# OHS Professional Development and Accreditation in Developing World

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2022

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A thesis submitted to National National University of Sciences and Technology, Islamabad

in partial fulfillment of the requirements for the degree of

Master of Science in

Construction Engineering and Management

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# THESIS ACCEPTANCE CERTIFICATE

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Date: _____

*This thesis is dedicated to my family, friends and my teachers.*

# ACKNOWLEDGMENTS

Countless gratitude to Almighty ALLAH, who is the omnipotent, omnipresent & who blessed with the chance and choice, health, courage, strength, patience and knowledge, enabled me to complete my research work.

I would like to express my sincere gratitude to my research supervisor Dr. Muhammad Usman Hassan, whose countless inspiration and guidance made it possible to complete this research. His patience, motivation, encouragement and immense knowledge helped me during research and in writing of this thesis. I genuinely appreciate the valuable time and personal support accorded by him.

I am also thankful to the committee members, Dr. Khurram Iqbal Ahmed Khan and Dr. Muhammad Umer Zubair for their kind help and guidance during the course of my work.

In the end, I would like to thank my parents, family and my friends for their unconditional love, prayers, support and continuous encouragement.

# ABSTRACT

Historically, the lack of a defined body of knowledge was identified as inhibiting development of OHS professional, the quality of OHS advice and recognition of the profession. The development of a certification process for OHS professionals is inhibited by lack of agreement on the required knowledge. Personal capability is an important factor influencing individual performance. The objective of this study is to develop a capability framework for OHS professionals and investigate the attributes and tasks contributing to their capability to achieve greater safety performance. *Method:* In this study, 116 participants (116 OHS professionals) completed self-administered questionnaires. *Results:* The results of exploratory factor analysis revealed that the capability framework for OHS professionals comprised four levels. It clarifies the roles and required attributes and tasks together with the challenges experienced along the way. It further explores a process for development of capability of OHS professional by suggesting a curriculum that will help establish and guide training programmes in each competence for safety professionals as a way to help them better carry out their tasks and hence manage safety in construction works. *Impact on industry:* This study discusses possible reasons for the influence of the attributes and tasks and explains how the results can contribute to the development of safety capabilities and curricula.

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| | |
|---|---|
| OHS | Occupational Health and Safety |
| OHS BOK | Occupational Health and Safety Body of knowledge |
| INSHPO | International Network of Safety & Health Practitioner Organisations |
| ECC | European Communities Council |
| ILO | International Labour Organization |
| UK | United Kingdom |
| EFA | Exploratory Factor Analysis |
| SIA | Safety Institute of Australia |
| DMAIC | Define, measure, analyse, improve, and control |
| EQF | European Qualification Framework |
| ASSE | American Society of Safety Engineers |
| SME | Subject Matter Expert |
| RII | Relative Index of Importance |
| KMO | Kaiser-Meyer-Olkin |
| OSHA | Occupational Safety and Health Administration |
| IOSH | Institution of Occupational Safety and Health |

*Chapter 1*

# INTRODUCTION

## 1.1. Background

Personal capability is an important factor influencing individual performance (Chang et al., 2012). Capability is required to prevent serious errors and negative results (Axley, 2008). OHS professional should definitely use their capability to get desirable safety performance and to add value to businesses. In 2004, absence of agreed core body of knowledge for OHS professionals was found to be a factor which is limiting professional development (Pryor, 2019; Pryor et al., 2012). Our construction industry lacks competent safety professional because of which projects suffer resulting in work-related injuries and fatalities.

A good understanding of functions and roles of Environmental health and safety professionals, and their respective levels of competency, can develop the capability of Environmental health and safety professionals and augment business support for suggested environmental health and safety projects and programs (Chang et al., 2012; Nagy, 2014). Therefore, capability of Occupational health and safety professionals has become basis of human resource development and management (Gulash, 2015). This introduced a capable OHS professional whose job is to help safety and health be incorporated into several construction process phases (Antonio et al., 2013).

Required skills and knowledge and job activities and the roles for OHS professionals is basically becoming an area of research (Austrailia, 2012). It is important to certify and accreditate those who are providing OHS advice ; however accreditation process was inhibited because there is no agreement on the knowledge required and process for recognizing OHS education programs that address that skills and knowledge (Pryor, 2016). There is no clear approach in the past works examined to the skills, techniques, competencies and tools that OHS professional should apply to his job activity and must be familiar with (Antonio et al., 2013). The absence of an agreed core body of knowledge was found to be factor which is inhibiting OHS professional education, the recognition of profession and quality of OHS advice (Pryor, 2019). A defined agreed Body of knowledge has long been thought to be a basic element of such professionalization (Pryor, 2019). Recently, many studies have been focused on the adoption of different approaches as a way to improve construction safety management.

The main purpose of this study is to create a capability framework informing development of assessment activities of OHS professional. The attributes and skill components of framework play a vital role in developing the professional skills. Describing the basic attributes and tasks needed for building a capability and its incorporation in OHS professional certification program is facilitated.

## 1.2. Previous Studies

Mainly discussed competence compared with capability. A research was conducted to examine the effect of the accreditation and OHS Body of knowledge, modern Australian government steps, on capability and derives impacts of accreditation evaluation to explain the effect on OHS professional development (Pryor, 2016). An objective was to create a framework addressing competency for OHS professionals and to determine attributes adding value to their competency. Questionnaires were conducted, while results showed that competency scale for safety professionals consisted of 5 factors. Most of the variance in competency was described by the factor "health and safety management and training" (Chang et al., 2012).

With the help of expert opinions, it was found that to help increase safety in the works which competencies are required by the health and safety professional. The results of analyses done using the suitable statistical methods, will help training programmes to be planned to make sure that OHS professionals have required knowledge to perform their tasks (Antonio et al., 2013). Described a system for producing OHS Body of Knowledge together with spur for the early exploration, starting the project, the validation and development of the framework. Next, addressed the plan of model by describing the underlying principles and intended users and, then finally addressing the final conceptual structure and meta-paradigm (Pryor, 2019).

International network for safety and health practitioners INSHPO created a framework for practice showing OHS professional organizations across ten countries with outcome witnessed by fifty-three organizations at a ceremonial signing of the Singapore Accord. Found a system for clarifying the required knowledge and skill and roles together with challenges faced all the way (A. Hale & Booth, 2019). Presented a short summary of evolution in United Kingdom which addressed the requirements and roles for education, work and training of budding professionals. Further, traced the steps which've characterized this system of professionalization, summarizing them utilizing as a model, the basis for becoming a recognized profession (Pryor et al., 2012).

## 1.3. Research gap

There is no clear approach in the past works examined to the skills, techniques, competencies and tools that occupational health and safety professional should familiar with and apply to his job activity.

In the previous studies, major focus has been towards development of competency and OHS professional practice but capability has not been focused. Studies performed on the developed world don't apply to the developing countries as the challenges are amplified and the factors are different.

There was no such work done to develop capability framework that can be used for OHS professional development. This introduced a capable OHS professional whose job is to help safety and health be incorporated into several construction process phases.

## 1.4. Research question

To address the research problem, the direction of collecting data can be very well defined by answering some research questions. Following question is the main driver which would help to address the issue:

- What are the different levels of capability of a safety professional and what are attributes and task of a capable safety professional?

## 1.5. Research objectives

The main purpose of this research is, 'OHS professional's development and accreditation in the developing world'. The sub-objectives are:

a. Determining attributes and tasks required in Capable safety professional
b. To Develop capability framework for OHS professional
c. To Suggest strategy for development of a capable OHS professional

## 1.6. Thesis Organization

The thesis consisted of five chapters with chapter 1 covering an introduction to development of OHS professional and chapter 2 describing literature review. Chapter 3

explains methodology used in the research and chapter 4 describing results and analysis. The final (5th) chapter presents the recommendations and conclusions.

*Chapter 2*

# LITERATURE REVIEW

## 2.1. Introduction

Construction work has highest accident rates than any other sector that's why it is considered very high risk in developing world. In 21 December 1987, the European Communities Council ECC named construction industry as one of three highest risk sectors (Antonio et al., 2013). This introduced a capable OHS professional whose job is to help safety and health be incorporated into several construction process phases. One in every six fatalities at job site happens on construction site according to ILO statistics. Gulash (2015) also highlighted the need of competency research to equip environmental health and safety professionals in global environment. Quality of OHS advice and issue of skills and knowledge was highlighted by one of OHS regulators, Work safe Victoria (Pryor, 2016). Department of Human Services and Health Unites states published in 1994 "The main agenda for 21$^{st}$ Century," which also highlighted the issues of education surrounding development of course to make sure that capable professionals can implement potential and existing health functions (Chang et al., 2012). So, there is a terrible need to implement and develop accreditation of safety professional education qualification; and to introduce a certification process for safety professionals to reduce injuries or fatalities.

## 2.2. OHS professional

OHS professional can be defined as, "OHS professional is the one who practices a multidisciplinary Body of knowledge in a different way to give enterprises with some piece of advice on arrangements of organization that will ultimately lead to systematic OHS management to prevent ill health, disease, work related fatality or injury" (Pryor, 2016).

Safety professionals are basically planners of technique regarding OHS management and organization within a broader context of external regulatory and business processes, societal and market influences. Their advice relies on technical and conceptual knowledge of management and operations, design, analysis of evidence, mediated by experience, and critical thought. The role of safety professional needs a deep understanding of unique multidisciplinary BOK regarding risk and reduction of illnesses, injuries and work-related fatalities as well as associated financial losses and property damage. Safety professionals also have a good know

how of a core range of hazard controls and hazards. They may contribute as part of a team, solo or guide others (International Network of Safety & Health Practitioner Organisations, 2017).

### 2.2.1. Evolution of OHS profession

Following elaboration of development of safety professional part is actually based on Pryor et al. (2012) briefing of evolution of profile and role of safety professional. Occupational health and safety has basically been governed by medical profession in the past (Quinlan, 2015). OHS practitioner role started to arise as a technical role in 1970s provided generally by people having trade background, designated following a mishap or incident of illness, work-related injury. The necessity for skilled occupational health and safety qualifications was found out and endorsed by current government, but few people had proper training (Austrailia, 2012).

The 1980s and 1990s witness the occupational health and safety practitioner role evolving into consulting/ advisory role with the start of occupational health and safety qualifications which is provided by sector of higher education (Dawson et al., 1984). The pressure for incorporation of practitioners into management was still there (Dwyer, 1992). The considerable shift to role of management was seen in suggestion that occupational health and safety practitioner should shift to a generalist from a technical expert with excellent management skills and human relations (Brun & Loiselle, 2002; Nrichment, 2000; Osment, 2002).

Legislation of Robens-style has resulted in safety professional with low profile with OHS regulators and national policy makers (Else & Pryor 2012). Rather than a community concern occupational health and safety was a ‘middle order’, ranked far below concern relating road safety, in spite of public relations campaigns by occupational health and safety regulators in the 1990s. Research with mini set ups found small proof of change in community perceptions,with ill-health and work-related injury attributed to ‘person’ factors i.e. lack of training and carelessness (Cowley, 2006). Occupational health and safety are seen as a responsibility of management in Australia; however qualified occupational health and safety advisers have a considerable part and this is also recognised in legislation of occupational health and safety in states.

Community perception and Historical context have much impact on integrity of the profession and OHS professional education. Current position is explained in relation to

disciplinary underpinning and role, occupational health and safety professional programs accreditation and educational requirements.

### 2.2.2. Lack of accreditation of OHS professional

There is proper process of accreditation in United Kingdom for occupational health and safety qualifications that is open for universities in Australia (Agency, 2004). However, role of Australian safety professional has much in common with its United Kingdom counterpart, restrictions of United Kingdom process and criteria were found out at SIA workshop in 2004.

The absence of mechanism of accreditation process for Australian safety professional means that training course approval is only subjected to each institute's internal processes. Implementation of safety professional accreditation system needs identification of approved training courses; however, that system cannot be established without agreed core body of knowledge. This lack will be communicated through 'Body of Knowledge' project that is funded by WorkSafe Victoria as phase of implementation of this project involves criteria development and a proper system for accreditation occupational health and safety programs for for generalist safety professionals (Professionals, 2010).

### 2.2.3. Characteristics of OHS professional & its barriers to professionalization

Wybo Van Wassenhove (2016) & Hudson & Ramsay (2019) suggested some main characteristics of an OHS professional; like definition of organization and mission of management system of safety, risk assessment, advising management and decision makers, diffusion of culture change and safety culture, communication and training, incident and accident investigation, crisis & emergency management, reporting & monitoring, knowledge and experience relevant to workplace etc.

A. R. Hale et al. (2020) also identifies eight barriers to professionalization, being; decision makers & advising management, definition of organization and mission of management system of safety, risk assessment, regulatory compliance, decision makers & advising management, diffusion of culture change and safety culture, communication and training and incident and accident investigation.

### 2.2.4. Benefits of employment of OHS professional on construction sites

According to Antonio et al. (2013), employing OHS professional on construction sites can be very beneficial in so many ways. Work-related injuries or no. of fatalities to workers and personnel on job sites can be reduced through hazard control and prevention. It can further prevent major accidents risk, reduce clerical efforts, time of investigation, loss of experiences, control site risks in order to increase the productivity and minimize legal costs of fines, accident litigation, reducing expenses on supplies of emergency. Considerably reduced number of work-related injuries or fatalities will eventually lead to reduced costs on insurance compensations and other significant expenses that may devastate the company's bottom line.

## 2.3. Competency and capability

### 2.3.1. Competency

Competency is pretty much related with vocational training sector in Australia and considered as leading to educational outcome. Competency can be defined as: "The application of skills and knowledge to standard set for performance needed in workplace. It includes the ability to apply and transfer skills and knowledge new environments & situations (Pryor et al., 2019).

