

# AUS Repository

## A Decision Support Tool for Enhancing Social Sustainability within the UAE Construction Sector

Item Type	Dissertation
Authors	Saboor, Sara
Download date	2026-06-08 18:16:31
Link to Item	<a href="http://hdl.handle.net/11073/24071">http://hdl.handle.net/11073/24071</a>

A DECISION SUPPORT TOOL FOR ENHANCING  
SOCIAL SUSTAINABILITY WITHIN THE  
UAE CONSTRUCTION SECTOR

by  
Sara Saboor

A Dissertation Presented to the faculty of the  
American University of Sharjah  
College of Engineering  
In Partial Fulfilment  
of the Requirements  
for the Degree of

Doctor of Philosophy in Engineering- Engineering Systems Management.

Sharjah, United Arab Emirates

May 2022

## **Declaration of Authorship**

I declare that this dissertation is my own work and, to the best of my knowledge and belief, it does not contain material published or written by a third party, except where permission has been obtained and/or appropriately cited through full and accurate referencing.

Signed.....Sara Saboor.....

Date.....14/06/2022.....

The Author controls copyright for this report.

Material should not be reused without the consent of the author. Due acknowledgement should be made where appropriate.

© Year 2022

Sara Saboor

**ALL RIGHTS RESERVED**

## Approval Signatures

We, the undersigned, approve the PhD Dissertation written by:  
Sara Saboor

Dissertation Title: A Decision Support Tool for Enhancing Social Sustainability  
within the UAE Construction Sector

Date of Defence: 4/28/2022

<b>Name, Title, and Affiliation</b>	<b>Signature</b>
-------------------------------------	------------------

---

Dr. Vian Ahmed

Professor/ Associate Professor  
Department of Industrial Engineering  
Dissertation Advisor

---

Dr. Ayman Alzaatreh

Professor/ Associate Professor  
Department of Mathematics and Statistics  
Dissertation Committee Member

---

Dr. Malick Ndiaye

Associate Professor  
Department of Industrial Engineering  
Dissertation Committee Member

---

Dr. Hussam Alshraideh

Associate Professor  
Department of Industrial Engineering  
Dissertation Committee Member

---

Dr. Mahmoud Awad

Associate Professor  
Department of Industrial Engineering  
Dissertation Examiner

---

Dr. Anupa Manewa

Associate Professor  
Department of Liverpool John Moores University  
External Examiner

Accepted by:

Dr. Mohamed El-Tarhuni

Vice Provost for Research and Graduate Studies  
Office of Research and Graduate Studies

## **Acknowledgements**

I would like to thank my advisor Dr. Vian Ahmed for providing knowledge, guidance, support, and motivation throughout my research stages. I'm deeply beholden for her great assistance, worthy discussion, and suggestions.

I would like to thank my committee members who helped me in this journey of research. I appreciate their dignified advice and motivation. I would like to extend my sincere thanks to the American University of Sharjah for providing the students platform to grow as researchers and potential leaders. I express sincere gratitude to AUS Graduate Assistantship.

## **Dedication**

To my parents, husband, and kids that have remained my biggest support in this journey.

## Abstract

The construction sector is considered to be one of the most significant sectors globally as it aids in creating jobs across different sectors such as transportation, real estate, manufacturing, trade, warehousing, wholesale, and leasing services. In addition, it alone employs about one-quarter of the world's workforce. However, despite the importance and prominence of the sector, grave issues of mental health and social sustainability have been reported. Although the literature reports on several studies and reliable scales over the years that have linked the concept of employee mental health and wellbeing with job satisfaction, productivity, absenteeism, and low turnover rates, however, they tend to work in isolation and focus only on certain aspects of mental health. Moreover, little or no research has been conducted to support an organization in decision-making to facilitate enhancing the social sustainability and mental health of employees in the construction sector, thus indicating a research gap. Therefore, this study adopts a mixed-method approach by adopting semi-structured interviews, surveys, and case studies to identify and validate the list of underpinning criteria that define employees' social sustainability. Structural Equation Modeling (SEM) is adopted that aids the study in determining the significant criteria that have an impact on employees' social sustainability. Moreover, the decision criteria identified from the literature and structural equation modeling are integrated to develop the Decision Support Tool (DST) based on Hybrid Analytical Hierarchy Process (AHP) and Fuzzy Multi-Objective Optimization based on Ratio Analysis (F - MOORA) method. The DST presents the optimal solution to the organization to ensure the social sustainability of employees. The present study has proposed a conceptual framework for monitoring social sustainability as a complementary approach to address the non-dynamic nature of DST based on Blockchain and IoT Social Sustainability Management (BOTSSM). Finally, to validate the DST and BOTSSM framework, the study conducted a focus group with experts from the construction sector and WakeCap Technologies as experts in IoT and Blockchain.

**Keywords: Social Sustainability; Employee Mental Health and wellbeing; Multi-Criteria Decision Making; Analytical Hierarchy Process; Fuzzy MOORA.**

## Table of Contents

Abstract	6
List of Figures	10
List of Tables	12
List of Abbreviations	13
Chapter 1. Introduction	14
1.1. Introduction	14
1.2. Aim and Objectives	17
1.3. Research Questions	17
1.4. Methodological Steps	18
1.5. Dissertation Organization	19
Chapter 2. Literature Review	20
2.1. Construction Sector	20
2.1.1 UAE construction sector	23
2.2. Social Sustainability	25
2.3. Mental Health	26
2.4. Global Mental Health: Initiatives and Challenges	31
2.5. Measurement Scales	34
2.6. Employee Mental Health and Wellbeing	38
2.6.1 Underpinning criteria of employee mental health	40
2.7. Conclusion	65
Chapter 3. Multicriteria Decision-Making Techniques and Tools	67
3.1. Multi-Criteria Decision Making	67
3.2. Application of MCDM Techniques	70
3.3. Analytical Hierarchy Process (AHP)	77
3.3.1 AHP – steps and process	78
3.4. Multi-Objective Optimization based on Ratio Analysis (MOORA)	80
3.4.1 MOORA computation	82
3.5. Blockchain and IOT for Social Sustainability	86
3.5.1 Internet of Things (IoT)	89

3.5.2	Blockchain	93
3.5.3	BOT for the construction sector	97
3.6.	Conceptual Framework Blockchain and IoT-Based Social Sustainability Management	100
3.6.1	Framework architecture	104
3.6.2	The cost implication of the proposed solution	110
3.7.	Conclusion	111
Chapter 4.	Methodology	112
4.1.	Research Design	112
4.2.	Philosophy	112
4.3.	Research Approach	113
4.4.	Research Strategy and Method	114
4.4.1	Qualitative method	114
4.4.2	Quantitative method	116
4.5.	Time Horizon	117
4.6.	Data Collection Choices and Methods	117
4.7.	Validity and Reliability	118
4.8.	Ethical Approach	119
4.9.	Conclusion	120
Chapter 5.	Data Collection and Analysis	121
5.1.	Qualitative Analysis	121
5.1.1	Semi structure interviews	121
5.2.	Quantitative Analysis	129
5.2.1	Survey development	129
5.2.2	Demographic profile	132
5.2.3	Structural equation modelling (SEM)	134
5.3.	Case Study	141
5.3.1	Employees preference	142
5.4.	Conclusion	144
Chapter 6.	Decision Support Tool for Social Sustainability	146
6.1.	Decision Support Tool Development	146

6.2. Expert Validation	155
6.2.1 Focus group	155
6.3. Conclusion	161
Chapter 7. Discussion, Findings, Conclusion, and Recommendation	162
7.1. Discussion	162
7.2. Main Findings	163
7.3. Conclusion	165
7.4. Limitations and Future Work	165
7.5. Recommendation for future work	166
References	167
Appendix A	179
Vita	183

## List of Figures

Figure 2-1 Alarming Statistics of Construction sector [19, 20].....	21
Figure 2-2 Risks for stress and mental ill-health for different occupations. Source: [43] .....	22
Figure 2-3 Holistic Conceptualization. Source: Authors.....	25
Figure 2-4 The Dual Continua Model of Mental health and mental illness, Source: [22] .....	26
Figure 2-5 Core Dimensions of Psychological Well-Being and Their Theoretical Foundations. Source: [27].....	28
Figure 2-6 Contribution by different non-communicable diseases to disability-adjusted life-years worldwide in 2005. Source: [29] .....	30
Figure 2-7 Employee Mental Health and wellbeing. Source:[3] .....	39
Figure 2-8 Conceptual Framework. Source: [57] .....	42
Figure 2-9 Type of Organizational Variable. Source: [63].....	44
Figure 2-10 Findings of the research. Source: [64] .....	44
Figure 2-11 Personal Factors. Source: [63] .....	46
Figure 2-12 The Conceptual Model. Source: [76].....	48
Figure 2-13 Conceptual Model Framework. Source: [57].....	50
Figure 2-14 The proposed Framework. Source: [87].....	52
Figure 3-1 MCDM widely adopted Decision Criteria. Source: [102]. Recreated .....	68
Figure 3-2 MCDM for developing DST .....	69
Figure 3-3 Hybrid Conceptual Framework.....	76
Figure 3-4 Analytical Hierarchy Process (AHP) .....	77
Figure 3-5 Saaty’s AHP scale. Source: [115] .....	78
Figure 3-6 Consistency Ratio.....	80
Figure 3-7 Proposed Decision Support Tool .....	85
Figure 3-8 Integration of DST and BOTSSOM as a Proposed Solution .....	88
Figure 3-9 IOT Functionality. Source: [138], Recreated: Author .....	90
Figure 3-10 IOT-based construction worker physiological data monitoring platform. Source: [147], Recreated: Author .....	91
Figure 3-11 Worker 4.0. Source: [149], Readapted: Author .....	92
Figure 3-12 HeadgearX. Source: [150], Readapted: Author .....	92

