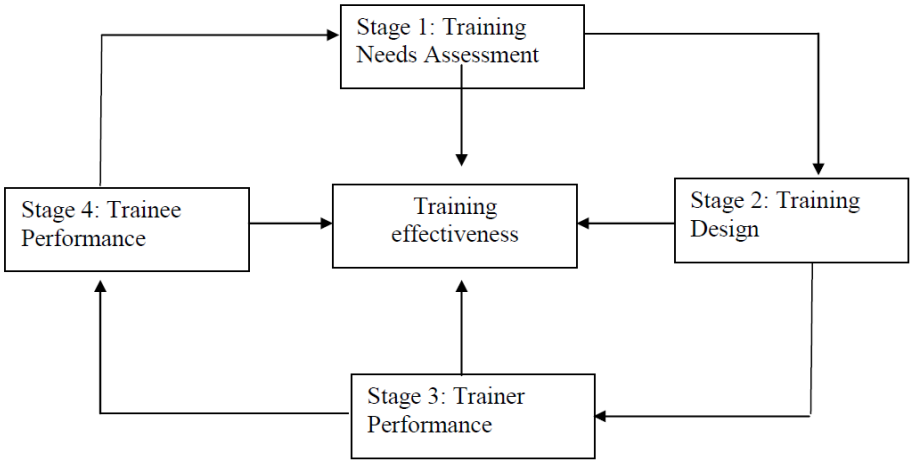

Figure 3. Evaluation Method of Training Effectiveness

In Stage 1, Training needs are determined based on gaps in trainees' knowledge, skill, ability, etc. The objectives of the training program should be formulated to be measurable, set a benchmark, and Training needs should evolve objectively from trainee requirements (Devi et al. 2020). Then, in Stage 2, training design includes training schedule, material, training aids, training methods used, plus the source of trainer decisions. All these variables must be evaluated independently. Following Stage 3, the performance of trainers has enormous influence on not only attracting trainees to program goals but also on the effectiveness of the overall training. If the trainer doesn't perform well, the whole training program will lose effectiveness regardless of how good the training aids and methods are. Lastly, Stage 4 involves not only acquiring critical knowledge within a training program but also effectively transferring that knowledge to the workplace (Devi et al. 2020).

According to recent statistics, employees with inadequate awareness and competency have committed illegal operations, constituting the cause of 80% of incidents involving production safety, environmental pollution, and employee health at petroleum and petrochemical companies (Qiu et al. 2017) and (Maršíková et al. 2015). Training in health and safety is therefore a proactive way of enhancing employees' HSE knowledge and skills, as well as their ability to perform their tasks regarding risk identification and control. Hence, building a better culture of HSE and continually improving HSE performance. Unfortunately, today's HSE training has problems that prevent it from meeting the organization's objectives (Qiu et al. 2017). Among these are:

- Lack of variety in training methods (boring, conventional, and simple), making trainees reluctant to accept them.
- The training content and post-training demands are inconsistent.
- Training initiatives are not adequately supportive of staff performance assessments, without direct links to training. In other words, training doesn't meet the job requirement.
- Lack of employees' engagement and participation in HSE Training.

The benchmarking process is a proven way to assess the HSE performance of an organization by comparing it with the performance of companies that use best practices. To make improvements to our workplace health and safety, we need a commitment from the top, but without commitment, we will not be able to secure the resources necessary to achieve those improvements including improvement in Training (IChemE online). Despite the necessity of responding to HSE incidents, preventing those incidents is naturally better for all stakeholders. Based on the HSE Training Benchmarking, the following are approaches/ strategies that companies consider to improve training (Devi et al. 2020):

- Provide On-the-job Training and competency-based training based on the job role.
- Engage the employee in an all-in-one employee training software.
- Provide a wide range of training methods and effective in-app employee training and development.

Moreover, few large and modern organization follows new Training methods or approaches, they are custom in-house training (Kumar et al 2017), Technology-Based Training or Simulation-Based Training (Gardner et al, 2015), and Gamification or Digital Game-Based Learning (DGBL) (Armstrong et al. 2018). However, these training methods hold their own advantages and disadvantages that need to be considered.

In this research study, a clear definition of knowledge, competency, and training will be presented, along with highlighting the significance of proper HSE training that will have a direct effect on minimizing possible accidents and promoting the performance of the organization as a whole from an HSE point of view. Moreover, this study also investigates the training methods approached globally for employees' training, and the drawbacks of the training programs offered in the present day.

As of today, site engineers and other individuals have not received adequate and comprehensive HSE training. This has a direct impact on the level of competency of workers handling all types of jobs in expanded cooperation. A certain workplace with inadequate training or improper implementation of training plans possesses a great risk to both the individual and the surrounding people. It also affects the organization as a whole from different aspects such as performance, quality, cost, and reputation. In particular, it affects HSE performance, such as the frequency of incidents, illnesses, and injuries that can be avoided. Moreover, studies showed incidents related to the process industry have been increasing drastically throughout the years.