### 2.3.2. Capability

Capability can be defined as: "The theoretical knowledge which supports practice in professions and occupations and the industry specific skills and knowledge which transcend tacit knowledge of workplace and particular workplace" (Wheelahan & Moodie, 2011).

### 2.3.3. Comparison of Competency and capability

Organizations, industries and professions are focusing mainly on capability rather than frameworks of competency (Griffin et al., 2014; Pryor, 2016). There is significant variation in use of terminologies like 'capability' and 'competence' as shown in table 2.1. The difference between capability and competency is important to understand conceptually, while to many people it can only be a difference of terminology.

The main difference between capability and competency is described in detail in capability framework introduction for education leaders that defines capability as considering the future and bringing it about, while competency is about delivering the present or current keeping in mind the past (Pryor et al., 2019; Stephenson & Yorke, 2013) while terminology vary, brief literature review (Hase & Davis, 1999; Phelps, 2002; Stephenson & Yorke, 2013; Wheelahan & Moodie, 2011) shows some significant features that can address the discussion on capability mentioned in Table 2.1.

Capability has a very important part that is competency (Hase & Davis, 1999; Stephenson & Yorke, 2013) but capability is about adaptability & confidence; the effective use and development of skills and knowledge in changing and complex circumstances involving those that have not been experienced in past. This feature basically urged Stephenson to start an argue that, defining competency in means of measurable outcome in contrast to approaches of reductionist, capability defy measurement. Capable people are those that have skills, knowledge, value and self-esteem i.e., they have pretty much confidence in their ability to:

- take appropriate and effective action
- elaborate what do they convey
- Relationship building
- continual learning from experience

**Table 2.1: Comparison of features of competency compared with capability derived from the literature**

| Competency | Capability |
|---|---|
| Workplace related knowledge | Theoretical knowledge relevant to the profession |
| Workplace related skills | Skills underpinned by theoretical knowledge |
| Application limited to defined circumstances | Also applicable in varying and complex circumstances |
| Defined standard for performance | Usually don't have defined standard |
| Regulatory process sets standard | External body sets standard |

## 2.4. Major Contributions towards development of OHS professional

Some of the major contributions towards development of an occupational health and safety professional are as follows;

### 2.4.1. Model of capability

The OHS education accreditation board of Australia has produced a capability model as shown in Fig. 2.1 in working with idea of capability, recognition of OHS as profession and ongoing development of OHS professionals. In model of capability the safety professional holds a framework supported by knowledge gained by means of education which is further mediated and developed through experience. Capability includes some other important factors as: values i.e., respect for others input; personal attributes such as flexibility in changing environments, creativity and self-reliance; and professional practice skills such as leadership. The sharp boundary shows that 'capable' safety professional combines these factors and may apply them in complex, changing and varied circumstances (Pryor, 2016).

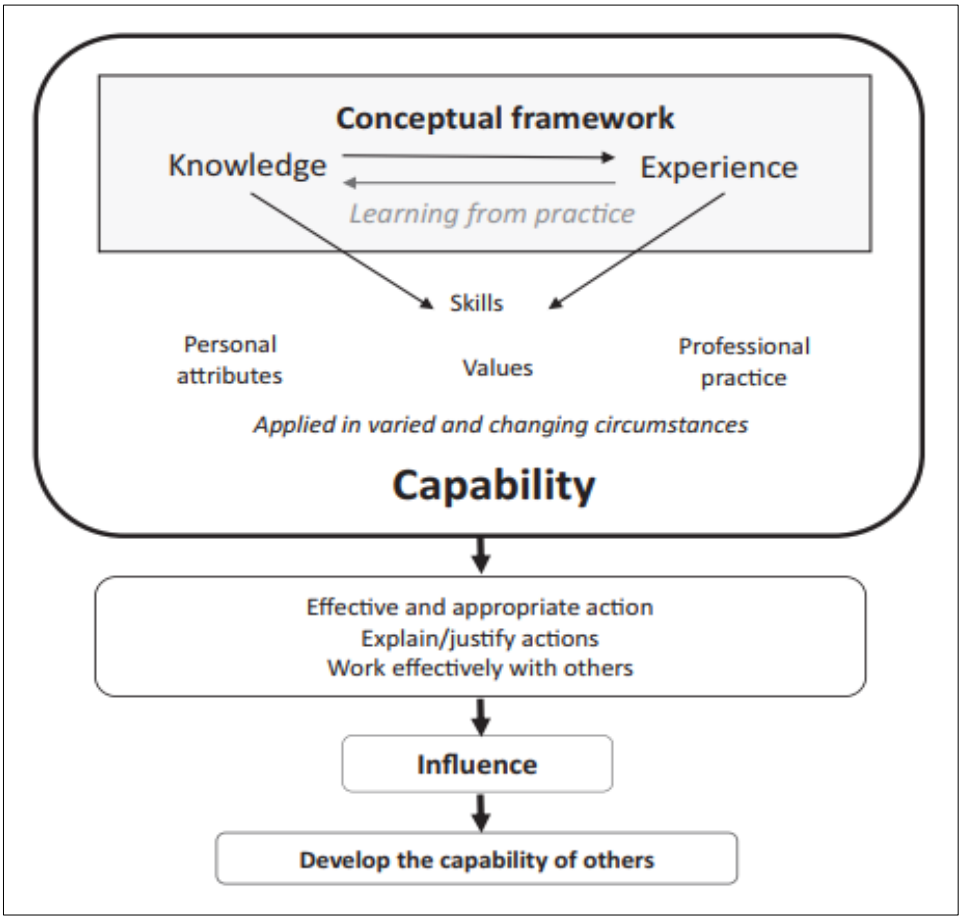


**Fig. 2.1. Model of Capability**

### 2.4.2. Competence model of safety professionals

A competency model for OHS professionals was developed and factors adding value to competency shown in Fig. 2.2, were investigated to get greater safety performance (Chang et al., 2012).

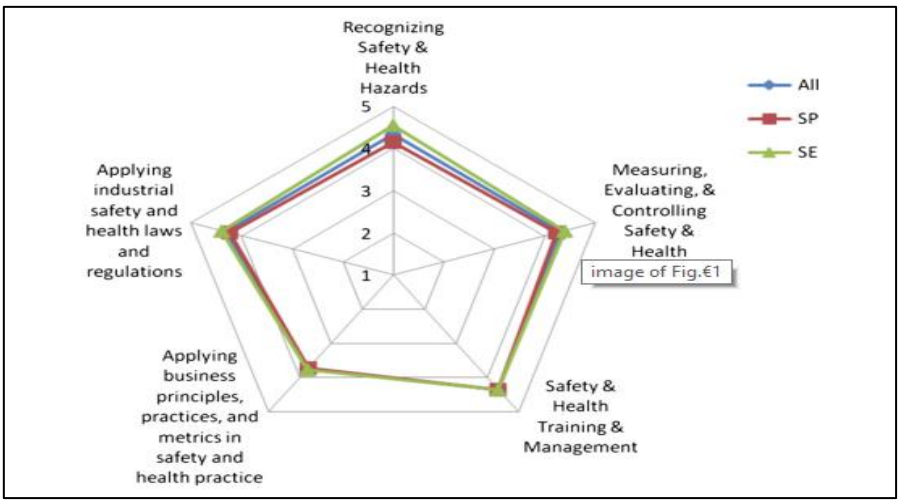


**Fig. 2.2. Competency model for safety professionals**

## 2.5. Studies on Exploratory Factor Analysis

### 2.5.1. General studies using Exploratory Factor Analysis

Chang et al., (2012) developed a safety professionals' competency model and determine the factors adding value to competency of OHS professionals to achieve greater safety performance. So, a professional competency scale was designed which contained 5 domains with total 28 items in it as shown in Table 2.2:

a) Identifying health and safety hazards
b) Controlling, evaluating and measuring health and safety hazards
c) Health and safety management and training
d) Applying business metrics, practices and principles in health and safety practices
e) Applying industrial health and safety regulation and laws

**Table 2.2: Professional competency scale**

| **Professional Competency Scale** | | | |
|---|---|---|---|
| **Recognizing safety and health hazards** | | | **Measuring, evaluating and controlling safety and health hazards** |
| C1 | Recognizing physical hazard | C6 | Measuring and monitoring safety and health hazards |
| C2 | Recognizing chemical hazard | C7 | Controlling safety hazards via engineering measures |
| C3 | Recognizing biological hazard | C8 | Controlling safety hazards via administrative measures |
| C4 | Recognizing ergonomic hazard | C9 | Assessing and testing of personal protective equipment |
| C5 | Recognizing social hazard | C10 | Usage & maintenance of personal PPE |
| **Safety & health training & management** | | | **Applying business principles, practices and metrics in safety & health practice** |
| C11 | Understanding emergency response procedure | C16 | Applying basic financial principles |
| C12 | Performing inspections | C17 | Applying basic statistics |
| C13 | Group dynamics | C18 | Metrics in safety and health leadership |
| C14 | Project management of safety | C29 | Metrics in safety and health culture |
| C15 | Conducting risk management | C20 | Metrics in safety and health performance |
| **Applying industrial safety laws and regulations** | | | |
| C21 | Applying Labour Safety and Health Act | | |
| C22 | Applying Labour Inspection Law | | |
| C23 | Applying Protection for Workers | | |
| C24 | Applying Labour Standards Act | | |
| C25 | Applying Labour Insurance Act | | |

Then we have complete look of Competence Model for safety professionals as shown in Fig 2.2. So, Chang et al., (2012) developed this competency model for safety professionals. The cluster analysis and exploratory factor analysis results made it clear that OHS professional competency scale actually consisted of five main factors which includes identifying health and safety hazards, controlling, evaluating and measuring health and safety hazards, health and safety management and training, applying business metrics, practices and principles in health and safety practices and applying industrial health and safety regulation and laws.

### 2.5.2. Exploratory Factor Analysis

Exploratory Factor Analysis is basically used to reduce/shrink data to small or limited set of summary variables and to find the underlying conceptual structure of whole process. It is a statistical technique which is normally used to find out the correlative relations between variables and to model this correlation with one and more latent variables. A causal relation between manifest indicator and latent variable(s) is assumed in a common factor model – elaborated with all its implications by (Borsboom et al., 2003).

#### 2.5.2.1.Study Design (Number of Items and Sample Size)

It is good to know that sample size in study of Ishiwatari et al. (1991) 20 years ago tend to be lower. The ability of studies relating to Ishiwatari et al. (1991) indicating larger sample size than the average of studies taken under consideration, shows confirmation that sequential education can assist to improve our psychological research.

#### 2.5.2.2.Extraction Method

The choice of suitable extraction method when performing exploratory factor analysis is another important decision. Results of exploratory factor analysis should necessarily be cross validated with confirmatory factor analysis, so we suggest to use LS or ML approaches despite of principal axis factoring as these methods of estimation are available for confirmatory factor analysis as well.one should go for ML estimation for normally distributed data., whereas for ordinal and nonnormal data one should opt WLS estimation. More than one method can work out and results can be checked for matching patterns depending on the particular data as recommended by (Goretzko et al., 2021).

#### 2.5.2.3.Factor retention criteria

Deciding how many factors we should have, been very important issue in exploratory factor analysis because of its basic influential power in EFA. So, more than fifty percent of exploratory factor analysis are based on criteria of multiple factor retention in present research. the percentage raises to eighty percent in articles relating to this article. There are some more papers for exploratory factor analysis suggesting these methods or entirely ignoring some suitable tools. Using CD and PA in collaboration with a descriptive measure like conceptual consideration or explained variance. However, this is most tough decision in exploratory factor

analysis. It is unavoidable to be aware of its results and to address every matter relating to this issue (Goretzko et al., 2021).

### 2.5.2.4.Rotation method

Researchers always try to rotate the component matrix after extraction, to get better results which are easy to perceive. The current research needs transparency, because for 1 out of 5 cases, the method of rotation was not addressed (Goretzko et al., 2021). The highly suggested process by Browne (2001)– only 2 studies used distinct method of rotation and compare distinct solution. Nevertheless, a positive main aspect is that more than seventy percent of all exploratory factor analysis make use of oblique methods of rotation. It has actually been found out that fifty three percent of studies which are examined had used the varimax rotation.

## 2.6. Clarifying OHS roles

OHS professionals are the problem solvers, for different type of problem they are needed to solve range from assisting organizations finding hazards and their associated risks, to control those hazards. Senior managers may call upon OHS professionals to give advice on combating rising and plateauing rates of injury, illness and work-related fatality, suggesting process to give model for OHS action and decision making and interrogating accidents and near misses.

Role of safety professional should be reconsidered as value engineer as opposite to present consideration of role as only an enforcer or a problem solver. The role of OHS professional needs to be that of safety engineer which actually gets works process acting as complete system and suggest solution to augment system of work just before an actual damage or injury is find out or anything goes wrong.

Terminologies as coaching and soft skills are unclear and can be better perceived from view of teaming. Concomitant with soft skills, changing role, which includes relationship building and working effectively with others at various levels of cultural maturity, portraying as skills in demand for safety professionals. The capability to create a series of relationships enables safety professional to positively affect others to bring evolution in practices of organization which are focused on control of risk, which should permit organization to go

towards safety culture ladder (International Network of Safety & Health Practitioner Organisations, 2017).

### 2.6.1. OHS profession

The Occupational health and safety role supports and advices management in entire task of how to manage risk to mitigate or prevent work-related illnesses, injuries and fatalities. This profession is not properly defined globally or locally. The role of occupational health and safety has its origin in so much workplaces as a compliance officer, trained through vocational track and normally engaged at bottom levels of workplace, giving some advice on Personal protective equipment PPE, reactive response and compliance. Nevertheless, the management of occupational health and safety has been grown over a twentieth century, the safety professional is one who is qualified enough or has secured higher education.