Figure 3-13 Blockchain. Source: Recreated: Author .....	94
Figure 3-14 Mechanism of Blockchain. Source: Recreated: Author .....	95
Figure 3-15 Benefits of Blockchain. Source: Recreated: Author .....	96
Figure 3-16 Blockchain and IoT for construction sector. Source: Author .....	98
Figure 3-17 Integration of Blockchain and IOT for SSM in construction sector. Source: Author .....	100
Figure 3-18 Proposed Framework – BOTSSM. Source: Author .....	102
Figure 3-19 Proposed Graphical User Interface. Source: Author .....	108
Figure 3-20 Proposed User-Friendly Interface for BOTSSM. Source: Author .....	110
Figure 4-1 Methodological Steps Flowchart. Source: Author .....	114
Figure 4-2 Research Strategies. Source: Authors .....	116
Thus, the methodological steps in Figure 4-3 aids the research to develop its methodology and adopts the suitable research strategies and methods. ....	117
Figure 5-1 Interview Response Word Cloud. Source: Author.....	125
Figure 5-2 Level of Satisfaction in employees. Source: Authors .....	133
Figure 5-3 Self-evaluation of Subjective Wellbeing. Source: Authors .....	134
Figure 5-4 Diff b/w CFA and ESEM. Source: [169].....	135
Figure 5-5 ESEM Model.....	141
Figure 5-6 AHP Hierarchy Framework .....	143
Figure 6-1 Development Process of Decision Support Tool .....	149
Figure 6-2 EMW Decision Support Tool Interface .....	149
Figure 6-3 Interface Main Panel .....	150
Figure 6-4 Decision Maker Panel .....	151
Figure 6-5 Decision Criteria Interface .....	152
Figure 6-6 Alternative Evaluation Interface .....	153
Figure 6-8 Decision Panel.....	154
Figure 6-9 Existing System based on IOT. Source: WakeCap Technologies .....	157
Figure 6-10 WakeCap technologies Solutions.....	157

## List of Tables

Table 2-1 Mental Health Definition.....	29
Table 2-2 Challenges for Global Mental Health.....	32
Table 2-3 Measurement Scale of Mental Health .....	37
Table 2-4 Organizational Factors.....	45
Table 2-5 Personal Factors. Source: Author .....	51
Table 2-6 Social Factors. Source: Author .....	53
Table 2-7 Environmental Factors. Source: Author .....	54
Table 2-8 Literature Review Summary.....	55
Table 3-2 MCDM Comparison.....	75
Table 3-3 Linguistic Scale .....	83
Table 5-1 Participant’s Profile .....	122
Table 5-2 Relevant Keywords .....	127
Table 5-3 Content Validity .....	128
Table 5-4 Criteria and indicators for employee’s social sustainability. Source: Authors .....	130
Table 5-5 Demographic Profile. Source: Authors .....	132
Table 5-6 KMO and Bartlett's Test. Source: Authors.....	135
Table 5-7 Exploratory Factor analysis.....	136
Table 5-8 Factor Interpreted. Source: Author.....	136
Table 5-9 Goodness of Fit. Source: Author.....	138
Table 5-10 SEM Path List.....	138
Table 5-11 Cronbach’s $\alpha$ , AVE and composite reliability (CR) scores.....	139
Table 5-12 Discriminant Validity .....	140
Table 5-13 Prioritization .....	143
Table 6-1 Underpinning Criteria Description .....	146
Table 6-2 Participant’s Profile .....	147
Table 6-3 Decision Criteria.....	148
Table 6-4 Linguistic Scale .....	152
Table 6-5 Focus Group Construction Sector Experts .....	155
Table 6-6 DST Expert Evaluation.....	159

## **List of Abbreviations**

AHP	Analytical Hierarchy Process
BOT	Blockchain of Things
BOTSSM	Blockchain and IOT-Based Social Sustainability Management
CDC	Centres for Disease Control
DST	Decision Support Tool
EMW	Employee Mental Health and Wellbeing
SEM	Structural Equation Modelling
MOORA	Multi-Objective Optimisation based on the Ratio Analysis method
SDGs	Sustainable Development Goals
UAE	United Arab Emirates
WHO	World Health Organization

## Chapter 1. Introduction

### 1.1. Introduction

The construction sector is considered to be an essential economic pillar for every country around the world, as it aligns with the development of infrastructure and economic growth of the country. Moreover, its ability to create employment in different sectors such as transportation, real estate, manufacturing, trade, warehousing, wholesale, and leasing services, this sector is considered the single largest industry globally with a net worth valued at USD 7.28 trillion in the year 2021, which is expected to increase by USD 14.41 trillion by 2030 [1]. However, despite the importance of the sector, grave issues of mental health and social sustainability were reported over the years. Recent studies have shown the construction sector is at high risk for suicide and mental health issues due to uncertain factors involved such as uncertainty of seasonal work, demanding schedules, workplace health, and safety risks [2]. Thus, highlighting a significant problem that needs to be addressed.

Where the recent pandemic COVID 19 has not only shaken the world in general but has also affected the global workforce and construction sector to the worst in terms of unemployment, mental health issues of employees, and work-life balance. As reported by many researchers the issues related to mental health have resulted in an adverse effect on the population globally with an increase in the number of cases of depression, anxiety, and suicide each year [3]. This results in several failures in the industry such as low productivity and performance, costs of illness, absenteeism, staff turnover, and onsite accidents as evident from the example of the UK where about 80 million days are lost every year due to mental health illnesses that cost up to one or two billion pound sterling [4].

At this point, it can be established that the construct carries significant importance to the communities 'wellbeing and the success of a nation. Sustainable development has been widely adopted as a measure of competitive advantage by nations, communities, and organizations around the world. Though the concept has been talked about in the literature, however, the adoption of the concept of social sustainability in an organization is at the earliest stages [5]. Social sustainability is defined as "*the process for creating sustainable places that promote wellbeing (Physical and Mental Health),*

*by understanding the needs of people from the places they live and work.”* [6]. Moreover, in corporate, social sustainability is seen considering human rights, fair labour practices, living conditions, health and safety, wellness, diversity, equity, work-life balance, empowerment, engagement, organization commitment, and more [6]. Thus, adopting the definition and factors of social sustainability, several studies have found a holistic conceptualization of social sustainability with mental health and wellbeing. Which suggested that to ensure the social sustainability of an individual it is pertinent to ensure mental health and wellbeing.

Moreover, the importance of social sustainability and mental health is also evident from the initiatives taken by World Health Organization (WHO), over the years; from the UN calls for the improvement of mental health care (1991), World Bank exposing the alarming burden of mental health problems (1993), Harvard University creating awareness about the complexity of mental disorders (1995) to the WHO launching a global program, *‘Nations for Mental Health’* in 1996 [7]. The program adopts a three-step approach envisaged putting mental health as a significant factor in nations’ success on the political agenda.

However, still, the alarming estimates show that one in four of the world’s population suffers from a different form of mental disorder. The report by the Global Burden of Disease 2010 claims that about 400 million people suffer from depression globally [8]. Besides, the Global burden of mental health, the economic strain, and the financial costs are also staggering as the United States (USA) in 2014 has to spend \$239 billion on the expenditures related to mental health and substance abuse treatment with the costs of human suffering being incalculable [9]. The global economic impact of mental health problems such as depression and anxiety disorder is estimated to be 1 trillion US dollars per year in loss of productivity to a report conducted by WHO [10].

Therefore, from the statistics, it is evident that mental health has been neglected for far too long. The construct is crucial for the overall well-being of individuals, societies, and countries, hence ensuring social sustainability. Consequently, it should be universally regarded in a new light, where the inclusion of social sustainability in terms of mental health and psychosocial wellbeing as an integral part of the Sustainable Development Goals (SDGs) came as a promising effort to promote the construct as a unified global agenda. The universal nature of SDGs commits the world leaders to

prioritize and promote social sustainability by giving importance to mental health and wellbeing [11].

Hence, it is important to understand the concept of mental health in general and employee mental health and well-being specifically in the construction sector that ensures social sustainability. Though the literature also reports on several studies and reliable scales that have been proposed over the years that have linked the concept of employee mental health and wellbeing with job satisfaction, productivity, absenteeism, and low turnover rates [8, 12, 13], but they tend to work in isolation and focus on only certain aspects of mental health. Besides, little or no research has been conducted to support and monitor the organizations in working on enhancing the social sustainability and mental health of employees in the construction sector, thus indicating a research gap.

The adverse impact of mental health on the construction sector of the United Arab Emirates is no different than the other developing and developed nations, where about 42 percent of its entire workforce experiences some degree of stress with the inability to maintain a good work-life balance [14, 15]. This study focuses on the United Arab Emirates, a land of a diverse workforce, the sixth country to host the largest number of international migrants and expatriates as an area of this study [16]. In addition, the UAE government has always presented a compelling vision with several initiatives like the national program for happiness and positivity for its diverse workforce.

Moreover, techniques like artificial intelligence and machine learning [96, 97] have been proposed to identify the problem of Employee Mental Health and well-being (EMW) in the organization. However, none of those techniques allows the decision-makers to prioritize their objectives and goals. Thus, it is within the intent of this study to identify a set of underpinning criteria that define Social Sustainability i.e., employee mental health and well-being, and to propose a decision support tool based on the Hybrid AHP and F-MOORA that can be adopted by the organizations to take a strategic decision on the optimal solution to enhance the EMW in the construction sector in the United Arab Emirates (UAE). In addition, to complement the non-dynamic nature of the decision support tool and ensure the continued successful implementation of social sustainability in the organization of the construction sector by aligning it with the vision of the Government of the UAE to make the region labour-friendly, the study proposes

a conceptual framework based on Internet of Things (IoT) and Blockchain technologies to monitor and incentivize the organizations.

## **1.2. Aim and Objectives**

This study aims to underpin the criteria that define Employee's Social Sustainability and develop a decision support tool that assist decision-makers with making strategic decisions that enhance employees' mental health and wellbeing within the UAE construction sector.