3.Project Methodology

Two methods of data collection were utilized to gather the required data in order to address the research question, which are online surveys and interviews with subject matter experts. The online survey targets low-grade employees and focuses on three main aspects which are: evaluating training effectiveness, evaluating risk assessment and emergency response, and examining employee confidence and judgment in performing the required job. The questionnaire of the survey consists of 6 different opinion-based questions which will emphasize the competency element mentioned previously in the literature review. Furthermore, subject matter experts will also be interviewed mainly to understand the actual state of the training within the organization and identify any weaknesses or other issues regarding its HSE training.A survey has been circulated to organization employees who are working at the refinery site such as operators, maintenance technicians, supervisors, etc. A total of 440 personnel from various departments participated. Each department contributed in the following proportions: operations 45%, maintenance 15%, HSE 13%, technical 12%, project 10%, and support services 5%.

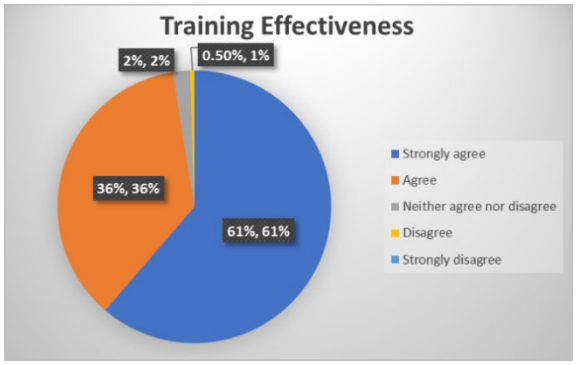

Figure 4. Training Effectiveness Survey Results

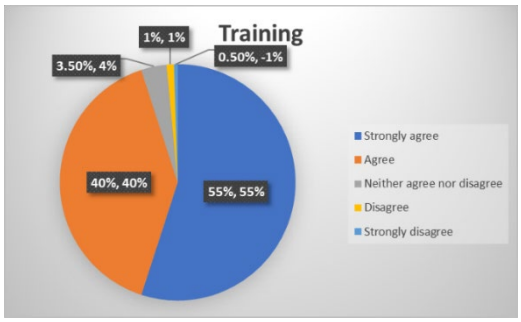

Figure 5. Statement 2 – Training Survey Results

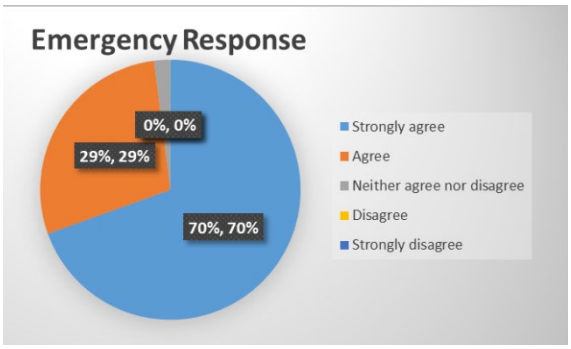

Figure 6. Emergency Response Survey Results

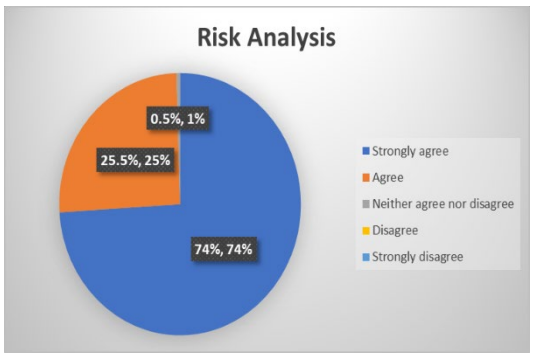

Figure 7. Risk Analyses Survey Results

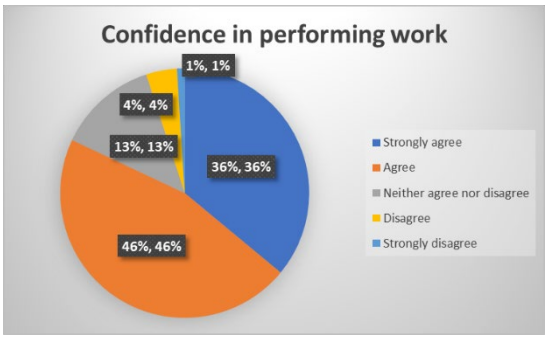

Figure 8. Work Performance Confidence Survey Results

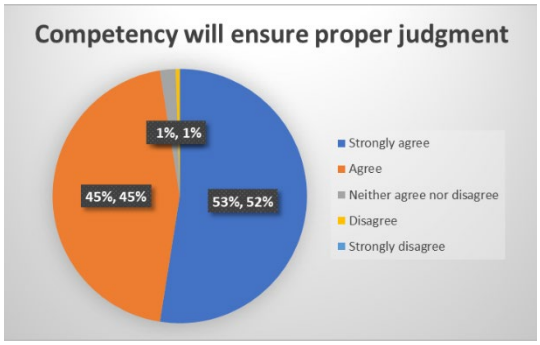

Figure 9. Judgment Competency Survey Results

Section-1: As mentioned above, the survey covered 3 aspects. In the first part, the personnel was asked to self-evaluate their formal competency enhancement process to perform their assigned job safely, the results of which are shown in Figure 4. This leads to the second question, which assessed the individual's understanding of HSE procedures and information for carrying out the assigned job safely as shown in Figure 5.

Section-2: The second aspect that was assessed in the survey was the knowledge about how to perform risk assessments before executing or performing a task. Figure 6 illustrates the responses to this statement. Moreover, Figure 7 addressed whether personnel is familiar with emergency procedures at their working sites in the event of an emergency.