Role of occupational health and safety professional is shown in Table 2.3. The Occupational health and safety professional is strategist. Key analyst and advisor in taking charge of OHS risk management (International Network of Safety & Health Practitioner Organisations, 2017).

**Table 2.3: Role of OHS Professional**

| OHS Professional |
|---|
| Designer of model for occupational health and safety for risk management |
| Builds relationships and work effectively with others |
| Produce systems for monitoring. Should indulge in change management and organizational review |
| Considers broader perception of processes of business and societal, market and regulatory influences |
| Action or advice which is actually based on technical and conceptual knowledge |
| Capable enough to get a complete understanding and control to complex and unknown risks |
| Works with responsibility and within own initiative but should welcome or entertain collaboration |
| Normally works in the complex, big and more hazardous organizations |
| Usually qualified or educated enough or has secured higher education. |

### 2.6.2. Scope of practice in context of other professionals and specialists

The main focus or centre of activity for occupational health and safety professional is giving support and advice for management and prevention of illnesses, injuries, work-related fatalities, associated financial and social loss and property damage. Promotion of mental and physical wellness and work health are becoming main areas for safety professional. The role of OHS encompasses management and prevention of hazards of environment and management and promotion of sustainability, in most countries (International Network of Safety & Health Practitioner Organisations, 2017).

### 2.6.3. Six sigma model development

Six sigma is basically set of techniques and management tools which are planned to help improve business usually by minimizing occurrence of error. Six sigma policies look forward to improve quality of manufacturing by eliminating and finding out the cause of flaws and reducing variability in business process and manufacturing. Each project of six sigma has some specified value targets and follows a particular procedure, like increasing satisfaction of customer and minimizing pollution(Ertürk et al., 2016).

### 2.6.4. Six Sigma Levels

The training levels of six sigma should conform necessarily to eligibility, education criteria, job standards and training requirements.

#### 2.6.4.1. Yellow Belt

Here the participant:

- Gets thorough understanding of different procedures and DMAIC
- Reviews improvements in process
- Takes an active part as team member of project

#### 2.6.4.2. Green level

This expertise level necessitates the following criteria:

- Minimum experience of at least 3 years of full-time employment

- Good understanding of processes and tools used for solving the problem
- Should have hand-on practice on projects including some sort of transformation of business
- Complete guidance for projects of black belt in analysis and collection of data
- Lead teams and projects of green belt

### 2.6.4.3.Black level

A candidate must possess following to reach this level:

- Minimum experience of at least 3 years of full-time employment
- Enough experience in main area of knowledge
- Proof should be attached of completion of at least 2 projects of six sigma
- Coaching and training teams of project
- Leading different teams in projects for problem solving
- Demonstration of practice or experience at suggesting solution in challenging situation

### 2.6.4.4.Master Black Belt

A candidate must possess following to reach this level:

- Should have certification of black belt
- Minimum experience of at least 5 years of full-time employment or Proof should be attached of completion of at least 10 projects of six sigma
- Have trained and coached Black and Green belts
- Develop strategies and key metrics
- Proven portfolio of work with individual particular requirements as given for an example
- Have served already as an internal transformation advisor for technologist for six sigma

## 2.6.5. The Six Sigma Certification Levels

Certification of six sigma as shown in Fig 2.3, is just more like system of certification normally practiced in martial arts, actually where professional of six sigma starts with upskills

and white belt his way up to be an expert of pack Expert Black Belt; or get a combined certification which been offered by institutions.

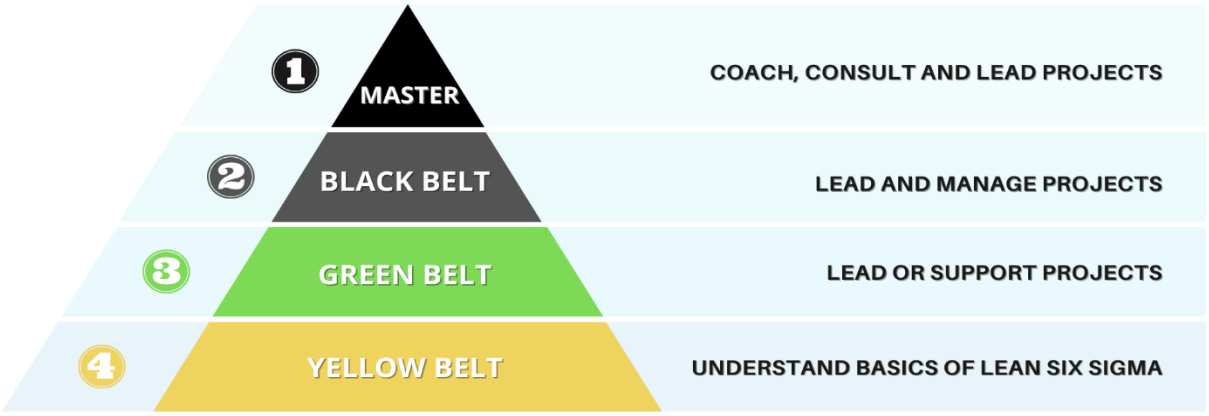


**Fig. 2.3. The four-tiered levels of Six Sigma Certification (Ertürk et al., 2016)**

## 2.7. Attributes and tasks of OHS Professional

The attributes and tasks of a capable occupational health and safety professional are as follows;

### 2.7.1. Attributes

The health and safety department in an organisation is just as important as other operations. The person who are basically responsible for ensuring pleasant and saft environment for working are safety and health officer, and whole credit goes to them for success of organization's safety and health program. The personal attributes and qualities of such people are important in impressing employees to get most advanced safety level while exceeding and maintaining requirements of productivity. Some main safety professional's attributes include;

- Build Relationships
- Effective communication
- Maintain a proactive approach
- Leadership
- sound knowledge on legal requirements

- Incident investigation ability
- Develop positive safety culture
- Continual Improvement

### 2.7.2. Tasks

An OHS professional, is a main person or key professional in the environment of work. Safety professionals usually give advice on monitoring, safety management, workplace reporting and work effectively with others to ensure safety at the workplace. Some important OHS professional tasks are following;

- Lay out a vision for safety
- Monitor and find out hazardous situations, normally involves categorization of risk
- Try to reduce hazards and control risk in workplace
- Developing measures to assure personnel safety
- Train and develop around your emergency response plan.
- Track and create objectives related to the safety, goals and metrics for organization
- Investigate near-misses or incident
- Enforce safety processes and standards
- Make sure to conduct analysis of job hazard
- Track, investigate and record all incidents to find root cause
- Communicate and interact with some governing bodies and labour department because it is regarding health and safety
- Make sure that whole staff is equipped for roles and has completed the necessary training

## 2.8. Capability frameworks in OHS

International Network of Safety & Health Practitioner Organisations (2017) has created this document (shown in Table 2.4) to:

- To facilitate and to highlight the importance of role of occupational health and safety professional

- Position the occupational health and safety professional as leader, strategist and key advisor in fully integrating OHS risk management into business practice which is sustainable.

This framework is basically designed for main targeted 6 audiences: Occupational health and safety professionals, Occupational health and safety professionals and concerned certification bodies, Community, Recruiters and employers, Occupational health and safety educators and Occupational health and safety regulators.

The document encourages a relatively high status of capability for occupational health and safety professionals and also informs regulators and employers as to distinguish between capabilities of OHS professional and OHS practitioner. The most important and main part on skills and knowledge set benchmark for occupational health and safety associations and training bodies and education in producing the professional development which is continual, educational programs and certification schemes detail. It is known that dissimilarities will rather be there in emphasis and terminology across various countries based on industry mix, history, regulatory and legal frameworks.

This document was produced by distinguishing document given by occupational health and safety certification bodies and occupational health and safety professional bodies for European Union countries, United States, Russian federation, Singapore, Canada and Australia. Difference in the organizing principles and structure of this framework lent itself to development of new structure. This structure is actually explaining the activities of occupational health and safety practitioners and occupational health and safety professionals at generic level that permits for differences in culture, regulation and histories.

This framework begins by explaining occupational health and safety professional roles. It also addresses position profiles that explains the basic roles in context of organization. It declares then these gradations are somehow regarding dissimilarities in occupational health and safety management maturity in employing organization. Lastly it just addresses the hazards, knowledge, skills and activities that occupational health and safety professional may be expected to give some advice on.

To make use of this document, online tools and guidelines have been produced to help support different target audience basically in applying document for their specified context and purpose (International Network of Safety & Health Practitioner Organisations, 2017).

**Table 2.4: Position profiles for OHS Professional**

| | Professional Level 1 | Professional Level 2 | Professional Level 3 |
|---|---|---|---|
| **Position details** | | | |
| **Representative titles** | **Graduate OHS Advisor** | **OHS Manager** | **General/Group Manager, OHS/Safety VP/Director OHS/Safety** |
| **Purpose of OHS professional role** | To support maintenance and development of healthy and safe work environment. | To apply specialist knowledge and skills of occupational health and safety base to give strategic support and direction to managers. | To set lead development and corporate direction of strategy for occupational health and safety by applying specialist skills |
| **General reporting line** | In large organizations as OHS manager<br><br>MD/CEO in small organizations | In large organizations as GM<br><br>MD/CEO in small organizations | Risk Head<br><br>Chief Executive Officer |
| **Professional Parameters** | | | |
| **Autonomy** | Does his job under broad direction, in the form of team or independently; accountable for meeting deadlines | Makes judgements; provides guidance | Makes independent judgements relating strategic and technical OHS issues |
| **Leadership/ Influence** | Builds external and internal relationships to help OHS site personnel and line managers to achieve their objectives | Builds relationships with senior management | Build long-term relationships with operational managers and senior management |
| **Knowledge and skills** | | | |
| **Knowledge** | Demonstrates understanding of OHS concepts with depth of strategic and technical knowledge | Makes sure understanding of technical knowledge and OHS concepts within coherent OHS BOK | Demonstrates integrated and advances understanding of complex body of OHS knowledge |
| **Evaluate and analyse information** | Apply technical and cognitive skills to review and critically evaluate information from internal and | Apply technical and cognitive skills to review and critically evaluate information to evaluate and | Apply technical and cognitive skills to analyse and investigate complex information and to generate new ideas |

| | | | |
|---|---|---|---|
| | external sources to inform OHS practice | generate complex ideas | |
| **Solving problem** | Applies information gathering, judgment, critical thinking and communication skills to analyse and identify complex occupational health and safety problems | Applies information gathering, judgment, critical thinking and communication skills to analyse and identify complex occupational health and safety problems to generate evidence-informed solutions | Applies some critical reflection to established theory and synthesize information from several sources to generate evidence-informed solutions within business environment |
| **Qualifications** | | | |
| **Qualification level** | EQF 6/AQF 7 | EQF 6/AQF 8 | EQF 7/AQF 9 |

## 2.9. OHS professional curriculum development

Hudson & Ramsay (2019) performed research with a twofold: 1 (to explain how OHS curriculum was developed and how new standards were produced for discipline of OHS from that; and 2) especially by leveraging the following set of education standards and OHS model curriculum, how road map may be developed for professionalization of discipline of OHS which of course contains occupational closure.

The authors suggested that American society of safety professionals should sponsor 02 national workshop to produce a minimum core of competencies of occupational health & safety. Thirty-one OHS subject matter experts were called to meet in April 2015 to start the system of producing a set of knowledge domains which would define the intellectual core of profession. The main purpose of each workshop was to have subject matter experts define and identify the knowledge domains of OHS, then capabilities in every domain which could be further utilized to develop an academic program (Voorhees, 2001). Another meeting was conducted on in January 2016 after the success of first workshop.

The main focus of meeting held afterwards was twofold: 1) to confirm the basic support of knowledge domain definitions and titles; and 2) to brief a set of outcome-based competencies for every domain.

### 2.9.1.1.Evidence- based:

The safety professional will make use of evidence and research to incorporate practical solutions into main organizational goals.

OHS literature explains the necessity for evidence-based practice, involving the further necessity to advance from old practices of safety, i.e. education, engineering enforcement and controls, to research-based & models of continuous improvement (Management & Standard, 2014). Elaborated the expectation of implementing practice based on evidence in their hiring guide definition which articulates the function and scope of OHS practitioner.

### 2.9.1.2.Communication

The safety professional will communicate effectively with employees, colleagues and stakeholders, and promote mutual respect to enhance worker health and safety. Verbal and written communication effectiveness are needed throughout one's career and education (McAdams et al., 2011).

Ramsay & Hartz (2017) found that absence of effective communication plays an important part in deaths of construction worker and once mentioned, contributed to risk management. Another study commissioned by Ramsay & Hartz (2017) explored that lack of communication between leadership of organization and OHS professionals as the source of important perception gap.

### 2.9.1.3.Risk Management

The safety professional will contribute to process of earning powers and saving assets of an organization by reducing effects of loss.

Risk management is fundamental part of OHS professional practice and it definitely exists in professional organizations. Ramsay & Hartz (2017) define the main purpose of OHS professional as, to provide an understanding of OHS professional role as leader, strategist and key advisor in sustainable business practice and risk management. The management systems of OHS that are identified in occupational safety and health administration's Voluntary protection program are designed on process of continuous improvement which includes risk management (Fred A. Manuele, 2006).

### 2.9.1.4.Business Skills

The safety professional will be able to execute, articulate and develop a business case for taking care of or managing the company's external or internal assets, community and the stakeholders.

Various solutions explain the necessity for approach of business solution and its alignment with organizational goals, to positively influence organizational change and further position controls on hazard and as a way to ensure sustainability of business (Ramsay & Hartz, 2017).

### 2.9.1.5.Leadership

The safety professional will have an ability to impact the behaviour of work groups, systems and individuals in a way which will assist in achieving the organizational goals.