This aim can be achieved by the following objectives:

- Develop an understanding of the evolvement of mental health definitions, concepts, global initiatives, and measurement scales with a focus on understanding EMW and social sustainability.
- Identify a set of criteria that underpin the definition of employees' mental health and explore the current practices, tools, and challenges associated with the employees' mental health and social sustainability initiatives in the UAE construction sector.
- Propose a conceptual framework for the development of a decision support tool that enables organizations to make strategic decisions to enhance their employees' mental health and wellbeing.
- Develop the DST by integrating the underpinning criteria of social sustainability and decision criteria of an organization by adopting Hybrid AHP and F-MOORA.
- Validate the decision support tool using a selective case study within the UAE construction sector.
- Draw a set of recommendations for the effective utilization of the decision support tool within the UAE construction sector organizations to enhance employees' social sustainability and mental health and well-being.

## **1.3. Research Questions**

To guide the aim and objectives of this study, the following research questions will be addressed:

- Q1: What are the underpinning criteria of employees' social sustainability that impact employees' mental health within the UAE construction sector?
- Q2: How can the latest technologies and techniques be adopted to enhance employees' social sustainability within the UAE construction sector.
- Q3. How best can organizations make strategic decisions to enhance their employee's social sustainability?

#### **1.4. Methodological Steps**

To achieve the research, aims, and objectives, the following steps will be taken

##### **1. Literature Review:**

- Developing an understanding of mental health and wellbeing and how the construct and its scales have evolved to the concept of social sustainability.
- Develop an understanding of social sustainability i.e., employees' mental health and well-being, and identify a set of underpinning criteria that define the concept in the industry particularly and the construction sector especially.
- Develop an understanding of multi-criteria decision-making methods and how the organization can adopt Hybrid AHP and F-MOORA to take strategic decisions to ensure employee social sustainability.
- To explore the benefit of adopting the latest technologies for ensuring social sustainability management i.e., employees' mental health and well-being of its employee.

##### **2. Data Collection**

###### **a. Qualitative Data Collection:**

- To validate and tailor the factors deduced from the literature with the aid of semi-structured interviews with experts in the UAE construction sector. In addition, to exploring the current practices, tools, and challenges in the implementation of EMW initiatives in the UAE construction sector.
- To understand and validate the adoption of conceptual framework BOTSSM with experts in the fields such as WakeCap Technologies.

- b. Quantitative Analysis:** To conduct a descriptive analysis of the data collected by conducting a questionnaire survey with the employees of the organization to understand the correlations between the variables. Furthermore, using SEM to understand the structure and relationship of criteria and to validate the conceptual framework based on a set of underpinning criteria of EMW identified through literature and validated through the qualitative analysis.
- c. Decision Support Tool:** This stage aims to propose the steps that lead to the development and validation of a decision support tool based on adopting the Hybrid AHP and F-MOORA for the organizations to be able to take a strategic decision to enhance the employee's social sustainability, using UAE construction organization as a case study.
- d. Conceptual Framework:** This stage aims to propose the conceptual framework by adopting Blockchain and IoT technologies for social sustainability management which allows the stakeholders and government to monitor and incentivize the organization that works towards ensuring the employee's social sustainability of their employees. To validate the conceptual framework the study adopts expert validation with WakeCap Technologies known as experts in providing IoT solutions to the construction sector for ensuring employee social sustainability.

### **1.5. Dissertation Organization**

The rest of the dissertation is organized as follows: Chapter 2 provides the understanding of social sustainability and mental health with a focus on identifying the underpinning criteria for employee mental health and wellbeing to develop a decision support tool. The suitable techniques and technologies to develop and complement the decision support tool are discussed in Chapter 3. Chapter 4 presents the methodology and schematic framework that guides the development of the decision support tool and conceptual framework based on Blockchain and IoT to ensure the social sustainability of employees in the construction sector. Chapter 5 and Chapter 6 discuss the data collection methods and analysis with Chapter 6 focusing on the development of the proposed decision support tool and conceptual framework based on BOTSSM. Finally, Chapter 7 concludes the dissertation and outlines the future work.

## **Chapter 2. Literature Review**

The construction sector has been considered a significant contributor to the economy globally and nationally. However, reports have shown some alarming situations of mental health issues and challenges to social sustainability in the construction sector. Though there exists literature that considers mental health generally, little has been reported on adopting this concept for employees in the construction sector. Therefore, it is within the intention of this chapter to identify the issues of mental health and social sustainability facing the construction industry. Moreover, to propose a suitable solution the chapter focus on developing an understanding of social sustainability and mental health and how the concept has evolved, its related scales, the global initiatives, and the associated challenges that have evolved in parallel over time. The chapter also focuses on understanding the EMW that has been defined over the years by a set of criteria. The chapter also investigates a set of criteria that underpin the definition of social sustainability and employee mental health and wellbeing in the construction sector to propose a suitable approach toward developing a decision support tool and conceptual framework for evaluating and enhancing the EMW within organizations.

### **2.1. Construction Sector**

In the industry, the construction sector has been considered a significant contributor to the economy globally as it is an investment-led sector by the government and international investors. The construction sector as one aids in developing other sectors of the industry; the activities of the construction sector are dispersed over different sectors such as transportation, real estate, manufacturing, trade, warehousing, wholesale, and leasing services. It is considered the single largest industry globally valued at USD 7.28 trillion in the year 2021, which is expected to increase by USD 14.41 trillion by 2030 [1]. The sector alone comprises 25% of the world's workforce directly or involved in the activities related to construction; where the United Kingdom's construction sector alone creates 2.4 billion jobs in the year 2019 [17, 18].

However, despite the importance of the sector, reports have shown that workers and employees in the construction sector are more vulnerable to burnout and mental stress than in any other field. Where report by the Centres for Disease Control (CDC) presents alarming statistics of the highest suicides rates in the construction sector which sums

up to 53.2 suicides per 100,000 workers, which corresponds to around 2 to 3.5 times higher rates of suicides reported in Australia and the United Kingdom (UK) constructions sector in comparison to the other sectors in the industry nationwide, the frequency of the suicide alone in the UK are 6 times more than casualties occurring from falling from height as shown in Figure 2.1 below [19, 20].



Figure 2-1 Alarming Statistics of the Construction sector [19, 20]

Besides, [21] presents how different levels of stress and mental health issues exist for different occupations based on the work pace and skills required; where construction workers and architects tend to show higher stress levels as indicated in Figure 2.2.

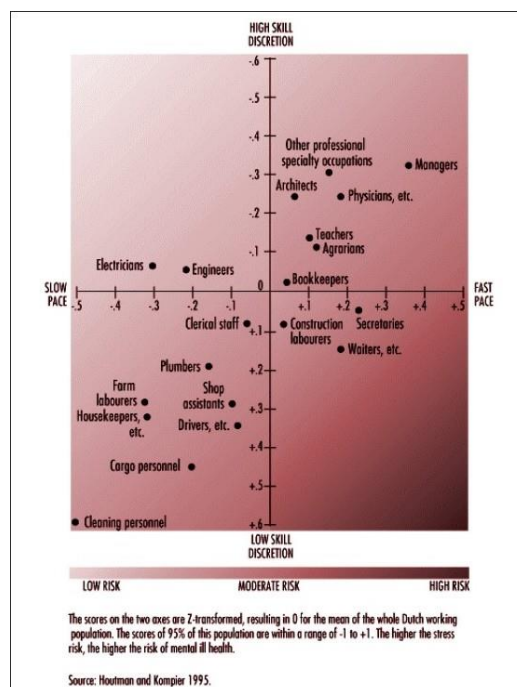


Figure 2-2 Risks for stress and mental ill-health for different occupations. Source: [43]

The figure, therefore, indicates that architects belong to the high skill discretion with a high pace of work, but they tend to have a higher risk of stress and mental health issues associated with their work. Similarly, the construction workers, fall into the low-skill discretion category that demands a high pace thus they also tend to have a higher risk of stress and mental health issues.

Besides, the literature also reports on several alarming studies conducted in the sector. Similarly, [22] identifies work stress as the major factor affecting the productivity, efficiency, and well-being of the employee in the construction sector in Malaysia.

Likewise, [23] adopted a mixed-method approach to determine the factors that impact the well-being of employees in the UK construction industry. The study suggested that there exist major mental health problems in the industry due to the failure to recognize the issue and the associated stigma. The factors considered by the study to measure the mental health of its employees were the environmental conditions, workload, social context, education, mental health training, and workplace sentiments. The study thus proposes many strategies to enhance the mental health and well-being of employees in the UK construction industry.

Moreover, [24] conducted a study to explore the perception of an employee on the rising number of psychological ill-health conditions developing the construction workers in Ghana. The study adopted a mixed-method approach and found that deadline pressures, abusive supervisors, job demand, poor relationships, and work conditions. Lack of role clarity and control and lack of organizational commitment are the significant factors behind the psychological ill-health of construction workers. Similarly, [25] by adopting the focus group and survey approach also found that accident-prone, chronic pain, insomnia or sleep disturbances, job dissatisfaction, and workload are the major factors that cause occupational psychological disorders.

It can be stated at this point that though the construction sector acts as the backbone of the nation's success, the sector experiences a great amount of threat from mental health issues and a lack of social sustainability. To the alarming statistics of 3.7 times higher suicide rates in the UK construction sector, the second leading cause of death in the US construction sector, and about 70 to 75 percent of the employee in the construction

sector in Australia and New Zealand are more likely to commit suicide than any other sectors in the countries [26].

Similarly, the effect on mental health is no different than the other developing and developed nations in the UAE, where about 4 percent of the population in the UAE can be classified as clinically depressed with around 15 percent of the population expressing mental health issues and mild episodes of anxiety and depression [27]. Whereas according to the 2013 report, the UAE industry reports about 42 percent of its entire workforce experiencing some degree of stress with the inability to maintain a good work-life balance [14, 15].

The construction sector also shows similar alarming statistics alike the sector globally with around 25 percent of workers suffering from depression and anxiety disorders with suicide cases recorded in the UAE construction sector as 6.3 percent and 2.5 percent of suicide attempts, especially in the migrant workers [28].