Section-3: Finally, as represented in Figure 8, the survey assessed the individual's confidence in performing all tasks correctly and whether they feel comfortable with the way used to approach them. Whereas in Figure 9, employees were asked about evaluating their co-workers' competence in performing their job safely and ensuring a proper judgment.

Subject matter experts' were asked to identify the weaknesses and shortcomings of the current training program in the organization. Also, they were asked about the complaints that are coming from the learners, and what are the ways to improve the training and enhance the competency of the employees in performing a job effectively and safely.

4. Results

Based on the obtained data from the online survey, some strengths and weaknesses have been identified. The strengths include 94% of participants have undergone formal competency training and 97% agreed they had a thorough understanding of the procedures for carrying out their job. The weaknesses are that 20% of employees are not confident they complete all tasks in the proper manner and 15% of the respondents requested more training and the assignment of competent people. The conducted interview with Subject Matter Experts (SMEs) revealed more shortcomings in the existing HSE training which is the overload of information by delivering the same material in different ways without adding any other value. This results in a lack of employee engagement, and employees only care about marking course attendance. Furthermore, the method of delivering the training materials was found to be ineffective, although the various methods mentioned in Table 2 were utilized in combination. Lastly, limitations on the trainer's competency and assessment shortcomings that reflect the personnel's actual skill shall be addressed.

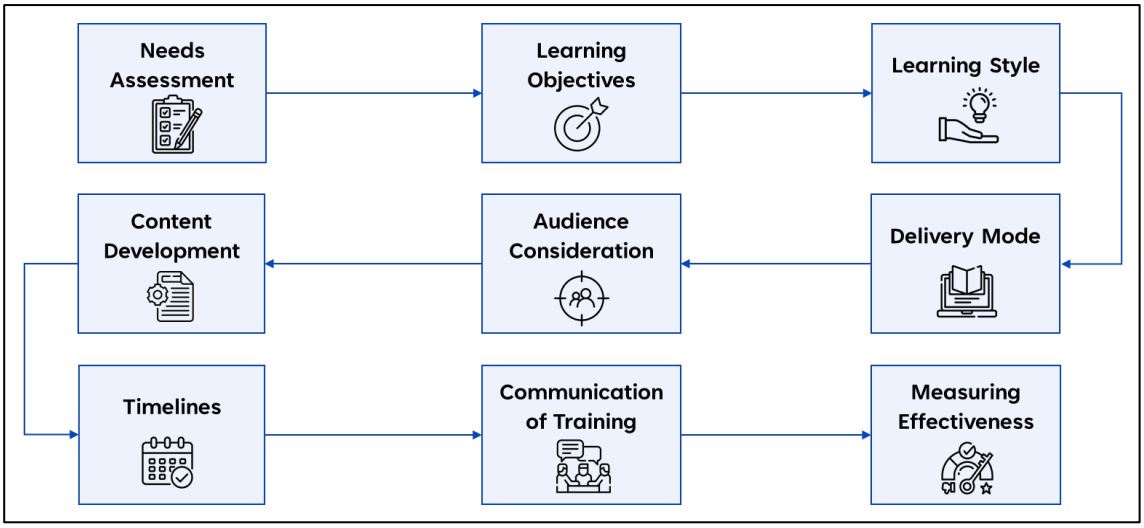

Figure 10. Elements of developing a training framework

Following the feedback from SMEs and data collection through a developed online survey, a proposed solution is to develop a custom in-house training framework. The focus of this framework was to simplify the training material by covering the key information. Accordingly, to develop a new framework, we must consider the elements shown in Figure 10. The proposed training framework will focus on three main aspects which are: delivery mode, development of training materials, and evaluation of the training assessment. The following will be the implementation of Figure 10 which consists of an element description of each step, along with the proposed solution of the framework.