Leadership occurs in context or is situational and is learnable (Parks, 2007). Employers demand for much more leadership from safety graduates of bachelor's-level with communication skills and additional leadership (McAdams et al., 2011). Ramsay & Hartz (2017) explains safety leader as "one who impacts others in company regarding safety". Geller (2000) has provided qualities i.e., outcome, learning, listening and process as a way to drive total culture of safety.

### 2.9.1.6.Informatics

The safety professional will have an ability to use and gather the technology and basic information to effectively communicate, support decision making, mitigate risk and manage knowledge.

Ramsay & Hartz (2017) explains in detail the publishing of an final report as "important for a occupational health and safety professional's connection with management". Massachusetts Department of Higher Education (2010) found eleven knowledge domains containing informatics, that is "making use of technology and credible information to effectively communicate, support decision making, mitigate risk and manage knowledge". Transference of basic technical knowledge to people with huge range of cultural skills and language is a most needed skill set found in NIOSH's national occupational health and safety workshop assessment research (McAdams et al., 2011).

### 2.9.1.7.Professionalism

The safety professional would be held accountable to develop workplace programs & advocacy practices of worker safety and health in socially responsible, moral, ethical and legal manner.

From the last fifty years, American society of safety professionals ASSE has been striving to stick to the journey of professionalization. Ramsay & Hartz (2017), criteria for developing the functions and scope of the professional position of safety, defines the safety professional as one who has a "relatively much high competence standard, informing regulators and employers as to the OHS professional capabilities and giving credible data to be used in certification process and professional education.

In the previous studies, major focus has been towards development of competency and OHS professional practice but capability has not been focused. Studies performed on the developed world don't apply to the developing countries as the challenges are amplified and the factors are different.

There was no such work done to develop capability framework that can be used for OHS professional development. This introduced a capable OHS professional whose job is to help safety and health be incorporated into several construction process phases.

*Chapter 3*

# RESEARCH METHODOLOGY

## 3.1. Introduction

This chapter chronologically describes the method adopted for research and steps that are taken to conduct the study. Research strategy depicts that actually how researchers are carrying out their study to answer and achieve objectives of research (Saunders et al., 2007). brainstorming sessions, interviews and questionnaire survey are main methods for generating and collecting data of research. The purpose of this research is to develop a capable OHS professional in developing world. Research methodology adopted in this research is shown in figure 3.1.

## 3.2. Research question

In order to address the research problem, the direction of collecting data can be very well defined by answering some research questions. Following question is the main driver which help to address the issue:

- What are the different levels of capability of a safety professional and what are attributes and task of a capable safety professional?

Finding the attributes and tasks of a capable safety professional is a very important step to answer our first research question. Responses to this will help in proposing capability framework so we could accreditate our existing OHS professionals. Proposed capability framework will help in evaluation of performance as main basis for professional development, in employing OHS personnel and in creating position descriptions for roles of OHS.

## 3.3. Research Methodology

The methodology adopted in this research applies exploratory factor analysis. Attributes and tasks which we found came from literature, then we have validated them after conducting brainstorming sessions with experts. The literature data was acquired from different research articles after thorough literature review and the field data was collected via questionnaire-based surveys. It is mainly a Three-Stage research process as shown in Figure 3.1 and all three stages are explained in detail as follows.

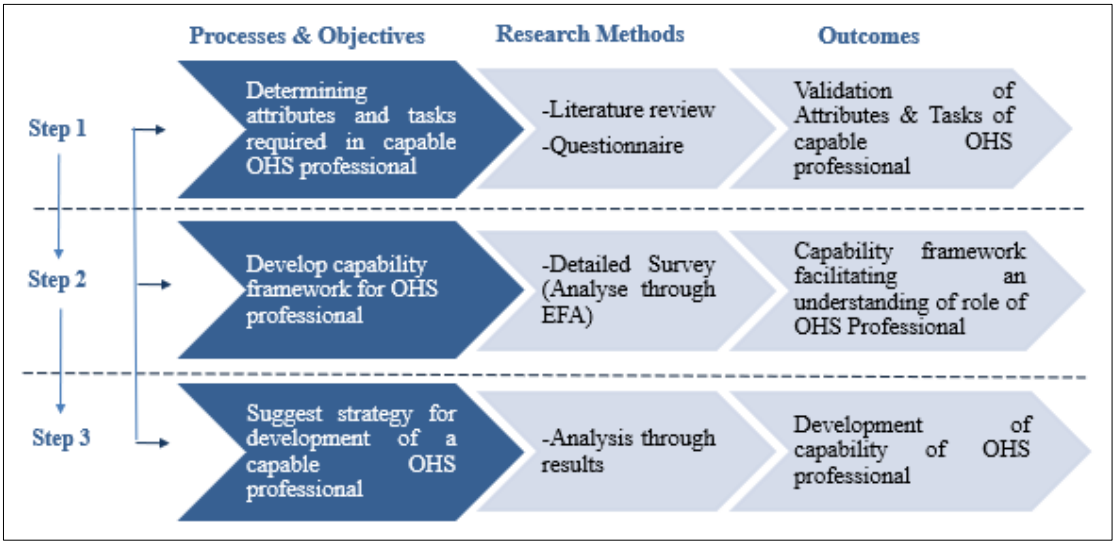


**Fig. 3.1 Research Methodology**

### 3.3.1. Literature Score

In the first stage, the research problem was identified from research gap and problem statement, which led to the formulation of research objectives. The extensive study of literature was carried out from research articles, conference papers and relevant books to establish the research gap. It was identified from the previous literature studies that there are different attributes and tasks of OHS professional in OHS contributing towards capability of OHS professional. These attributes and tasks play an important role in providing a capability framework for OHS professional, which needs to be highlighted and studied. Considering all these trends and research gaps, the research objectives of the study were formulated and finalized.

Firstly, the attributes of OHS professional were identified from critically examining the literature and a total of 16 attributes were identified. Secondly, the tasks of OHS professional were identified from critically examining the literature and a total of 13 tasks were identified. The identified attributes and tasks were then ranked by performing content analysis. In the literature analysis, the identified attributes and tasks were given a literature score based on the frequency of its occurrence in literature and its significance, as assessed by each respective author, on a three-point Likert scale (1=Low, 3=Medium and 5=High) (Ullah et al., 2016). Hence, the literature score was calculated for each attribute and task by finding the product of

its frequency and impact score, respectively. The literature score was also normalized before using it for further analysis. Table 3.1 shows the details of all attributes of OHS professional including their normalized score, cumulative score and ranking.

**Table 3.1: Accessed Attributes of capable OHS professional**

| Attributes of OHS professional | Normalized Score | Cumulative Score | Ranking |
|---|---|---|---|
| Knowledge and experience relevant to workplace | 0.100660396 | 0.100660396 | 1 |
| Technical Competence | 0.089453672 | 0.190114068 | 2 |
| Effective communication | 0.087052231 | 0.2771663 | 3 |
| Influence and develop OHS Capability of others | 0.08425055 | 0.36141685 | 4 |
| Relationship Building | 0.070042025 | 0.431458875 | 5 |
| Effective and appropriate action | 0.068441065 | 0.49989994 | 6 |
| Explain/justify action | 0.066639984 | 0.566539924 | 7 |
| Personal attributes (learning ability, education, professional practice) | 0.065639384 | 0.632179308 | 8 |
| Continual Improvement | 0.062037222 | 0.69421653 | 9 |
| Ability to follow ethical code of practice | 0.0548329 | 0.74904943 | 10 |
| Commitment to project | 0.050830498 | 0.799879928 | 11 |
| Accident investigation ability | 0.046427857 | 0.846307785 | 12 |
| Management and Leadership aspects | 0.045827496 | 0.892135281 | 13 |
| Benchmark for knowledge, education and training | 0.042225335 | 0.934360616 | 14 |
| Agreed body of knowledge for OHS | 0.033019812 | 0.967380428 | 15 |
| Ability to learn from past | 0.032619572 | 1 | 16 |

Table 3.2 shows the details of all tasks of OHS professional including their normalized score, cumulative score and ranking.

**Table 3.2: Assessed Tasks of capable OHS professional**

| Tasks of OHS professional | Normalized Score | Cumulative Score | Ranking |
|---|---|---|---|
| Safety and health training and management | 0.156536201 | 0.156536201 | 1 |
| Hazard and risk assessment | 0.14448083 | 0.301017032 | 2 |
| Monitor health and safety compliance | 0.137396352 | 0.438413383 | 3 |
| Design and Evaluate SH&E programs (objectives, planning, audits) | 0.137330302 | 0.575743685 | 4 |
| Labour safety and health Management | 0.066270193 | 0.642013878 | 5 |
| Accessing and analysing Information | 0.066138094 | 0.708151972 | 6 |
| Resource management | 0.059648061 | 0.767800034 | 7 |
| Emergency and crisis management | 0.059251764 | 0.827051797 | 8 |
| Strategic planning and goal setting | 0.046535897 | 0.873587695 | 9 |
| Cost optimization | 0.045611203 | 0.919198898 | 10 |
| Innovation | 0.027660246 | 0.946859144 | 11 |
| Applying industrial safety and health laws and regulations | 0.026933701 | 0.973792845 | 12 |
| Application of theoretical knowledge as underpinning practice | 0.026207155 | 1 | 13 |

## 3.3.2. Field Validation

After literature analysis, brainstorming sessions with experts were conducted to include input from field professionals' as well, for the purpose developing the capability framework. The technique of judgement sampling was adopted to find out the experts for particularly for brainstorming session. The main and important drawback of this technique is that the data is taken from some specific people, which actually limits randomness in data of sample. This issue can be addressed by choosing some reliable experts in particular field (Islam et al., 2019). In this research, a panel comprising of some particular 3 representatives from field of OHS dealing, were engaged in three group sessions of brainstorming. Since it was already planned to carry out a survey later, and the basic aim of these sessions of brainstorming was to filter out

initial set of chosen attributes and tasks of capable OHS professional, a little group of some reliable people was deemed to suffice.

A number of previous studies made use of some particular group of experts to filter out their theoretical presumption prior to conducting a survey (Tripathi & Jha, 2018; Zahoor et al., 2017; Zubair & Zhang, 2020). All three-session conducted for brainstorming continued for two hours, provided an opportunity to explore and understand the information which is actually based on experience of experts, each of whom had experience in field of OHS around 15 years.

The proposed attributes and tasks of capable OHS professional were emailed to members of panel before the first session started, to explain them a purpose of research. At the beginning of meeting, a small introduction was given to expert panel about the usefulness of included attributes and tasks. The panel consisting of experts found out that there was major lack of capable OHS professional in our industry to prevent work-related fatality or injury or illnesses, which shows the contribution of this research towards our industry. The panel acknowledged that proposed attributes and tasks are collectively contributing towards development of capability of OHS professional; however, However, there main concern was that since so many factors were needed to be evaluated, so factors of least importance should be removed. The panel suggested (1) removing the three attributes "Influence and develop OHS Capability of others, Personal attributes (learning ability, education, professional practice), Continual Improvement", and (2) removing three attributes "Ability to follow ethical code of practice, Benchmark for knowledge, education and training, agreed body of knowledge for OHS". After the implementation of these suggestions, we were left with 10 attributes in total. An email containing new list of attributes was sent to three experts and one more session for brainstorming was requested.

The panel members suggested reducing the number of tasks of OHS professional in the second session. The panel suggested (1) removing two tasks "Applying industrial safety and health laws and regulations, Application of theoretical knowledge as underpinning practice". After the implementation of these suggestions, we were left with 11 tasks. The tasks were modified or reduced according to recommendations of panel members and later results were sent to them. The members of panel critically went through each attribute and tasks in the third session. The panel members showed satisfaction with the 10 attributes and 11 tasks after small discussion, which were used for questionnaire later.

### 3.3.3. Field Survey

After conducting brainstorming sessions, field survey was conducted. As the area of study of this research was limited to developing countries, the questionnaire was only circulated to developing countries of the world. Questionnaire survey is one of the main sources of gathering data in this research work. In order to solicit the opinion of expert professionals in field of occupational health and safety research, a structured online questionnaire survey was used for gathering the required data. Questionnaires are used to collect data by asking people to respond to a same set of questions. The data collected is usually analysed by using different computer tools and techniques (Saunders et al., 2007).

An online questionnaire survey is somehow an easiest and 37 fastest ways for the collection of primary data, globally. It enables the researcher to reach those respondents who are at a far geographical distance in a shorter time span. While taken in consideration all the challenges and limitations, so much effort and time was invested for preparation of questionnaire survey.

For collecting the survey data, an influence matrix questionnaire was developed through Google forms (Rasul et al., 2019) comprising of three sections. The first section inquired about personal information including respondent's organization, years of professional experience and field of work. After the initial information, the respondents were then questioned to rate the magnitude of importance of each attribute of OHS professional on a five-point Likert scale (1= Not Important, 3= Somewhat Important and 5= Very Important) in section 02. While in section 03, the respondents were then questioned to rate the magnitude of importance of each task of OHS professional on a five-point Likert scale (1= Not Important, 3= Somewhat Important and 5= Very Important).