### **2.1.1 UAE construction sector**

The UAE's construction boom, notably in the emirate of Dubai, is one of the country's most important sectors of economic growth which was estimated to expand by 3.7 percent of annual growth by 2023-2026. The growth of the sector is due to the country's commitment and agenda to strengthen industrial, transportation, and energy infrastructures. The sector has been considered one of the world's largest and fastest expanding construction marketplaces. Construction has propelled the UAE economy's expansion, accounting for 8% of overall GDP and 11% of non-oil-related GDP.

The UAE construction sector comprises large, state-backed, or self-owned enterprises, that have dominated the UAE construction market since the early 2000s, undertaking exceptionally large-scale urban development projects. The construction market operates through a broad and complicated network of enterprises due to the massive scope of these projects, which can often include tens of thousands of residential units. Where the project management and funding have been frequently controlled by state-owned or funded development enterprises. A tiny number of huge multinational enterprises work directly under these development companies, hiring professional migrants but rarely employing lower-wage manual laborers. This accounts for 80 percent of the migrant workers both high and low skilled in UAE's total population.

Whereas the migrant construction worker varies by geography, occupation, and sector. The UAE construction industry is almost entirely made up of non-citizens, nearly every foreign worker in the UAE construction sector is a migrant on a temporary work visa, from the highest-paid architects, engineers, surveyors, and designers to the lowest-paid demolition workers, water carriers, and cleaners. By the mid-2000s, the UAE had received an estimated 700,000 construction migrants, mostly low- and semi-skilled workers from India, Pakistan, Bangladesh, Nepal, Sri Lanka, and the Philippines. [29]

Also, like other developed and developing countries, the UAE reports similar issues of mental health as about 4 percent of the population in the UAE can be classified as clinically depressed with around 15 percent of the population expressing mental health issues and mild episodes of anxiety and depression [27]. Whereas according to the 2013 report, the UAE industry reports about 42 percent of its entire workforce experiencing some degree of stress with the inability to maintain a good work-life balance [14, 15].

The construction sector also shows similar alarming statistics alike the sector globally with around 25 percent of workers suffering from depression and anxiety disorders with suicide cases recorded in the UAE construction sector as 6.3 percent and 2.5 percent of suicide attempts, especially in the migrant workers [28].

Thus, this indicates that the UAE construction sector comprises mostly migrant workers and shows similar grave issues of mental health. Reports indicate that migrant workers have been mostly affected by episodes of mental health and social sustainability [28].

Besides the alarming statistics, it was identified from the literature that several studies have been conducted on the concept of individual mental health. However, one aspect of individual life; the professional and work-life was not given due importance. In addition to this, literature reports on several studies and scales proposed for mental health; however, these studies and scales tend to work in isolation and focus on only a certain aspect and criteria that impact employee mental health and wellbeing. Thus, there is a lack of evidence of a set of underpinning criteria for employee social sustainability in the construction sector that can be adopted to address the issue. Besides, no or a little has been reported on decision support tools available to enhance employees' social sustainability in the construction industry. This study, therefore, aims to identify a set of underpinning criteria that define employee mental health and well-

being which ensure social sustainability of employees in the construction sector; to propose a decision support tool that can be adopted by the UAE construction sector to make strategic decision to enhance their employee’s social sustainability.

Hence, to propose a solution for the issue of mental health and social sustainability in the construction sector, it is important to develop an understanding of the evolvement of concepts, scales, and initiatives that have also evolved in parallel.

## 2.2. Social Sustainability

Sustainable Development has been widely adopted as a measure of competitive advantage by nations, communities, and organizations around the world. Where the debate on sustainability has grown from the concept of environmental sustainability to economic and social pillars. Though the concept has been talked about in the literature, however, the adoption of the concept of social sustainability in the organization is at the earliest stages [5].

Social sustainability is defined as *“the process for creating sustainable places that promote wellbeing (Physical and Mental Health), by understanding the needs of people from the places they live and work.”*. In corporate, social sustainability is seen considering *human rights, fair labour practices, living conditions, health and safety, wellness, diversity, equity, work-life balance, empowerment, engagement, organization commitment, and more.* [6]

Thus, adopting the definition and factors of social sustainability, several studies have found a holistic conceptualization of social sustainability with mental health and wellbeing. Which suggested that to ensure the social sustainability of an individual it is pertinent to ensure mental health and wellbeing [30] as shown in Figure 2.3.



Figure 2-3 Holistic Conceptualization. Source: Authors

Therefore, the study assumes that to ensure social sustainability, mental health and wellbeing must be addressed. Thus, the research will adopt the terms of social

sustainability and mental health and wellbeing interchangeability as one holistic concept. Hence it is important to develop an understanding of Mental Health and how the concept has evolved, its related scales, the global initiatives, and the associated challenges that have evolved in parallel over time.

### 2.3. Mental Health

Over the years the concept of mental health has evolved into several theories. However, despite the dynamic nature of the concept one of the assumptions that remained similar and adopted by the scientists and researchers was the difference between mental health and mental illness [31]. As presented in Figure 2.4, Mental health and mental illness are orthogonal to each other as they belong to the two different but correlated continuums.

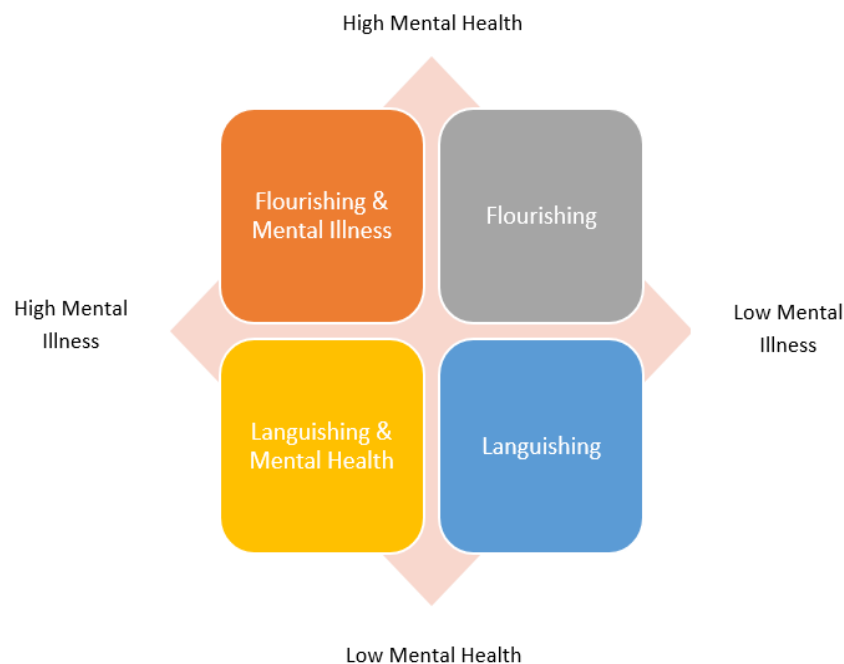


Figure 2-4 The Dual Continua Model of Mental health and mental illness, Source: [22]

The figure demonstrates the theory of two continua where one represents the presence and absence of mental health, and the other orthogonal continuum represents the presence and absence of mental illness. As illustrated in the first quarter (clockwise); an individual with high mental health and low mental illness is termed to be flourishing. However, considering the fourth quadrant shows a person with high mental health and high mental illness can still be termed as flourishing but with issues or episodes of

mental illness. This implies that the concepts of mental health and mental illness are different from each other, and the absence of mental illness does not imply the presence of mental health. Therefore, this study only focuses on the concept of Mental health and the underpinning criteria that impacts the mental health of employees in an organizational setup.

Mental Health and well-being have been identified as significant concepts for the communities' well-being and a nation's success in ensuring social sustainability. However, throughout history, the concept of mental health has been evolved into three theories namely, the pathogenic approach, salutogenic approach, and the complete state approach [32].

Among which the first approach introduced was *the pathogenic approach*, inspired by the Greek word *pathos*, which indicates suffering or emotion of sympathy. This approach defines health as the absence of illness. Later in history around 1979, *the salutogenic approach* was introduced by Antonovsky, who perceived health as the presence of positive feelings, capabilities, behaviour, and thinking. The name was derived from the Greek word *Salus* which indicates health as the positive capacity and functioning of the human being [33].

Finally, the last approach derived from the word *hale* meaning whole was called *the complete state model* [34]. Since then, the theory of mental health as a complete state of an individual's well-being has been adopted and accepted by the researchers. Therefore, for this study, the theory of the complete state model will be adopted. However, to develop a better understanding of mental health it is pertinent to review the history and to discover how the concept of mental health, its related scales, and initiatives have evolved.

One of the earliest definitions of mental health, as reported by the literature, was by Jhoda 1958 which defines "*the existing behavioural and social scientific vision of mental health as not merely the absence of mental illness but the presence of something positive*" [35]. It can be noted here that as defined before mental health and mental illness have always been considered different concepts. Hence mental health does not merely mean the absence of the illness, but it represents the presence of positive behaviour, attitude, or feeling.

Similarly, in 1980 the concept of mental health was for the first time introduced as subjective well-being, where the presence of mental health was termed as *flourishing* and the absence of mental health was considered as *languishing* in life. Another aspect of mental health was defined in 1985 by Watson and Tellegen that consider the emotional well-being of an individual as their mental health [36]. This implies that by 1985 the presence and absence of positive feelings in one's life were viewed as the mental health of an individual.

Likewise, Ryff (1989) introduces the concept of mental health as a symptom of positive feelings and functioning of life [37]. Where the positive functioning was defined using six dimensions that include: self-acceptance, positive relations, personal growth, life purpose, environmental mastery, and self-sufficiency as shown in Figure 2.5.