Table 3. Framework Elements

Step	Framework Element	Element Description	Proposed Solution
1	Needs Assessment	This part requires you to consider what kind of training is needed in your organization. Once you have determined the training needed, you can set learning objectives to assess at the end of the training.	The training type that will be assessed are the organization's standards, specifically operation safety standards (Confined space entry activity, welding and grinding activity, working at height activity…) and risk assessment standards (permit to work, job safety analysis, Management of change..).
2	Learning Objectives	Training objectives will be specific to each course, however, it will not cover the theoretical part, instead, it will focus on the practicality and key information of a standard.	The new course material will be straightforward and to the point. Each course will have its own objectives along with a course syllabus.
3	Learning Style	Ensuring to teach various learning styles because it is important for the development of training programs.	This framework adopts different learning styles considering all learner's differences. Visual that will focus on charts, graphs, and pictures), auditory where these courses will be recorded by SME with verbal instructions), and finally kinesthetic where the learner will be learning things by doing/ practicing in the training rooms.
4	Delivery Mode	Selecting the best way to deliver the required information (web-based/ mentoring/ job shadowing/ etc.)	The course will consist of 2 modes: E-learning and Practical training.
5	Audience Consideration	Selecting the workers that will be part of the training considering their job roles.	The training matrix in the company is mapped for all the employees based on the job positions.

6	Content Development	Choosing the content that needs to be delivered and taught.	The E-learning course material will be modified by SMEs in the company to be simpler, and the practical training will be scenario-based.
7	Timelines	The time required to develop the training, and the deadlines associated with the program.	The training framework will be completed in different phases, each phase will cover a specific set of standards.
8	Communicatio n of Training	Communicate to the employees the training availabilities.	The training course will appear on the employee learning page with a specific time to complete it.
9	Measuring Effectiveness	Evaluate whether the training method is working and its effectiveness.	The effectiveness will be measured by course evaluation and methodological written and practical assessment.

5. Discussion

The proposed framework will require the involvement of three departments. These three departments will be responsible for the development of a new framework that will be mandatory for the whole organization. First is Learning and Development (L&D), whose main responsibility is to ensure that learners are credible and to track their progress through the organization's training system. The second contribution will come from the IT department which plays an important role in utilizing the latest technologies to overcome various business challenges and adding the required training courses to the employee learning portal. Lastly, the major contributor is the HSE and Process Safety (PS) Team. They will be responsible for developing training materials, writing training scripts, and recording training videos. The learner will go through the steps for each course in order to complete the first part of the training. The 6 stages of the learner journey will be decided as follows:

Course Registrations: A theoretical training will be assigned to a learner through an employee learning portal. Then the learner will be able to register for practical training based on the availability and schedule suitability.

Learning & Practical: The training will be delivered through different delivery modes like E-learning and blended learning (as shown in Table 3).

Examination: After theoretical training, there will be a short assessment. However, the overall score will consist of Theoretical 40%, and Practical 60%.

Feedback: The feedback stage will contain different evaluations of the course, trainer, and trainee performance. This is in order to measure the effectiveness of the proposed training framework as shown in Figure 3 of the literature review. As well as filling the gap of the identified weakness in the interview with SME that's related to the limitation on the trainer competency, and assessment shortcomings which reflect the personnel actual skill.

Profile Update: A completion certificate will be generated by the system.

Documentation: Attendance recording will be after the course completion.

6. Conclusion

An excellent training program can contribute to enhancing employees' performance in any required HSE-related jobs and reducing the number of incidents where their root causes are the competency of the employee. Hence, it is important to provide HSE training, which will enable the employees to become more aware and considerate of their safety by avoiding health risks. This paper will explain a clear definition of knowledge, competency, and training, along with highlighting the significance of proper HSE training that will have a direct effect on minimizing possible accidents and promoting the performance of the organization as a whole from an HSE point of view. Moreover, this study also investigates the training methods approached globally for employees' training, and the drawbacks of the training programs offered in the present day. Both online surveys and interviews with subject matter experts were used to gather information to find the following shortcomings;

- Lack of employee confidence in performing the job correctly.
- Competency of a trainer and training materials.
- Ineffective delivery modes in the existing training.
- Ineffective assessment evaluation

These gaps were identified, studied, and resolved in the proposed solution of proposing a new training framework of developing custom in-house training utilizing a new practical training room utilizing virtual reality technology. A scenario-based confined space entry activity is carried out as a case study to demonstrate the training framework. This new training framework will be more engaging, consumes less time, practical along with methodological assessment procedure.

Further areas of research for the proposed framework can be in utilizing and investing more of the new technologies that will be fulfilling the identified gaps that are found in today's training programs. However, this will require cost for developing this program of investing in artificial intelligence.

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