The survey was floated to developing countries across the globe through online social and professional community platforms such as Facebook®, LinkedIn®, via email etc. The survey was conducted from Aug-Dec 2021 and consequently a total of 116 responses were gathered from different countries. As generally acknowledged, a minimum sample size of 30 or above is required to satisfy the central limit theorem (Chan et al., 2018). Once the data was collected, it was then arranged and responses were evaluated for reliability and consistency using basic statistical tools. The Cronbach's coefficient alpha method was applied for measuring the consistency and reliability of collected data. The minimum acceptable value for

Cronbach's alpha is 0.7 (Wang et al., 2019). The collected data had a Cronbach's alpha value of 0.88 for attributes and 0.86 for tasks, which is a good value in terms of reliability and consistency of data. After the evaluation of collected survey data, Relative Importance Index (RII) method was adopted to rank important relations. The RII is a statistical method which is used to rank factors (Hossen et al., 2015; Muneeswaran et al., 2020). Equation (1) was used to calculate the RII as follows:

$$\textbf{Relative importance index (RII)} = \frac{\sum \mathbf{W}}{\boldsymbol{A}*\mathbf{N}} \quad \textbf{……. Eq. 1}$$

where,

W = weight assigned in Likert scale (ranging from 1 to 5),

A = maximum weight assigned in the scale (i.e., 5 in this study), N = Number of respondents in total (i.e., 116 in this study)

The value of RII is directly related to the importance of the factor or relation or category. If the RII value of any factor is closer to 1, it means that the factor is important and vice versa. According to Rooshdi et al. (2018), the RII has been categorized into five levels such as RII scores ranging from 0 to 0.2 as '*Low*', 0.2 to 0.4 as '*Medium-Low*', 0.4 to 0.6 as '*Medium*', 0.6 to 0.8 as '*High-Medium*' and 0.8 to 1 as '*High*'. RII value of attributes of OHS professional are shown in Table 3.3.

**Table 3.3: RII of Attributes of OHS professional**

| Attributes of OHS professional | RII | Ranking |
|---|---|---|
| Knowledge and experience relevant to workplace | 0.855 | 1 |
| Technical Competence | 0.811 | 2 |
| Effective communication | 0.810 | 3 |
| Effective and appropriate action | 0.781 | 4 |
| Ability to learn from past | 0.767 | 5 |
| Management and Leadership aspects | 0.765 | 6 |
| Accident investigation ability | 0.756 | 7 |
| Relationship Building | 0.696 | 8 |
| Explain/justify action | 0.665 | 9 |
| Commitment to project | 0.634 | 10 |

Table 3.4 shows the RII value of tasks of OHS professional.

**Table 3.4: RII of Tasks of OHS professional**

| Tasks of OHS professional | RII | Ranking |
|---|---|---|
| Hazard and risk assessment | 0.862 | 1 |
| Safety and health training and management | 0.837 | 2 |
| Labour safety and health Management | 0.808 | 3 |
| Accessing and analysing Information | 0.743 | 4 |
| Emergency and crisis management | 0.742 | 5 |
| Design and Evaluate HSE programs | 0.732 | 6 |
| Strategic planning and goal setting | 0.696 | 7 |
| Monitor health and safety compliance | 0.681 | 8 |
| Resource management | 0.665 | 9 |
| Cost optimization | 0.639 | 10 |
| Innovation | 0.627 | 11 |

## 3.4. Exploratory Factor Analysis

The main purpose of conducting survey was to develop a capability framework. So, first survey was analysed using exploratory factor analysis. Exploratory Factor Analysis is basically used to reduce/shrink data to small or limited set of summary variables and to find the underlying conceptual structure of whole process. It is a statistical technique which is normally used to find out the correlative relations between variables and to model this correlation with one and more latent variables. A causal relation between manifest indicator and latent variable(s) is assumed in a common factor model – elaborated with all its implications by (Borsboom et al., 2003).

The approach used in this analysis is linear and sequential, despite exploratory factor analysis actually being an complex statistical method apparently (Zientek, 2008). Exploratory factor analysis has following objectives (Marjorie A. Pett et al., 2003; Zientek, 2008) are:

- Prove theories which are already proposed
- Examination of variables structure or relationship
- Evaluation of validity of construct in questionnaire

- Unidimensionality of detection and evaluation of constructs
- Reduce the number of variables
- Theoretical constructs development
- Explore the multicollinearity among correlated factors

There are some five major methodological issues that one should necessarily take into consideration while applying exploratory factor analysis according to (Ishiwatari et al., 1991). First one is to find as if exploratory factor analysis is the most suitable method to achieve aim of the study. Second one is nature; sample size and variables of the study should be selected. Third is procedure of selection should be selected and then to find suitable method to decide that how much factors should be retained. Fifth, one should choose suitable rotation method to get a final solution which should definitely be interpretable or easy to perceive. Above mentioned issues should be properly followed, failure to make appropriated decision may limit utility of exploratory factor analysis (Hogarty et al., 2005). Steps included in exploratory factor analysis are shown in Figure 3.2.

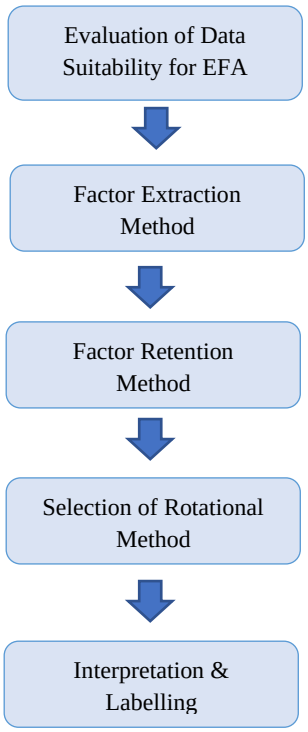


**Fig. 3.2. Steps of Exploratory factor Analysis**

### 3.4.1. Conceptual Model

Exploratory Factor Analysis is basically used to reduce/shrink data to small or limited set of summary variables and to find the underlying conceptual structure of whole process. It is a statistical technique which is normally used to find out the correlative relations between variables and to model this correlation with one and more latent variables.

When survey is analysed using exploratory factor analysis, this method finds the relationships (highly correlated variables adopts the form of group) between the variables in order to reduce big number of variables to small composite factors as shown in Fig 3.3. So, the final small set of composite factors which we get is basically a result of finding relationships in the data.

After getting the composite factors, it is interpreted that what sense do factors make. Interpretation is a system of examination to choose variables that are attributable to construct and suggesting a name to that construct. The labelling or naming of construct is inductive, theoretical and subjective process (Marjorie A. Pett et al., 2003; Taherdoost et al., 2014). It is to make sure that at least two or three variable must load on factor to provide a meaningful interpretation(Henson & Roberts, 2006).

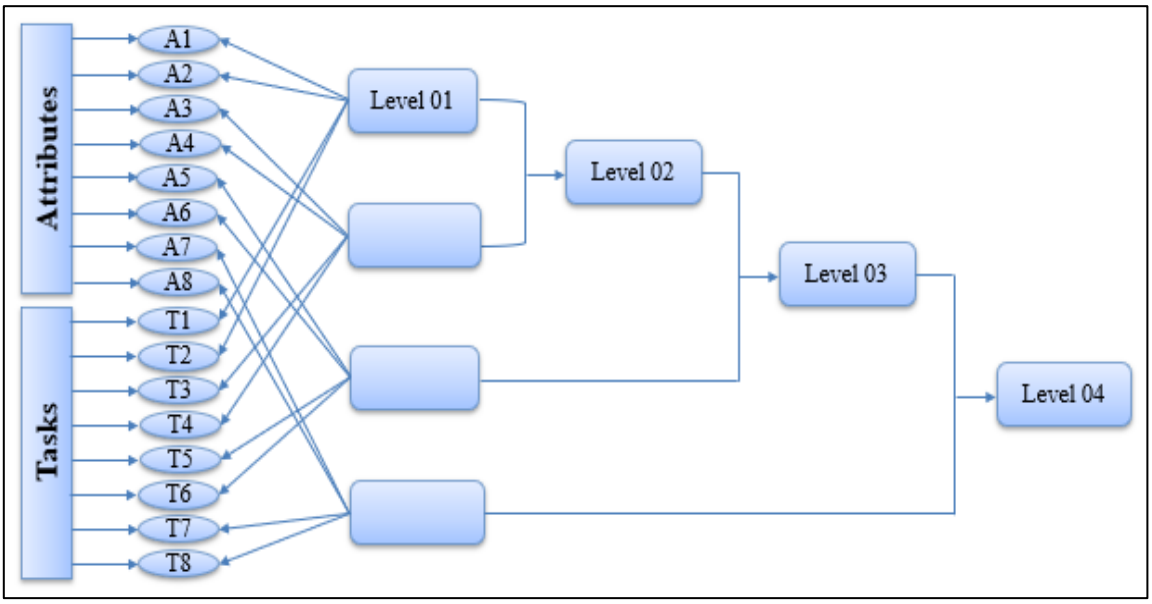


**Fig. 3.3. Conceptual Model of EFA**

## 3.5. Demographics of Survey

The demographics of survey includes the following;

- Professional Experience
- Designation in field of safety

### 3.5.1. Professional Experience

The respondents had varying years of professional experience. Figure 3.4 shows the distribution of professional experience of respondents in years. Most of them (24.1%) had professional experience ranging from 10 to 15 years, while 14.7% of them had professional experience of 15 to 20 years, 16.4% of them had experience of above 25 years, 9.5% of them had professional experience of 1 to 5 years, 19.8% of them had experience of 5 to 10 years, and 15.5% had 20 to 25 years.

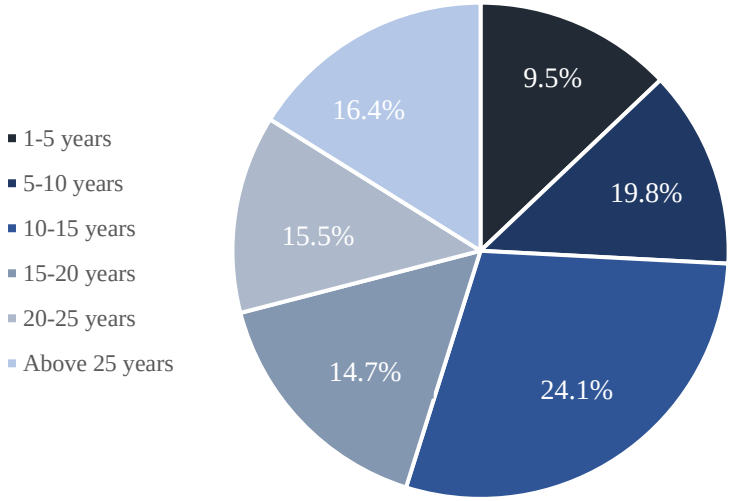


**Fig. 3.4: Professional Experience**

### 3.5.2. Designation in field of safety

The respondents were also classified for their organizational type as shown in the Figure 3.5 below. Majority of the respondents were safety professionals (60.3%) while 47.4% respondents were safety managers, 12.9% were safety educators, 25.9% were safety engineers

and 9.5% of the respondents were others. The distribution of professional experience shows the integration of input from all categories of responses.

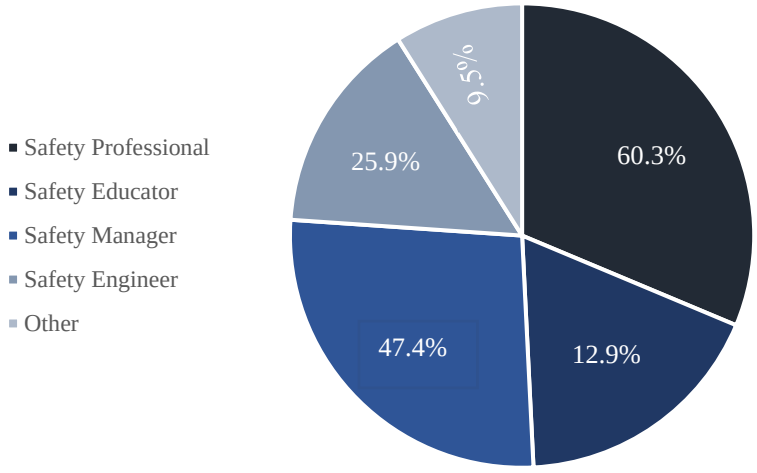


**Fig. 3.5: Designation in field of safety**

So, in research methodology, firstly research questions were raised, then attributes and tasks of OHS professional were identified through literature review and after that they were validated by conducting brainstorming sessions with experts. Later, a detailed survey is conducted on those shortlisted attributes and tasks to develop a capability framework. Once the data was collected, it was then arranged and responses were evaluated for reliability and consistency using basic statistical tools. The two statistical tests Cronbach's alpha and Relative Importance Index (RII) test was applied to responses.

*Chapter 4*

# RESULTS AND ANALYSIS

This chapter presents and explains the results and analysis of survey developed using exploratory factor analysis approach in this research. The capability framework designed to develop capability of OHS professional as well as its respective four levels contributing towards capability of an OHS professional are explained here.

## 4.1. Statistical test on Survey

Following are the lists of tests applied to survey;

- Kaiser-Meyer-Olkin (KMO)
- K1 - Kaiser's eigenvalue > 1
- Scree Test

### 4.1.1. Kaiser-Meyer-Olkin (KMO) and Bartlett's Test

There are some tests as shown in Table 4.1 that must be carried out to check the suitability or appropriateness of data and adequacy of the sample for factor analysis, before the extraction of constructs. Measures of sampling adequacy as shown in Table 4.2, basically checks how tightly correlated an item is with other items in exploratory factor analysis correlation matrix. A chi-square output which should be significant, is provided by bartlett's test of sphericity. The data is suitable for factor analysis if its significance is less than 0.05 and it shows that matrix is not an identity matrix.

In short, Bartlett's test of sphericity shows that item correlation matrix is not an identity matrix and KMO shows adequacy of sample, which means one can move forward with EFA.