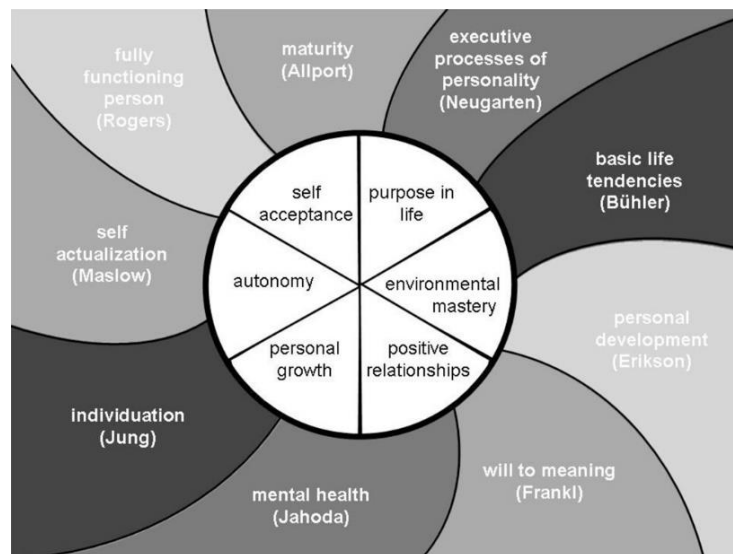


Figure 2-5 Core Dimensions of Psychological Well-Being and Their Theoretical Foundations. Source: [27]

Though over the years the definition has been critiqued by many researchers such as (Keyes 1988) that argued that there is more to mental health than just psychological well-being and positive functioning, therefore proposing the concept of social well-being which includes social coherence, social actualization, social-integration, social-acceptance, and social contribution. Thus, indicating mental health does not merely depend on the individual's satisfaction with life but it is a mere outcome and dimension of mental health.

Thus, at this stage, it can be argued that an individual’s mental health and well-being is a combination of emotional, psychological, and social well-being that can be translated as the subjective well-being of an individual. This was later supported by William A. Scott that argues that the degree of mental health can be accessed using subjective well-being such as subjective happiness, self-confidence, and morale [38].

Furthermore, during the 1900s, David Satcher, the Surgeon General 1999 defined mental health as the state that results in successful performance, productive activities, adaptivity, coping with adversity, and the ability to be in a relationship with people [32].

Hence, at this point in history, the concept of mental health can be defined as the subjective well-being of an individual that considers the emotional, psychological, and social factors of the well-being that allows the individual to be productive, able to make a relationship and perform successfully with happiness and confidence, which aligns to the theory of the complete state model. Thus, considering the above findings from history; the definition proposed by the WHO [8],[7] in their historic report in 2004 was the closest definition that defines mental health as

*“a state of well-being in which every individual realizes his or her potential can cope with the normal stresses of life can work productively and fruitfully, and can make a contribution to her or his community”*

Therefore, based on the findings of the evolution of mental health as summarized in Table 2.1 and the comprehensive nature of the World Health Organization that considers mental health in terms of subjective well-being (emotional, psychological, and social wellbeing) where the person can function positively and productively is adopted for this study.

Table 2-1 Mental Health Definition

Year	Definition
1958	The existing behavioural and social scientific vision of mental health is not merely the absence of mental illness but the presence of something positive
1980’s	The concept of mental health as subjective wellbeing was first introduced, where the presence of mental health was termed as <i>flourishing</i> and the absence of mental health was considered as <i>languishing</i> in life
1985	Mental health in terms of emotional well-being can be defined as the presence and absence of positive feelings in one’s life.
1989	The concept of mental health as a symptom of positive feelings and functioning of life
1988	There is more to mental health than just psychological wellbeing and positive functioning, therefore proposing the concept of social wellbeing

	The degree of mental health can be accessed using subjective well-being such as subjective happiness, self-confidence, and morale.
1999	The Surgeon General, then David Satcher, conceived of mental health as “a state of successful performance of the mental function, resulting in productive activities, fulfilling relationships with people, and the ability to adapt to change and to cope with adversity”
2004	“a state of well-being in which the individual realizes his or her abilities can cope with the normal stresses of life can work productively and fruitfully, and can make a contribution to his or her community”

Thus, keeping in mind, the definition of *social sustainability focuses on creating a place that promotes well-being and Mental Health that defines the state of well-being and focuses on creating an environment where the individual realizes his or her potential when the needs of people from the places they live and work are met* [6]. Thus, for this study, the holistic definition of social sustainability and mental health and wellbeing will be adopted.

Moreover, from the table, mental health has been considered significant for almost over a decade. However, still, the estimates show that one in four of the world’s population suffers from a different form of mental disorder. The report by the Global Burden of Disease 2010 claims that about 400 million people suffer from depression globally [8]. The alarming statistics as shown in Fig 2.6, the economic strain and the financial costs of the expenditures related to mental health and substance abuse treatment with the costs of human suffering are incalculable [39]. The global economic impact of mental health problems such as depression and anxiety disorder is estimated to be 1 trillion US dollars per year in loss of productivity to a report conducted by WHO [10].

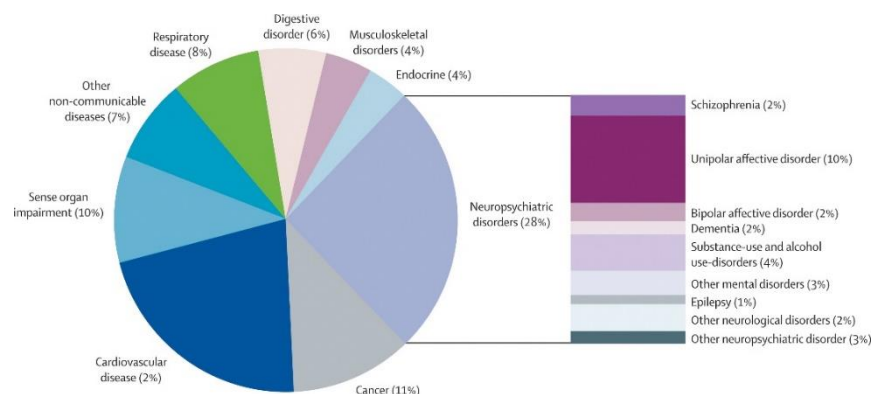


Figure 2-6 Contribution by different non-communicable diseases to disability-adjusted life-years worldwide in 2005. Source: [29]

The report also shows that neuropsychiatric conditions or mental health conditions account for 28% in comparison to the different non-communicable diseases of the disability-adjusted life-year as shown in Figure 4, which makes it necessary to explore the global initiatives by the government and international organizations such as WHO and United Nations (UN) for mental health. The findings will further aid in understanding the concept and history of the evolution of mental health, its measurement scales, and the challenges associated that can be used as guidance to improve and negate the impact of the challenges to enhance mental health.

#### **2.4. Global Mental Health: Initiatives and Challenges**

According to the WHO at any point in time out of four one person suffers from a different form of mental health issue. Unfortunately, with these striking figures of issues identified globally, the commitment toward Mental health has been ignored globally by the leaders and policymakers. According to [7, 40], the journey took a decade of progress for mental health to be recognized globally as highlighted in the following steps below;

***1991 - UN calls for improvement in mental health care:*** The UN adopted twenty-five Principles of Protection of Persons with the aim of basic rights and freedom for people with mental illness. The set of principles was aimed to act as a guide to government, international organizations, and specialized agencies to assist them in helping them investigate the problems and application of these rights.

***1993 - Alarming Burden of Mental Health Exposed:*** The World Bank in its report in 1993 published some alarming statistics that claim about 8 percent of the global burden of disability and morbidity is due to mental health, which increases up to 42 percent if behavioural issues are included.

***1995 - Complexity of Mental disorders in developing countries:*** The UN Secretary-General Boutros-Ghali urged to consider the issue of mental health as the foremost challenge based on the book published by Harvard University that highlights the challenges (behavioural, social) and complexity of mental health disorders in the developing countries.

Thus, to address these alarming situations WHO 1996 took upon the challenge to promote mental health as a global agenda in collaboration with the United Nations (UN).

**1996 – A Nation is Born:** WHO initiated a global program dedicated to improving the mental health and wellbeing of the world’s population to be called ‘*Nations for Mental Health*’. The program was based on a three-step approach that includes: General awareness of mental health (the aim was to increase the awareness with the aid of a series of high-profile events that will gain the attention of the public); Efforts to attract ‘Key political authorities’ and finally efforts to make mental health a part of political agenda by the policymakers. In addition to these the *Nations for Mental Health* was based on achieving the following goals: to raise awareness, stimulate innovative approaches, generate the human capital, and promote service development at the country level. Likewise, in 2015, the inclusion of mental health and psychosocial wellbeing as an integral part of the SDGs 2015 [41], came as a promising effort to promote the construct as a unified global agenda. The universal nature of SDGs commits the world leaders to prioritize and promote mental health and wellbeing and universally regard it in a new light and a vision.

However, with the promising efforts and global commitment, the literature reports on several challenges as highlighted in [42] to global mental health that can be classified into four categories such as conceptual, social, economic, human rights, political, health system, and international/national policy as summarised in Table 2.2.