**Table 4.1: KMO (sig > 0.5) and Bartlett test of sphericity (sig < 0.05)**

| | | |
|---|---|---|
| Kaiser-Meyer-Olkin Measure of Sampling Adequacy. | | 0.905 |
| Bartlett's Test of Sphericity | Approx. Chi-Square | 2449.150 |
| | df | 210 |
| | Sig. | 0.000 |

**Table 4.2: KMO Measure of Sampling Adequacy**

| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Knowledge & experience relevant to workplace | .898[a] | 0.092 | 0.000 | -0.173 | 0.125 | -0.189 | -0.069 | -0.236 | -0.076 | -0.313 | 0.095 | -0.524 | -0.026 | -0.025 | 0.058 | 0.194 | 0.213 | 0.164 | -0.049 | 0.245 | -0.101 |
| Technical Competence | 0.092 | .906[a] | 0.030 | -0.306 | 0.010 | -0.188 | 0.004 | 0.041 | -0.215 | 0.069 | -0.298 | -0.234 | 0.080 | 0.036 | -0.055 | 0.043 | 0.094 | 0.097 | -0.077 | 0.214 | -0.110 |
| Effective Communication | 0.000 | 0.030 | .926[a] | -0.385 | 0.188 | -0.521 | 0.005 | 0.078 | -0.323 | -0.022 | -0.105 | -0.152 | 0.065 | -0.084 | 0.106 | 0.185 | -0.156 | -0.112 | -0.100 | -0.009 | 0.042 |
| Relationship Building | -0.173 | -0.306 | -0.385 | .889[a] | -0.245 | 0.242 | -0.335 | -0.020 | 0.151 | -0.042 | 0.070 | 0.217 | -0.085 | -0.313 | -0.081 | -0.115 | -0.112 | 0.333 | 0.170 | -0.006 | -0.039 |
| Effective & appropriate action | 0.125 | 0.010 | 0.188 | -0.245 | .886[a] | -0.452 | -0.044 | 0.020 | -0.141 | -0.242 | 0.085 | -0.544 | 0.111 | 0.192 | 0.054 | 0.221 | -0.029 | -0.074 | -0.140 | 0.238 | 0.026 |
| Explain/justify action | -0.189 | -0.188 | -0.521 | 0.242 | -0.452 | .878[a] | -0.119 | -0.037 | 0.216 | 0.281 | 0.005 | 0.328 | -0.316 | -0.118 | -0.012 | -0.312 | 0.005 | 0.159 | 0.072 | -0.275 | 0.031 |
| Commitment to | -0.069 | 0.004 | 0.005 | -0.335 | -0.044 | -0.119 | .933[a] | 0.040 | -0.009 | 0.156 | 0.084 | 0.049 | -0.230 | 0.145 | 0.149 | 0.044 | 0.008 | -0.551 | -0.027 | -0.047 | -0.178 |
| Accident investigation ability | -0.236 | 0.041 | 0.078 | -0.020 | 0.020 | -0.037 | 0.040 | .875[a] | -0.564 | -0.151 | -0.328 | 0.075 | -0.093 | -0.072 | -0.308 | 0.339 | 0.046 | -0.206 | -0.030 | -0.137 | 0.254 |
| Management & leadership aspects | -0.076 | -0.215 | -0.323 | 0.151 | -0.141 | 0.216 | -0.009 | -0.564 | .864[a] | 0.099 | 0.070 | 0.243 | 0.034 | 0.141 | 0.068 | -0.375 | 0.005 | 0.021 | -0.007 | -0.119 | -0.032 |
| Ability to learn from past | -0.313 | 0.069 | -0.022 | -0.042 | -0.242 | 0.281 | 0.156 | -0.151 | 0.099 | .905[a] | -0.091 | 0.265 | -0.228 | 0.061 | 0.184 | -0.396 | -0.207 | -0.034 | -0.068 | -0.067 | -0.276 |
| Safety & health training and management | 0.095 | -0.298 | -0.105 | 0.070 | 0.085 | 0.005 | 0.084 | -0.328 | 0.070 | -0.091 | .888[a] | -0.225 | 0.163 | 0.053 | -0.006 | -0.170 | 0.060 | -0.039 | -0.054 | 0.185 | -0.217 |
| Hazard & risk assesment | -0.524 | -0.234 | -0.152 | 0.217 | -0.544 | 0.328 | 0.049 | 0.075 | 0.243 | 0.265 | -0.225 | .805[a] | -0.207 | -0.035 | -0.231 | -0.187 | -0.148 | -0.170 | 0.343 | -0.265 | -0.044 |
| Monitor health & safety compliance | -0.026 | 0.080 | 0.065 | -0.085 | 0.111 | -0.316 | -0.230 | -0.093 | 0.034 | -0.228 | 0.163 | -0.207 | .948[a] | -0.182 | 0.055 | 0.025 | -0.127 | -0.103 | -0.351 | -0.014 | 0.132 |
| Design & evaluate HSE programs | -0.025 | 0.036 | -0.084 | -0.313 | 0.192 | -0.118 | 0.145 | -0.072 | 0.141 | 0.061 | 0.053 | -0.035 | -0.182 | .949[a] | -0.027 | -0.230 | 0.083 | -0.097 | -0.055 | 0.061 | 0.048 |
| Labour safety & health management | 0.058 | -0.055 | 0.106 | -0.081 | 0.054 | -0.012 | 0.149 | -0.308 | 0.068 | 0.184 | -0.006 | -0.231 | 0.055 | -0.027 | .931[a] | -0.192 | -0.113 | -0.079 | -0.094 | -0.053 | -0.134 |
| Accessing & analyzing information | 0.194 | 0.043 | 0.185 | -0.115 | 0.221 | -0.312 | 0.044 | 0.339 | -0.375 | -0.396 | -0.170 | -0.187 | 0.025 | -0.230 | -0.192 | .890[a] | -0.064 | -0.091 | -0.222 | 0.120 | 0.109 |
| Resource management | 0.213 | 0.094 | -0.156 | -0.112 | -0.029 | 0.005 | 0.008 | 0.046 | 0.005 | -0.207 | 0.060 | -0.148 | -0.127 | 0.083 | -0.113 | -0.064 | .968[a] | -0.148 | -0.116 | -0.042 | 0.107 |
| Emergency & crisis management | 0.164 | 0.097 | -0.112 | 0.333 | -0.074 | 0.159 | -0.551 | -0.206 | 0.021 | -0.034 | -0.039 | -0.170 | -0.103 | -0.097 | -0.079 | -0.091 | -0.148 | .924[a] | -0.102 | 0.109 | 0.017 |
| Strategic planning & Goal setting | -0.049 | -0.077 | -0.100 | 0.170 | -0.140 | 0.072 | -0.027 | -0.030 | -0.007 | -0.068 | -0.054 | 0.343 | -0.351 | -0.055 | -0.094 | -0.222 | -0.116 | -0.102 | .948[a] | 0.023 | -0.228 |
| Cost optimization | 0.245 | 0.214 | -0.009 | -0.006 | 0.238 | -0.275 | -0.047 | -0.137 | -0.119 | -0.067 | 0.185 | -0.265 | -0.014 | 0.061 | -0.053 | 0.120 | -0.042 | 0.109 | 0.023 | .834[a] | -0.576 |
| Innovation | -0.101 | -0.110 | 0.042 | -0.039 | 0.026 | 0.031 | -0.178 | 0.254 | -0.032 | -0.276 | -0.217 | -0.044 | 0.132 | 0.048 | -0.134 | 0.109 | 0.107 | 0.017 | -0.228 | -0.576 | .877[a] |

### 4.1.2. K1 - Kaiser's eigenvalue > 1

The eigenvalue represents the total variance explained by each factor. Factors whose eigen values are greater than 01 should only be retained , according to K1 - Kaiser's (Kaiser, 1960) method. This approach is most used in practice and best known because of its ease of use and theoretical basis.

The main purpose of exploratory factor analysis is to produce those factors which understandably and accurately elaborated the observed correlation matrix. Another factor should not be added to resultant number of factors in order to benefit them and if a factor is removed then the model should perform considerably worse. Extreme care should be taken while making factor retention decisions in exploratory factor analysis and an array of methods of factor retention exist. These include parallel analysis, Kaiser criterion and visual scree plot analysis. Therefore, results hand how much factors to retain can be different. K1 - Kaiser's eigenvalue is applied to survey as shown in Table 4.3; those factors whose eigen value are smaller than 1 are eliminated and retained only those factors showing eigen value greater than one.

### 4.1.3. Scree Test

Cattell's scree (Cattell, 1966) test includes the visual exploration of a graphical representation of the eigenvaluesfor discontinuities or breaks and it is the most popular used method for finding out that how much factors to be retained. A scree plot is basically a line plot of eigenvalues of factors in an analysis. The main purpose conducting this test is actually to find out the number of factors to retain in an exploratory factor analysis. It is a plot of factor number and eigenvalues with regard to order of extraction which is applied to survey as shown in Fig 4.1. This plot is normally used to determine the optimal number of factors that needs to be retained in the final solution.

The actual number of datapoints which are above the break (excluding those points at which break occurs) is exact number of factors that needs to be retained. The main logic hidden behind this is that this point divides major or important factors from trivial or minor factors. Interpreting Scree plot is purely or entirely subjective, requiring or demanding one's own perspective or judgement.

**Table 4.3: Eigen Values**

| Total Variance Explained | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Component | Initial Eigenvalues | | | Loadings | | | Loadings | | |
| | Total | % of Variance | Cumulative % | Total | % of Variance | Cumulative % | Total | % of Variance | Cumulative % |
| 1 | 12.304 | 58.593 | 58.593 | 12.304 | 58.593 | 58.593 | 7.293 | 34.728 | 34.728 |
| 2 | 1.543 | 7.350 | 65.942 | 1.543 | 7.350 | 65.942 | 3.311 | 15.765 | 50.493 |
| 3 | 1.168 | 5.564 | 71.506 | 1.168 | 5.564 | 71.506 | 3.158 | 15.037 | 65.530 |
| 4 | 1.075 | 5.120 | 76.626 | 1.075 | 5.120 | 76.626 | 2.330 | 11.096 | 76.626 |
| 5 | 0.768 | 3.656 | 80.282 | | | | | | |
| 6 | 0.678 | 3.231 | 83.513 | | | | | | |
| 7 | 0.579 | 2.758 | 86.270 | | | | | | |
| 8 | 0.498 | 2.370 | 88.640 | | | | | | |
| 9 | 0.369 | 1.756 | 90.397 | | | | | | |
| 10 | 0.317 | 1.508 | 91.905 | | | | | | |
| 11 | 0.279 | 1.331 | 93.236 | | | | | | |
| 12 | 0.247 | 1.175 | 94.411 | | | | | | |
| 13 | 0.218 | 1.039 | 95.450 | | | | | | |
| 14 | 0.213 | 1.016 | 96.466 | | | | | | |
| 14 | 0.178 | 0.848 | 97.313 | | | | | | |
| 16 | 0.134 | 0.639 | 97.952 | | | | | | |
| 17 | 0.118 | 0.561 | 98.512 | | | | | | |
| 18 | 0.102 | 0.486 | 98.999 | | | | | | |
| 19 | 0.093 | 0.442 | 99.440 | | | | | | |
| 20 | 0.070 | 0.334 | 99.774 | | | | | | |
| 21 | 0.047 | 0.226 | 100.000 | | | | | | |

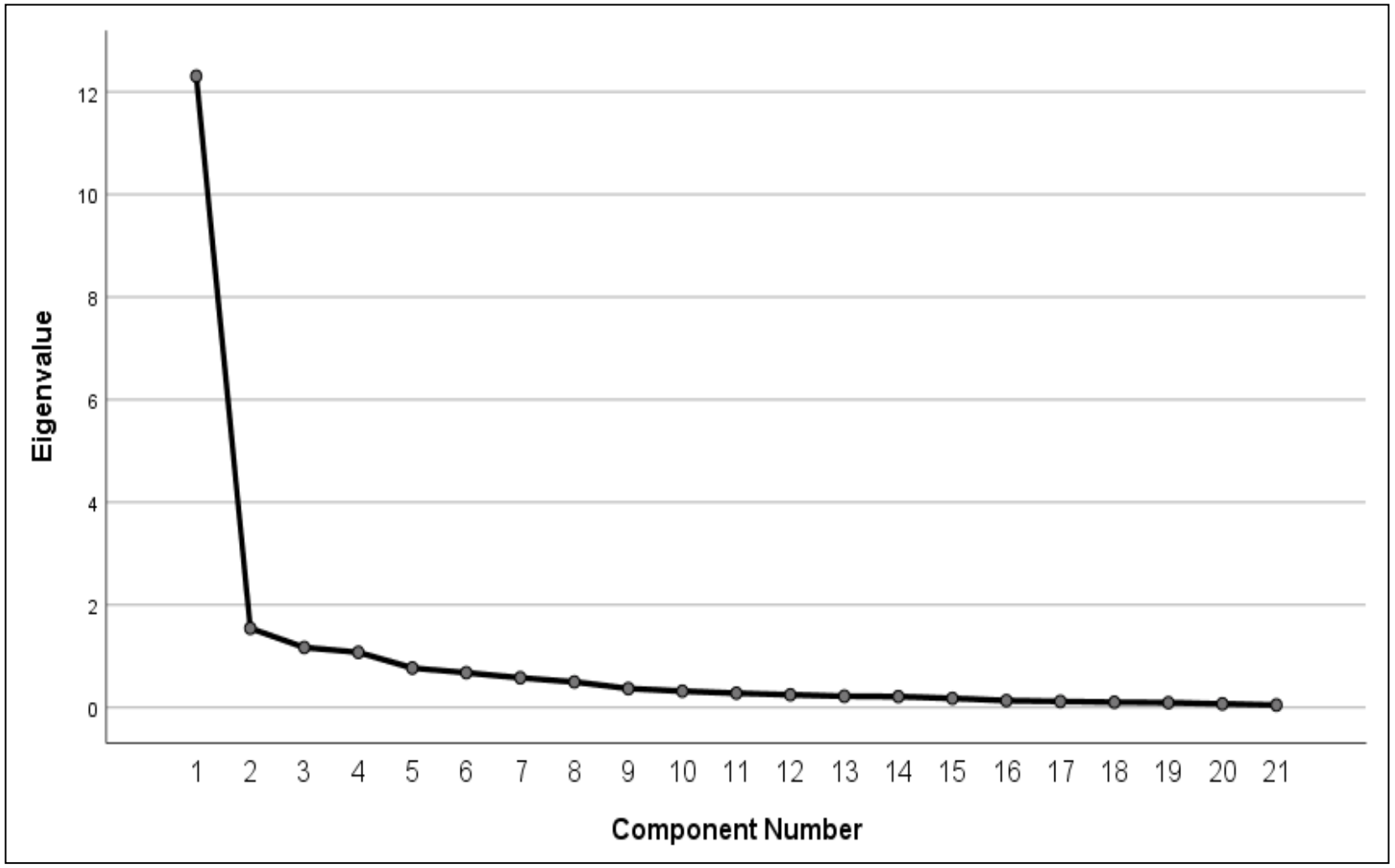


**Fig. 4.1. Scree Plot**

## 4.2. Retained Factors

The main purpose of exploratory factor analysis is to produce those factors which understandably and accurately elaborated the observed correlation matrix. Extreme care should be taken while making factor retention decisions in exploratory factor analysis and an array of methods of factor retention exist. Many methods create factor cutoffs usually through looking over eigenvalues, that are basic numerical values showing the “total variance explained by each factor”. So, the Kaiser criterion is probably the first retention method that has been applied to our survey and which recommends that all those factor whose eigen values are above than one should only be retained.