Table 2-2 Challenges for Global Mental Health

Categories	Challenges	References
<b>Health System Challenges</b>	<ul style="list-style-type: none"> <li>- Limitation of the availability of resources for mental health especially in low-income countries.</li> <li>- Increase in competition and reduce collaboration among organizations and health personnel due to the availability of scarce resources.</li> <li>- Limited health infrastructure and human resources especially in low-income countries.</li> <li>- Pressure on the international and domestic health policy to prioritize certain diseases rather than a comprehensive public health approach</li> <li>- Lack of strong advocacy and support from major donors, ministers, or civil servants of health ministries of integration of mental health into national annual operational plans and essential packages, whereas it is always integrated as a part of social care, education, and criminal justice system.</li> </ul>	[42, 43]

	<p>This integration results in a lack of effective implementation.</p> <ul style="list-style-type: none"> <li>- Difficulty in sustaining funding from tax and social health insurance mechanisms.</li> <li>- The exclusion of mental health information from the routine information system causes donors and countries to not support the construct.</li> </ul>	
<b>Conceptual Challenges</b>	<ul style="list-style-type: none"> <li>- Among many of the challenges, the first and foremost is the lack of information available about basic mental health and its resources in the world. The global population does not have any knowledge about the availability of policies, legislation, and programs in different countries.</li> <li>- Lack of knowledge regarding the availability of professionals and psychiatric beds are not publicly available.</li> <li>- Lack of cross-national evidence on the cultural, socioeconomic, and services factors underlying disparities in incidence, diagnosis, treatment, and outcomes</li> <li>- Lack of valid and reliable definitions, models, and measurement tools for quantitative assessment at the individual and population levels for use across cultures and settings.</li> </ul>	[7, 42, 44]
<b>Social, economic, human rights, and political challenges</b>	<ul style="list-style-type: none"> <li>- The complicated relationship between mental health, poverty, and debt; the negative impact of mental health increases the chances of households falling into poverty, for those households already marked below poverty tend to fall into debt which leads to starvation.</li> <li>- The policy makers have failed to prioritize the investment; due to which there exists a lack of research on cost-effective interventions especially for low- and middle-income countries.</li> <li>- Availability of limited funding that can allow the ease of access to mental health services.</li> <li>- Lack of strategically allocated resources of limited resources as the main cities in the country enjoy more resources which causes other parts of the country to face deprivation.</li> <li>- Lack of access to services and global architecture for mental health; (Lack of establishing minimum health-care standards around the world).</li> <li>- The need to draw strategic policy and dialogues.</li> <li>- The human rights approach is not given importance in the mental health policy and implementation.</li> <li>- Ease of access to psychotropic drugs, and availability of mental health reporting systems are grossly inadequate.</li> <li>- Lack of training and availability of culturally and ethnically diverse lay and specialist providers to deliver evidence-based services.</li> <li>- Lack of established minimum health-care standards around the world.</li> <li>- Exclusion of mental health among other diseases for investment into research, training, treatment, and prevention.</li> <li>- The stigma, discrimination, and issue of social exclusion of patients and families across cultural settings.</li> </ul>	[42, 45]
<b>International and national policy challenges</b>	<ul style="list-style-type: none"> <li>- Unplanned and rapid urbanization.</li> </ul>	[42, 46, 47]

	<ul style="list-style-type: none"> <li>- Lack of defined policy at international and national levels causes difficult access to mental health interventions.</li> <li>- Perception of the definition of mental health into psychosocial issues by the policy makers causes a focused policy including only certain diseases.</li> <li>- Lack of integration of mental health into the social development perspective</li> <li>- Availability of scarce Human resources and lack of support from national and international policy makers causes uneven planning of human resources.</li> <li>- A non-amenable perception onsistent43f Mental illness by the policy makers.</li> <li>- One of the biggest challenges faced by the construct is the lack of visible core indicators. The indicators of mental health are not defined internationally in the list of agreed health needs and desired outcomes.</li> </ul>	
--	--	--

Thus, though the government and international organizations continue to work towards improving mental health, there exist a great number of global challenges such as the literacy challenge of accepting the problem of mental health as the first and foremost significant challenge, especially in underdeveloped and developing countries where the concept is considered as taboo. Besides, the lack of consideration given to it in a national or international budget in comparison to the other diseases also make it harder for the limited and scarce resources to address the global issue. Finally, the lack of valid and reliable definitions, models, and measurement tools for quantitative assessment at the individual and population levels for use across cultures and settings also displays a huge challenge for the implementation at the global scale. Thus, it is important to understand and identify the measurement scales evolved and are accepted over time to measure mental health.

## 2.5. Measurement Scales

The literature reports on several theories and definition related to mental health that has evolved over the years that remain aligned to different scales evolved over the years by different scholars and researchers to measure the concept. Thus, this subsection intends to highlight the most widely accepted and reliable scales by considering when it was proposed, their purpose, and reliability measurement (Cronbach alpha) for internal consistency. Which will aid the study to identify the current practices and limitations of the scale to overcome the challenges.

Several scales have been identified from the literature; however, the section presents the most widely accepted and reliable scales such as:

### **A. *The Mental Health Continuum—Short Form***

The 14-item scale was derived from the long scales measuring the three forms of well-being including the psychological well-being scale (Ryff and Keyes 1995), emotional well-being (Cantril 1965; Mroczek and Kolarz 1998), and social well-being (Keyes 1998, 2005) [31]. The scale has been used over the years in pilot studies, which found that the internal consistency (Cronbach alpha) of the three scales was: 0.83 for psychological and emotional well-being and 0.74 for social well-being. The scale rate is 0.89 on the reliability of the total measurement scale. The most significant questions in the scale mentioned are: “*In the past month, how often did you feel: ...happy? ...that your life has a sense of direction or meaning to it? ...that people are good?*”.

### **B. *The Brief Symptom Inventory (BSI)***

The scale proposed by Derogatis 1975, was aimed to measure the effect of the last seven days and has become the most widely used scale in American mental health care. However, the scale is used to measure Somatization, Obsessive-compulsive Complaints, social phobia, Depression, Anxiety, Hostility, Phobic Anxiety, Paranoid Ideation, and Psychoticism [31]. The item in the scale includes: “*During the past 7 days, how much were you distressed by nervousness or shakiness inside?*” and “*During the past 7 days, how much were you distressed by feeling afraid to travel on buses, subways, or trains?*”. The BSI has been validated by (de Beurs and Zitman 2006) and the reliability (Cronbach Alpha) of the complete scale was calculated to be 0.95.

### **C. *LSI-Z Life Satisfaction.***

The scale developed in 1969 by Wood et al comprises multidimensional measures to compare the past and present life of oneself and the others in terms of the mood tone [48]. The scale was developed keeping the old people in mind, consisting of 13 items on a five Likert scale. The scale was aimed to measure mental health generally but morale particularly. The reliability of the total scale (Cronbach alpha) was found to be 0.743 for community patients and 0.837 for a clinical setting.

### **D. *Trait-Anxiety Inventory.***

The scale was developed in 1970 by Spielberger et al. (1970) to determine the Trait-Anxiety. The 20-item scale with the four-point Likert scale comprises measures for

individual general feelings to determine the stable aspect of anxiety [48]. The reliability of the total scale (Cronbach alpha) was found to be 0.87 for community patients and 0.929 for a clinical setting.

***E. The Centre for Epidemiological Studies Depression Scale (CES-D):***

The scale was developed by the National Institute of Mental Health Centre for the general population. The 20-item scale on a four-point Likert response aimed to determine the symptoms of depression with a focus on mood. The scale was designed to access the frequency of occurrence of the symptoms over the previous week [48]. The reliability of the total scale (Cronbach alpha) was found to be 0.851 for community patients and 0.9 in a clinical setting.

***F. General Well-Being Scale:***

The scale was developed in 1970 by Dupuy to be proposed to the National Center for Health Statistics Health Examination Surveys. The 14-item scale was aimed to act as a global index to subjective well-being and distress. The scale was designed to determine the feeling dimensions for the past month, with the first fourteen items based on a six-point Likert scale and the last four on an eleven-point Likert scale [48]. The reliability of the total scale (Cronbach alpha) was found to be 0.881 for community patients and 0.915 for a clinical setting.

***G. Affect Balance Scale:***

The scale was developed in 1965 by Bradburn for the general population to determine life satisfaction with positive affect and negative affect. The 10-item scale was aimed to access the life satisfaction of the individual for the past few weeks with yes or no questions [35, 48]. The reliability of the total scale (Cronbach alpha) was found to be 0.64 for community patients and 0.695 in a clinical setting.

***H. Emotional well-being:***

The scale was based on a self-administered questionnaire by the participants to indicate over a five-point scale if they had experienced any symptoms for the last 30 days. Besides, the participants used a scale from 0 to 10 to evaluate their current life satisfaction. the positive symptoms included in the questionnaire include cheerful, good

spirit, happiness, calm and peace, satisfaction, and full of life [35]. The internal reliability of the scale was calculated as 0.91.

***I. Psychological well-being:***

The scale developed in 1989 by Ryff was used to determine the psychological well-being of the individual, to how much an individual perceives himself to be thriving in life. The 18-item scale comprises items of subjective well-being with a focus on items such as self-acceptance, positive relationship, personal growth, environmental mastery, and autonomy [35]. The internal reliability of the overall scale is 0.81.

***J. Social wellbeing:***

The scale was developed in 1998 by Keyes (1998) comprising five subscales comprised of Social Acceptance, Social Actualization, Social Contribution, Social Coherence, and Social Integration [35]. The internal consistency of the total scale was calculated as 0.81.

It can be, therefore, argued that though literature reports on several reliable scales to measure mental health as shown in Table 2.3, these reliable tools tend to work in isolation or lacks comprehensiveness and do not reflect the definition by WHO. This indicates a research gap; therefore, it is important to identify the set of underpinning criteria of mental health that can be used to enhance the mental health and wellbeing of employees.

Table 2-3 Measurement Scale of Mental Health

<b>Name</b>	<b>Author</b>	<b>Scale</b>
Mental Health Continuum— Short Form	Keyes 2006; Keyes et al. 2008	14 items that correspond to our theoretical formulation of emotional, psychological, and social well-being.
The Brief Symptom Inventory (BSI)	Derogatis (1975)	Somatization, Obsessive-compulsive Complaints, Interpersonal Sensitivity (social phobia), Depression, Anxiety, Hostility, Phobic Anxiety, Paranoid Ideation, and Psychoticism
LSI-Z Life Satisfaction.	Wood et al (1969)	Morale (Mental Health) - 13 items on a five Likert scale
The Centre for Epidemiological Studies Depression Scale (CES-D)	National Institute of Mental Health Centre	The 20-item scale on a four-point Likert response aimed to determine the symptoms of depression with a focus on mood
Trait-Anxiety Inventory.	Spielberger et al. (1970)	The 20-item scale with the four-point Likert scale comprises of measure an individual general feeling to determine the stable aspect of anxiety

General Well-Being Scale:	Dupuy (1970)	The 14-item scale was aimed to act as a global index for subjective well-being and distress
Affect Balance Scale:	Bradburn (1965)	The 10-item scale was aimed to access the life satisfaction of the individual over the past few weeks with yes or no questions.
Emotional wellbeing	Cantril's (1967) Self-Anchoring Scale	The scale was based on a self-administered questionnaire by the participants to indicate over a five-point scale if they had experienced any symptoms over the last 30 days
Psychological wellbeing	Ryff (1989)	The 18-item scale comprises items of subjective well-being with a focus on items such as self-acceptance, positive relationship, personal growth, environmental mastery, and autonomy.
Social wellbeing	Keyes's (1998)	comprising of five subscales comprises of Social Acceptance, Social Actualization, Social Contribution, Social Coherence, and Social Integration.

However, despite all these global initiatives and proposed measurement scales. The literature reports on several failures in the industry especially in the construction sector in terms of low productivity and performance, costs of illness, absenteeism, staff turnover, and onsite accidents as evident from the example of the UK where about 80 million days are lost every year due to mental health illnesses that cost up to 1-2 billion pound each year [11]. Similarly, an estimate of around 30-40 billion US dollar, with an estimated 200 million days lost of work is reported in the United States each year, this indicates that mental health and social sustainability is a significant factor that affects the economy of the country and causes an adverse impact on the industry and particularly employee mental health and wellbeing [49].

Therefore, it is important to identify the set of underpinning criteria that affect employees' social sustainability in the construction sector which is considered a backbone of the economy.

## 2.6. Employee Mental Health and Wellbeing

This section aims to define employee mental health and its underpinning criteria that affect the well-being of an employee in an organizational setup.

Based on the definition by WHO; employee mental health and well-being can also be defined as the state of an individual to realize his potential, cope with natural life stresses, be able to be productive, and make a contribution to the community [10].

In addition to this, the concept of employee mental health and well-being can be further explained by the research conducted by [36] that identifies the what, why, and how of employee wellbeing and mental health. The research proposed three core components of employee well-being (1) subjective well-being; (2) workplace well-being and (3) psychological well-being as shown in Fig 2.7.

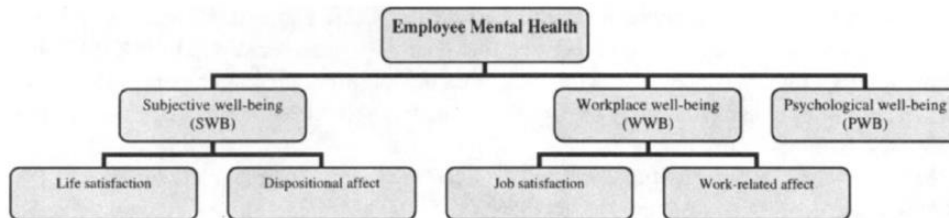


Figure 2-7 Employee Mental Health and wellbeing. Source:[3]

Thus, from the figure above it can be assumed that employee mental health and well-being can be defined by considering the Subjective Well-being (Social and Environmental factors), Workplace well-being (Organizational factors), and psychological well-being (Personal factors); like the holistic definition accepted before by the study in section 2.2.

However, from the literature, [50] it was found that the concept of employee mental health and wellbeing has been associated globally with different outcomes only such as:

- **United States of America:** evaluate the outcome of employee mental health and wellbeing in terms of healthcare cost.
- **Asia:** evaluate the outcome of employee mental health and wellbeing in terms of Absenteeism
- **Singapore:** evaluate the outcome of employee mental health and wellbeing in terms of social capital
- **Europe:** evaluate the outcome of employee mental health and wellbeing in terms of High Morale
- **UK:** evaluate the outcome of employee mental health and wellbeing in terms of Productivity

Therefore, it can be argued here that these outcomes are only a broad glimpse of an employee's mental health and do not define the comprehensiveness and in-depth understanding of employee mental health and wellbeing as proposed by the WHO. Thus, the next section intends to identify a set of underpinning criteria for employee mental health and wellbeing that can be used to propose a decision support tool.

### **2.6.1 Underpinning criteria of employee mental health**

The literature reports on several studies that investigated the impact of different criteria or factors on employees' social sustainability. However, the limitation of these studies was their narrow-focus on only one or a limited number of criteria; thus, failing to provide the complete measurement and definition of employee social sustainability in an organization.

Therefore, this study conducted an extensive literature review that identifies the underpinning criteria of employees' social sustainability and classified them into four categories as organizational factors, personal factors, social factors, and environmental factors for the ease of understanding the reader.

#### **1. Organizational Factors**

The workplace or an organization is a predominant part of an individual life. The organization varies in size, business activities, and sectors; however, despite these differences, the organizational factors play an essential role in an employee's life and mental health. As defined by [51], the organizational factors are the pillars that support the entire structure of the organization and assist the operational and functional management of the organization. such factors can be broadly identified as the structure of the organization (hierarchy), operational policies of the organization (work design, management involvement, and awareness, welfare schemes, appraisal scheme, competencies of supervisors, growth opportunities and training), and functional policies of the organization (shift system, work timings (no. of hours), flexible work systems or fixed and role conflict/ambiguity/ role clarity).

**Organization Structure** – Thus from the definition of organizational factors it can be argued that these factors are an essential domain of an individual's life. As argued by [13, 52] their studies found that organizational structure that refers to the nature of decision making (centralized or decentralized), knowledge management,

communication channels/levels, and organizational justice have a significant impact on employee mental health and wellbeing by influencing depression, anxiety, and work-related stress. Likewise, [53] also adopted the Herzberg two-factor theory on a sample of 318 participants by assessing the 11 hygiene–motivational factors using multiple regression and hierarchical regression models to identify the factors that affect employee job satisfaction. The research findings supported the argument that there exists an association between organizational factors such as organizational structure and employee wellbeing. Moreover, [54] also investigated the factors affecting the productivity and well-being of the employee in the construction sector in the UAE. The study found that organizational structures such as Hierarchy order and Delegations are significant factors impacting employee mental health.

Though the organization structure, the hierarchy and communication level, and organizational justice are important parameters to study employee wellbeing, they are not enough to draw a comprehensive picture as the nature of these factors is affected by other aspects of the organization also.

***Shift System*** - The significance of organizational factors can be also witnessed from the study by [55] who adopted a cross-sectional approach to determine the association between the sleep quality, shift system, and health and wellbeing of the employee by using a self-administered questionnaire along with the Short Form Health Survey, the Pittsburgh Sleep Quality Index (PSQI), Baron and Kenny's method, Sobel test and multiple mediation model. The study, therefore, found sleep quality of shift workers affects their mental health as they score low on the mental health survey.

Thus, it can be concluded from this study that organizational factors have a significant impact on employee mental health.

***Flexible work system/ Work timings*** - Likewise, [56] also highlighted the significant impact of organizational factors on employee mental health in his study. The author adopted a Confirmatory Factor Analysis (CFA) and SEM with a sample of 224 faculty members in the UAE to investigate the relationship between flexible work systems (FWS) on different aspects of employee life. The findings suggested that a flexible work system has indeed a positive impact on personal and social factors of employee

life such as work-life balance and organizational commitment as presented in Figure 2.8.

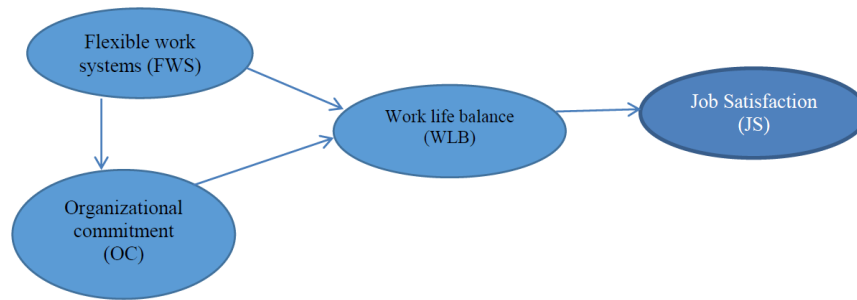


Figure 2-8 Conceptual Framework. Source: [57]

It can be seen in the figure that there exists an association exist between FWS, OC, and work-life balance which affect job satisfaction and mental employee mental health and wellbeing. Moreover, [54, 57, 58] also supported the importance of work timings and flexibility on the well-being of an employee. As [54] in the study identified the factors affecting the productivity and wellbeing of the employee. The study adopted the importance index method based on a structured questionnaire and found that Work timings and working hours are the significant factors. Likewise, [57] also aims to investigate the role of gender and organizational support in a work-family conflict that impacts an employee's mental health and wellbeing. The study adopted a two-step hierarchical regression model on a questionnaire response with a sample size of 236 married accountants in the UAE. The findings supported thus found that work schedule inflexibility results in the work-family conflict that impacts the employee mental health and wellbeing. The negative impact of long working hours on employee mental health was also supported by [58] that to conduct a study adopting a cross-sectional study in Shanghai using the patient Health Questionnaire-9 (PHQ-9) scale and the five-item Well-Being Index (WHO-5) scale. The results found that the respondents having working hours up to 60h are more prone to experience depressive episodes and poor mental health than those having working hours less or equal to 40h. Thus, the study concludes that the working hour indeed has a significant effect on the mental health of the employees.

Though these studies provide some interesting insights into a few of the criteria of organizational factors, they fail to address the comprehensive image of employee well-

being as there exist other criteria that play an indirect and mediating role in defining the wellbeing of an employee.