## 4.3. Factor loading & Rotation Method

Factor loadings actually are part of outcomes of EFA, that is data reduction method normally designed to show correlations between the observed variables by making use of little number of factors. It has to be greater than 0.6 in case of Exploratory factor analysis.

Initial results often get hard to interpret because principal axis estimation focuses on computational convenience without taking into account the conceptual clarity. Rotation of factor is designed to get a theoretically and simpler more interpretable solution by axis rotation within space of factor to bring them near to variables location. Among all orthogonal rotations varimax rotation is undoubtedly the most popular one, despite so many analytic rotations have been suggested.

Rotation will help by minimizing low item loadings and maximizing high item loadings in order to provide a more simplified and interpretable solution. Rotation technique has two types one is orthogonal rotation while other one is oblique rotation as shown in Fig 4.2. Orthogonal rotation provides uncorrelated factors. The most common type of orthogonal rotational methods for EFA is varimax rotation which was introduced by (Zientek, 2008) and will give a simple structure.

In simpler words, varimax rotation (also known as Kaiser-Varimax rotation) maximizes sum of squared loadings variance, where 'loadings' actually mean the correlation b/w factors and variables. This actually results, for smaller number of variables-high factor loadings and for the rest- low factor loadings.


**Fig 4.2. Illustration of varimax rotation (Watkins, 2018)**

When issue of factor loading also known as cross loading arises, when one variable shows high correlation with two factors, then we use varimax rotation to avoid that. After excluding the factors which has a factor loading of less than 0.6, varimax rotation was applied to the component matrix in order to interpret the factors as shown in Table 4.4.

**Table 4.4: Rotated Component**

| Rotated Component Matrix[a] | | | | |
|---|---|---|---|---|
| | Component | | | |
| | 1 | 2 | 3 | 4 |
| Monitor health & safety compliance | 0.845 | | | |
| Design & evaluate HSE programs | 0.793 | | | |
| Explain/justify action | 0.779 | | | |
| Strategic planning & Goal setting | 0.775 | | | |
| Commitment to project | 0.765 | | | |
| Effective Communication | 0.764 | | | |
| Resource management | 0.758 | | | |
| Accessing & analyzing information | 0.734 | | | |
| Relationship Building | 0.704 | | | |
| Emergency & crisis management | 0.680 | | | |
| Ability to learn from past | 0.648 | | | |
| Hazard & risk assesment | | 0.772 | | |
| Technical Competence | | 0.708 | | |
| Effective & appropriate action | | 0.646 | | |
| Knowledge & experience relevant to workplace | | 0.640 | | |
| Management & leadership aspects | | | 0.734 | |
| Accident investigation ability | | | 0.733 | |
| Safety & health training and management | | | 0.730 | |
| Cost optimization | | | | 0.851 |
| Innovation | | | | 0.780 |

**Table 4.5: Naming of Latent Variables**

| Rotated Component Matrix[a] | | | | |
|---|---|---|---|---|
| | Component | | | |
| | 1 | 2 | 3 | 4 |
| Monitor health & safety compliance | 0.845 | | | |
| Design & evaluate HSE programs | 0.793 | | | |
| Explain/justify action | 0.779 | | | |
| Strategic planning & Goal setting | 0.775 | | | |
| Commitment to project | 0.765 | | | |
| Effective Communication | 0.764 | | | |
| Resource management | 0.758 | | | |
| Accessing & analyzing information | 0.734 | | | |
| Relationship Building | 0.704 | | | |
| Emergency & crisis management | 0.680 | | | |
| Ability to learn from past | 0.648 | | | |
| Hazard & risk assesment | | 0.772 | | |
| Technical Competence | | 0.708 | | |
| Effective & appropriate action | | 0.646 | | |
| Knowledge & experience relevant to workplace | | 0.640 | | |
| Management & leadership aspects | | | 0.734 | |
| Accident investigation ability | | | 0.733 | |
| Safety & health training and management | | | 0.730 | |
| Cost optimization | | | | 0.851 |
| Innovation | | | | 0.780 |
| Extraction Method: Principal Component Analysis. Rotation Method: Varimax with Kaiser Normalization. | Lead Projects | Understands Basics | Supports Project | Coach, consult and Lead |
| a. Rotation converged in 15 iterations. | LEVEL 03 | LEVEL 01 | LEVEL 02 | LEVEL 04 |

## 4.4. Discussion and naming of latent variables

Factors interpretation demands a complete analysis of variables which are measured and their relationship with some other factors(Watkins, 2018). After getting the composite factors, it is interpreted that what sense do factors make. Interpretation is a system of examination to choose variables that are attributable to construct and suggesting a name to that construct. The labelling or naming of construct is inductive, theoretical and subjective process (Marjorie A. Pett et al., 2003; Taherdoost et al., 2014).

For example, a construct may involve four variables which all are regarding the satisfaction of user thus the label "satisfaction of user" will be given to that particular construct. It is to make sure that at least two or three variable must load on factor to provide a meaningful interpretation (Henson & Roberts, 2006).

We have followed the six-sigma naming convention and designated yellow, green, black, and master belts. So basically, six sigma has four certification levels, the very basic level named as yellow belt, the next higher level named as green belt, the next higher is named as black belt and the highest level is named as master belt. Yellow belt is very basic level which gives the overview of six sigma theory, processes and DMAIC , green belt is second higher level which tells the introduction to tools and methods for problem solving and DMAIC, while black belt is third higher level and a person gets black belt when he is trained enough in methodologies and tools for business transformation and master black belt is the most advanced level which is granted to person who master necessary skills to lead long-term business transformation using six sigma tools.

Our discussion and naming of latent variables for OHS professionals is shown in Table 4.5. So first we have factor 1 labelled as Level 03 (Lead Projects), then we have factor 2 labelled as Level 01(Understands Basics), then factor 3 labelled as Level 2 (Supports project) and last, we have factor 04 labelled as Level 4(Coach, consult and lead). However, each level has some attributes and tasks of capable OHS professional and each higher level contains all the attributes and tasks of previous lower levels. So, level 01 is a very basic level of OHS professional which includes two attributes and two tasks, second higher level consists of two attributes and one tasks, third higher level consists of five attributes and six tasks and the highest level which is level 04 contains two tasks of OHS professional.

## 4.5. OHS Professional Capability framework

Capability framework is designed basically to;

- Facilitate an understanding of the role of the safety Professional
- Position the safety professional as leader, strategist, coach, consultant, supporter and key analyst in fully incorporating the OHS risk management into sustainable construction industry.
- Position the occupational health and safety professional as communicator at site level, skilled implementor of occupational health and safety activities and an effective OHS supporter

This framework is basically designed for main targeted 6 audiences: OHS professionals, OHS professionals and concerned certification bodies, Community, Recruiters and employers, OHS educators and occupational health and safety regulators. This framework begins by explaining OHS roles. It also addresses levels that explains the basic roles in context of organization.

This conceptual framework encourages a relatively high status of capability for OHS professionals and also informs regulators and employers as to distinguish between capabilities of OHS professional. The most important and main part on attributes and tasks set benchmark for occupational health and safety associations and training bodies and education in producing the professional development which is continual, educational programs and certification schemes detail. It is known that dissimilarities will rather be there in emphasis and terminology across various countries based on industry mix, history, regulatory and legal frameworks.

### 4.5.1. Attributes and Tasks at each level

The attributes and tasks defined at each level of capability framework are as follows;

#### 4.5.1.1. Level 01 → Understands Basics:

Here, the OHS professional:

- Reviews improvements in process
- Gets thorough understanding of different procedures
- Takes an active part as team member of project

**Table 4.6: Level 01 → Understands Basics**

| Level 01 → Understands Basics | |
|---|---|
| **Attributes** | **Tasks** |
| Effective & appropriate action | Hazard & risk assessment |
| Knowledge & experience relevant to workplace | Technical Competence |

#### 4.5.1.2. Level 02 → Support Projects:

This expertise level necessitates the following criteria:

- Minimum experience of at least 3 years of full-time employment
- Good understanding of process and tools used for solving the problem
- Should have hand-on practice, knowledge and experience relevant to workplace while doing projects
- Lead teams and projects of level 02
- Complete guidance for projects of level 03 in analysis and collection of data

**Table 4.7: Level 02 → Support Projects**

| Level 02 → Support Projects | |
|---|---|
| **Attributes** | **Tasks** |
| Management & leadership aspects | Safety & health training and management |
| Accident investigation ability | |

#### 4.5.1.3. Level 03 → Lead Projects:

An OHS professional must possess following to reach this level:

- Minimum experience of at least 3 years of full-time employment
- Enough experience in main area of knowledge
- Proof should be given of completion of at least 2 projects of construction safety
- Coaching and training teams of project

- Leading different teams in projects for problem solving
- Demonstration of practice or experience at suggesting solution in challenging situation

**Table 4.8: Level 03 → Lead Projects**

| **Level 03 → Lead Projects** | |
|---|---|
| **Attributes** | **Tasks** |
| Explain/justify action | Monitor health & safety compliance |
| Commitment to project | Design & evaluate HSE programs |
| Effective Communication | Strategic planning & Goal setting |
| Relationship Building | Resource management |
| Ability to learn from past | Accessing & analysing information |
| | Emergency & crisis management |

#### 4.5.1.4. Level 04 → Coach, Consult and Lead:

An OHS professional must possess following to reach this level:

- Proven portfolio of work with individual particular requirements as given for an example
- Should have certification of level 03
- Minimum experience of at least 5 years of full-time employment or Proof should be given of completion of at least 10 projects of construction safety
- Have trained and coached level 02 and level 03
- Develop strategies and whenever required implement them

**Table 4.9: Level 04 → Coach, Consult and Lead**

| **Level 04 → Coach, Consult and Lead** | |
|---|---|
| **Attributes** | **Tasks** |
| | Cost optimization |
| | Innovation |

### 4.5.2. Conceptual Framework

Capability framework will help in development of capability of safety professionals. We have followed the six-sigma naming convention and designated yellow, green, black, and master belts. So basically, six sigma has four certification levels, the very basic level named as yellow belt, the next higher level named as green belt, the next higher is named as black belt and the highest level is named as master belt.

Our capability framework consists of four levels for OHS professionals as shown in Table 4.10; level 01 named as understands basics, level 02 named as supports project, level 03 named as lead projects and level 04 as coach, consult and lead projects. However, each level has some attributes and tasks of capable OHS professional and each higher level contains all the attributes and tasks of previous lower levels. So, level 01 is a very basic level of OHS professional which includes two attributes and two tasks, second higher level consists of two attributes and one tasks, third higher level consists of five attributes and six tasks and the highest level which is level 04 contains two tasks of OHS professional. Following are the advantages of developing a capability framework:

- This capability framework can also be generalized for other developing countries having similar work environment.
- It will help establish and guide training programmes in each competence for safety professionals as a way to help them better carry out their tasks and hence manage safety in construction works.
- It will assist to set criteria for choosing OHS professionals according to their capabilities.
- Considerably reduced number of work-related injuries or fatalities will eventually lead to reduced costs on insurance compensations and other significant expenses that may devastate the company's bottom line.
- Development of capability framework for accreditation of safety professionals is an addition to the field of construction safety research.

**Table 4.10: OHS Professional Capability Framework**

| | Understands Basics | Support Projects | Support Projects | Coach, Consult & Lead |
|---|---|---|---|---|
| **Levels** | **Level 01** | **Level 02** | **Level 03** | **Level 04** |
| **Attributes** | ✓ Effective & appropriate action<br>✓ Knowledge & experience relevant to workplace | ✓ Management & leadership aspects<br>✓ Accident investigation ability | ✓ Explain/justify action<br>✓ Commitment to project<br>✓ Effective Communication<br>✓ Relationship Building<br>✓ Ability to learn from past | |
| **Tasks** | ✓ Hazard & risk assessment<br>✓ Technical Competence | ✓ Safety & health training and management | ✓ Monitor health & safety compliance<br>✓ Design & evaluate HSE programs<br>✓ Strategic planning & Goal setting<br>✓ Resource management<br>✓ Accessing & analysing information<br>✓ Emergency & crisis management | ✓Cost optimization<br>✓Innovation |

## 4.6. OHS Professional Curriculum

A curriculum is developed as shown in Table 4.11 for development of capability of OHS professional. The main purpose of developing this curriculum is to help establish and guide training programmes in each competence for safety professionals. It contains 12 knowledge domains in total, while each knowledge domain has some further contents and learning outcomes. A content analysis of guides was performed for selecting the most suitable knowledge domain, it was further seen in content analysis that which attributes and tasks is present in which knowledge domain of any guide. These knowledge domains are named after the knowledge domains mentioned in following;

- OHS 3203 curriculum Guide
- OHS professional curriculum,
- OHS professional capability framework,
- Occupational health and safety administration OSHA
- Safe Work in the 21st Century: Education and Training Needs for the Next Decade's OHS Personnel by Institute of Medicine
- IOSH training courses

### 4.6.1. Learning outcome for each knowledge domain

OHS professional Curriculum has 12 knowledge domains in total, while each knowledge domain has some further learning outcomes which are given at the end as Annex-1. Each knowledge domain has some learning outcomes which demonstrates that what is expected from an OHS professional on field including his capabilities, tasks etc. The capable OHS professional should integrate all his capabilities and should apply them in complex, varied and changing circumstances.

A survey is analyzed using exploratory factor analysis and total of three statistical test are conducted which includes Kaiser-Meyer-Olkin KMO and Bartlett's Test, Kaiser-eigenvalue>1 and Scree test. So, we have got four levels in total which were named using Six Sigma naming convention and it finally led to OHS professional capability framework. A content analysis of guides issued by regulatory authorities is performed to develop OHS professional curriculum. Both OHS professional capability framework and curriculum will contribute towards development of OHS professional.

## Table 4.11: OHS professional Curriculum

| Sr. no. | Knowledge Domain | Contents | Level | Reference to others |
|---|---|---|---|---|
| 1 | Hazard Recognition, Evaluation & Control | Effective and Appropriate Action | L1 | 1.1.1, 1.1.2, 1.1.5, 2.1.1, 4.1.1, 4.1.2, 5.1.1, 6.2.1 |
| | | Hazard & Risk Assessment | L1 | 1.1.1, 1.1.3, 2.1.1, 4.1.1, 5.1.2, 6.2.1 |
| 2 | Emergency Preparedness and Response | Effective and Appropriate Action | L1 | 1.1.1, 1.1.2, 1.1.5, 2.1.1, 4.1.1, 4.1.2, 5.1.1, 6.2.1 |
| | | Safety & health training and management | L2 | 1.1.2, 1.1.3, 4.1.3, 5.1.4, 5.1.5, 6.1.1, 6.3.1 |
| | | Emergency & crisis management | L3 | 1.1.2, 1.1.3, 1.1.5, 4.1.2, 5.1.1, 6.4.1 |
| 3 | Accident and Incident Investigation | Accident Investigation Ability | L2 | 1.1.3, 1.1.4, 5.1.3 |
| 4 | Leadership Level 01 | Management & leadership aspects | L2 | 1.1.3, 2.1.3, 3.2.2, 6.1.1, 6.2.2 |
| | | Relationship Building | L3 | 2.1.3, 2.1.4, 3.2.2, 6.1.1, 6.2.2 |
| 5 | Leadership Level 02 | Management & leadership aspects | L2 | 1.1.3, 2.1.3, 3.2.2, 6.1.1, 6.2.2 |
| | | Commitment to project | L3 | 2.1.5, 3.2.2, 6.2.2 |
| | | Relationship Building | L3 | 2.1.3, 2.1.4, 3.2.2, 6.1.1, 6.2.2 |
| | | Monitor health & safety compliance | L3 | 1.1.3, 2.1.5, 3.2.2, 4.1.3, 5.1.5 |
| | | Innovation | L4 | 3.2.1, 3.2.2 |
| 6 | Evidenced Based | Knowledge and experience relevant to workplace | L1 | 2.1.2, 3.1.1, 3.2.1 |
| | | Explain/justify action | L3 | 2.1.2 |
| | | Ability to learn from past | L3 | 2.1.2 |
| 7 | Safety and Health program management | Safety & health training and management | L2 | 1.1.2, 1.1.3, 4.1.3, 5.1.4, 5.1.5, 6.1.1, 6.3.1 |
| | | Monitor health & safety compliance | L3 | 1.1.3, 2.1.5, 3.2.2, 4.1.3, 5.1.5 |
| | | Design & evaluate HSE programs | L3 | 1.1.3, 4.1.3, 5.1.2, 5.1.5 |
| 8 | Communication | Effective Communication | L3 | 1.1.3, 2.1.4, 3.1.2, 3.1.3, 5.2.1 |
| | | Relationship Building | L3 | 2.1.3, 2.1.4, 3.2.2, 6.1.1, 6.2.2 |
| 9 | Informatics | Accessing & analysing information | L2 | 2.1.7, 3.1.3 |
| 10 | Professionalism | Commitment to project | L3 | 2.1.5, 3.2.2, 6.2.2 |
| | | Monitor health & safety compliance | L3 | 1.1.3, 2.1.5, 3.2.2, 4.1.3, 5.1.5 |
| 11 | Complexity | Knowledge and experience relevant to workplace | L1 | 2.1.2, 3.1.1, 3.2.1 |
| | | Technical Competence | L1 | 3.1.1, 3.2.1, 6.1.1 |
| | | Innovation | L4 | 3.2.1, 3.2.2 |
| 12 | Business & Organizational Skills | Strategic planning & Goal setting | L3 | 3.2.3, 3.2.4, 6.2.3 |
| | | Resource Management | L3 | 2.1.6, 2.1.7, 3.2.4, 6.3.2 |
| | | Cost Optimization | L4 | 2.1.6, 3.2.4, 6.3.2 |

*Chapter 5*

# CONCLUSIONS AND RECOMMENDATIONS

## 5.1. Review of Research Objectives

The sub-objectives of this study are:

a. Determining attributes and tasks required in Capable safety professional
b. To Develop capability framework for OHS professional
c. To Suggest strategy for development of a capable OHS professional

The first objective is met by conducting brainstorming sessions with experts with the basic aim to filter out initial set of chosen attributes and tasks of capable OHS professional, a little group of some reliable people was deemed to suffice. While the second objective is achieved by carrying out a detailed survey from a developing world and then analysing the collected data using SPSS-26.0 to develop a capability framework. Third objective is met by doing the content analysis of knowledge domains issued by regulatory authorities and then curriculum was developed for OHS professional after doing field validation from some group of experts.

## 5.2. Findings

The main findings of this study are:

a. There are no attributes and tasks defined yet that contribute towards the capability of OHS professional.
b. Government of Pakistan has provided or formulated occupational health and safety laws but unfortunately, they are not yet enforced because of absence of any regulatory authority like OSHA etc.
c. Workers lack awareness about their basic rights to work under only ‘safe work environment’.
d. Absence of knowledge framework that will help set criteria for selecting safety professionals according to their competencies.
e. There is a misperception among all stakeholders that investing in safety will increase the project cost. No budget is allocated for safety by the client.

f. Safety can impact the total cost of project whereas it is normally overlooked as cost controlling measure. Almost all stakeholders are of opinion that investing in safety will definitely increase total cost of project.
g. There is no safety manager, even on mega projects.
h. Lack of strategy or absence of curriculum that will help establish and guide training programmes in each competence for safety professionals as a way to help them better carry out their tasks and hence manage safety in construction works.

## 5.3. Conclusion

The main concept of capability helps creating encompassing framework rather than competency, for recognition of profession and development of occupational health & safety professionals. By highlighting the importance of theoretical tasks and attributes that actually transcend particular industries and workplaces and that is applicable in complex and changing circumstances, together with values and personal attributes underpinning professional practice, the framework for capability makes sure that occupational health & safety professionals are equipped to work in changing and complex environment which is OHS.

The objective of this study was to develop a capability framework contributing towards the capability of OHS professional. Firstly, the attributes and tasks of OHS professional were identified from literature and field validation was performed. A detailed survey was conducted from a developing world and then collected data is analysed using SPSS-26.0 to develop a capability framework, with the basic aim of accrediting OHS professionals according to their capabilities, to facilitate an understanding of OHS Professional role as well as to position the OHS professional as leader, strategist, coach, consultant, supporter and key analyst in fully incorporating the OHS risk management into sustainable construction industry.

Six-sigma naming convention was followed and designated yellow, green, black, and master belts, with level 01 as very basic level while level 4 is the most advanced level. Thus, accreditation helps making an important contribution to make sure that that accredited occupational health & safety professionals are capable entry-level safety professionals.

Later, after doing the content analysis of knowledge domains issued by regulatory authorities and then curriculum was developed for OHS professional after doing field validation from some group of experts. The designed curriculum will help establish and guide

training programmes in each competence for safety professionals as a way to help them better carry out their tasks and hence manage safety in construction works.

## 5.4. Future Recommendations

The suggested capability framework will help set criteria for selecting OHS professionals according to their competencies and to facilitate an understanding of OHS Professional role. However, it also addresses levels that explains the basic roles in context of construction industry. The results further indicate that OHS professionals must possess various attributes and tasks defined at each level to provide comprehensive safety services.

This study found that safety can impact the total cost of project whereas it is normally overlooked as cost controlling measure. Therefore, it is crucial to change their perceptions. For that purpose, we can make the awareness raising talks, use labels and signs, implement safety protocols and have regular meeting on workplace safety. The suggested framework will also encourage a relatively high status of capability for occupational health and safety professionals and also informs regulators and employers as to distinguish between capabilities of OHS professional.

OHS professional curriculum is provided that will help establish and guide training programmes in each competence for safety professionals as a way to help them better carry out their tasks and hence manage safety in construction works. It is very important for OHS professionals to engage in lifelong learning to fulfil contemporary safety requirements. Firstly, it is very important to make stakeholder realize importance of OHS professional on construction sites. Conversely, safety curricula should be constantly updated to give capable OHS professionals to industry and it should necessarily contain safety practices too. This can be done by performing routine discussions, safety educators taking an active part especially in industrial workshops, and OHS professionals learning and teaching in universities and colleges.

Partnerships can be made between businesses and colleges to prepare students of OHS domains for the work environment. Safety educators should design suitable courses to train health and safety students for their careers in future. In other words, it is to be make sure that safety program courses should help graduates to equip themselves with enough safety capabilities. Therefore, OHS professionals can put their major focus on possessing enough capabilities in order to fulfil their appropriate role and to complete their tasks successfully.

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**ANNEX-1**

# OHS Professional Curriculum

| Knowledge Domain | Contents | Learning Outcomes |
|---|---|---|
| Hazard Recognition Evaluation & Control | Effective & appropriate action | Examine how people, equipment, materials and the environment (PEME) contribute to hazards<br><br>Generate controls based on risk assessment<br><br>Take appropriate preventive steps in case any hazard is identified |
| Emergency Preparedness & Response | Effective & appropriate action<br><br>Safety & Health training & management<br><br>Emergency & crisis management | Established and maintain response arrangements, preparedness and emergency prevention<br><br>Identify the likelihood for emergency situations and accidents, and try to prevent the OSH risks that are associated with them |
| Accident & Incident Investigation | Accident investigation ability | Investigate accidents/incidents and make recommendations based on investigations<br><br>Find out why their existing measures for control failed and what additional measures or improvements are required<br><br>Point to areas where the risk assessment needs reviewing |
| Leadership Level 01 | Management & leadership aspects<br><br>Relationship Building | Possess the ability to guide multidisciplinary teams<br><br>Promote relationship building with all stakeholders |

| | | |
|---|---|---|
| Leadership Level 02 | Management & leadership aspects<br><br>Commitment to project<br><br>Relationship Building<br><br>Monitor health & safety compliance<br><br>Innovation | Analyse human behaviour, individual performance and team dynamics to prevent occupational injury<br><br>Provide support to every stakeholder to control risk<br>Demonstrate problem-solving skills |
| Evidence Based | Knowledge & experience relevant to workplace<br><br>Explain/justify action<br><br>Ability to learn from past | Interpret, collect, discern and analyse related data to alleviate the risk profile of organization<br><br>To develop solutions for identified problems, make sure to do a literature review by making use of peer reviewed scientific literature<br><br>Apply best practices and knowledge of working requirements to revise, prepare and review OHS policy |
| Safety & Health program management | Safety & health training & management<br><br>Monitor health & safety compliance<br><br>Design & evaluate HSE program | Propose improvements to safety management system<br><br>Understand that how to design and implement OHS audit and inspection testing systems<br><br>Analyse OHS training needs and conduct basic safety training |

| | | |
|---|---|---|
| Communication | Effective communication<br><br>Relationship Building | Demonstrate delivery and development of effective training by employing different media<br><br>Apply problem-solving skills, facilitation and team-building |
| Informatics | Accessing & analysing information | Present related metrics in order to influence mainly decision making and utilize computer skills to collect applicable data<br><br>Demonstrate basic knowledge of different management systems of OHS |
| Professionalism | Commitment to project<br><br>Monitor health & safety compliance | Recognize and accept their level of competence and need for assistance<br><br>Address main gaps between practice and policy |
| Complexity | Knowledge & technical relevant to workplace<br><br>Technical competence<br><br>Innovation | Applies OHS knowledge combined with leadership and management skills in complex, diverse and often unfamiliar and developing in order to lead evaluation, implementation and formulation of OHS strategy<br><br>Innovative in implementing and developing strategies |
| Business & Organizational Skills | Strategic planning & goal setting<br><br>Resource management<br><br>Cost optimization | Understands wider business and organizational environment and the impact on interdependency of OHS as well as OHS management<br><br>Uses organizational and planning skills in order to lead a group to meet project deadlines |