**Work design (Role conflict/ Ambiguity/ role clarity)** – Recently work design has been given much importance as it is considered the heart of any organization. The work design aids in increasing productivity, financial growth, lower activity risk, and improvement in employee mental health and wellbeing. It can be defined as the content and context of an individual's job task, activities, associations, and responsibilities [59]. Thus, a well-defined work design assists the individual to have Job control, feel fit to do the job, autonomy, job challenge, and job meaningfulness that reduce the rate of depression and anxiety. The significance of the criteria can also be witnessed in the studies conducted by [54, 60, 61]. Where [61] conducted a multiple regression analysis on a sample of 205 employees in Vietnam to determine the factors that affect employee mental health in the NFPOs. The findings of the study concluded that work design (job fit, autonomy, challenge, and job meaningfulness) and work-life balance (Workload and organizational support) are positively related to employee engagement. Similarly, [60] identified six dimensions that can enhance the well-being of an employee in an organization among which the nature of work and work design are the important factors. Moreover, [61] identified work design (job fit, autonomy, challenge, and job meaningfulness) and work-life balance (workload and organizational support) as positively related to employee engagement.

Thus, it can be concluded from the above studies that the criteria of work design have a significant impact on employees' mental health and wellbeing. However, the criteria alone can't explain the dynamic nature of the mental health construct, thus indicating the limitations of these studies.

**Management Involvement** - Another significant criterion highlighted in several studies is the management involvement and support to the employee. As [54] investigated the factors affecting the productivity and well-being of the employee in the construction industry identified competencies of supervisors, leadership style, and management involvement and awareness as the most significant factors. Likewise, [62] conducted research to identify the variables that affect employee satisfaction and wellbeing. the study thus identified the organizational factors that affect employee well-being as organization development, compensation policies, leadership style, work group,

relationships with supervisor, working environment and condition, job security, job satisfaction, promotion, and career development in figure 2.9.



Figure 2-9 Type of Organizational Variable. Source: [63]

Similarly, [63] also supported the findings of previous studies and identified supportive leaders as among the important determinants of employee mental health and well-being as presented in Figure 2.10.

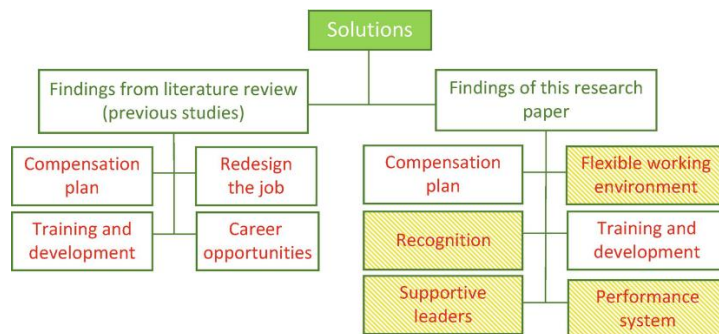


Figure 2-10 Findings of the research. Source: [64]

However, the study also supports the argument of this research that only management involvement or other organizational factors alone cannot be classified as the determinants of employee wellbeing. Thus, the studies above support a few criteria that impact employee wellbeing, but they fail to present a complete picture.

***Growth opportunity, Timely pay, Welfare schemes, Appraisal scheme, Training*** – Other significant criteria identified through literature is the general well-being or the image of the organization that involves growth opportunities, timely payment of salaries, welfare schemes, appraisal schemes, training, and development of its employee. the well-being of an organization has a significant impact on the mental

health of its employees as supported by [53, 54, 64] which investigated the significance of these criteria on employee mental health and wellbeing.

The findings of this section are concluded in Table 2.4, which summarized the organizational criteria that can be adopted to define employees' social sustainability. However, the study intends to find the significant impact of these criteria on social sustainability and EMW in the UAE construction sector.

Table 2-4 Organizational Factors

	<b>Criteria</b>	<b>Authors</b>
<b>Organizational Factors</b>	Organization Structure (Hierarchy), Shift System, Management involvement and awareness, Work Timings (No. of hours), Flexible work systems or Fixed, Work Design (Job control, job fit, autonomy, challenge, and job meaningfulness), Growth opportunity (Promotion), Timely Payment of Salaries (Satisfaction Pay/inflation) Welfare schemes, Appraisal scheme, Role conflict/ambiguity/ role clarity, Competencies of supervisors, Training	[12], [48-60]

Though the significance of these findings can be witnessed through the popular scale by McKinsey and Company in their quarterly report [65] that proposes the Organizational Health Index (OHI) to identify elements of the organization that drive the performance. However, the limitation of the scale is its dependence on the organizational factors alone, whereas the construct of employee wellbeing (satisfaction, performance, and mental health) can be defined by considering multiple factors such as personal, environmental, and social.

## 2. Personal Factors

Though the external factors have a significant impact on an employee's social sustainability personal factors are individual traits and characteristics that affect the decisions, behaviours, and relationship one's make. Thus, personal factors have a significant impact on the overall well-being of an individual and an employee in the workplace [66]. the personal factors of an individual as identified by [67] can be further classified as demographics (age, education, experience, level of academic achievements, individual culture), personality (work motivation/ intrinsic motivation, optimism, trait anxiety, hostility), and situational factors( sleep quality, emotional exhaustion, contract type, work-life balance, spousal support, job demand, and job satisfaction).

**Demographics (Age, Education, Past Experience, Level of Academic achievements, Individual Culture)** – The literature reports on several studies that investigated the significance of demographics on employee mental health and wellbeing. as identified by [62] that organizational and personal factors such as (personality, gender, age, education, and expectation) have a significant impact on employee wellbeing and mental health in figure 2.11.

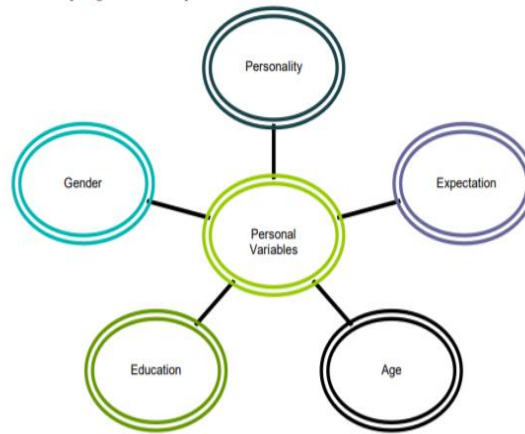


Figure 2-11 Personal Factors. Source: [63]

Similarly, [60] also conducted a systematic review with the inclusion criteria of Happiness and UAE; wellbeing and UAE; productivity and happiness; happiness and organization. The study identified six dimensions that need to be focused on to make the UAE the happiest country, among which one of the significant factors is the happiness goals per generation. Thus, this implies that age and generation change have a significant impact on employee wellbeing and mental health. The argument was also supported by [57] adopted a two-step hierarchical regression model to investigate the significant factors of employee mental health and well-being The study identified marital status, marital satisfaction, age, number of children, age of the youngest child, parents' residence with the married employee as personal factors that acts as determinants of employee mental health. Likewise, [54] investigated the factors affecting the productivity and well-being of the employee in the construction industry in the UAE. the study identified personal Factors such as Level of academic achievements or education, experience, Age, Individual culture, and Motivation as significant factors. number of people living in a household; ethnicity; the level of basic

education; the level of highest education; the number of years worked; the number of years worked in the current unit; whether working full-time or part-time.

Though these studies contribute to identifying the demographic factors of an individual that plays a significant role in employee mental health and wellbeing; the limitations of these studies are their focus on only one aspect of an individual life.

***Personality (Work motivation/ Intrinsic motivation, Optimism, Trait Anxiety, Hostility, Emotional Exhaustion (Burnout))*** – Over some time several studies have reported the effect of individual differences on job performance, productivity, satisfaction, and turnover intention. The studies also identified their significance for the well-being and mental health of an individual in the workplace [71].

In 1999, [72] investigated the relationship between work motivation, job stress, and employee wellbeing. The study adopted a quantitative approach by using random sampling procedures, descriptive analysis, bivariate correlation, and Multivariate Regression Analysis. A sample of 300 working adults in Kaohsiung city, Taiwan participated in the questionnaire. The study found that intrinsic work motivation and job satisfaction are positively related to each other. While extrinsic motivation was positive, social support is negatively related to depression. In summary work motivation and social support has a significant impact on employees' health and wellbeing.

Likewise, [73] conducted a multi-level analysis study to determine the effect of job control, trait anxiety, and hostility on employee mental health and wellbeing. The study implemented a multiple regression analysis on the questionnaire based on the General Health Questionnaire-12 with a sample size of 2,900 employees in the United States. The study found that trait anxiety and hostility played significant contributors to mental health at an individual level, whereas job control plays a multilevel role.

Similarly, [74] adopted a design science research approach, informed by machine learning to develop and evaluate a new construct artifact design for the mental health condition. The study uses a publicly available dataset for the IT professional with about 10,000 entries and 100 variables. The artifact description was divided into two phases; Phase 1: identifies the factors that affect the mental health condition of an employee at a workplace and Phase 2: comprises the design and evaluation approach as a solution.

The findings indicate that minimal risk, workplace concern, activity concern, and emotional stress are the significant factors that contribute to the mental health and wellbeing of IT professionals.

Moreover, [75] proposed a model based on the COR theory to determine the work-related depression in the hospitality industry in the UAE. The study targeted 135 employees and adopted hierarchical multiple regression analysis to identify the relationship between positive affectivity, intrinsic motivation, and emotional exhaustion to work-related depression as shown in Figure 2.12.

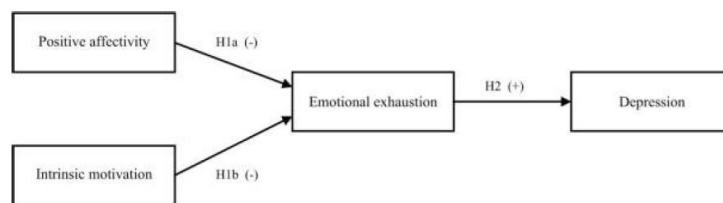


Figure 2-12 The Conceptual Model. Source: [76]

The findings of this study are consistent with the COR theory that suggested positive affectivity and intrinsic motivation as the important personal resources that protect the employee from experiencing work-related depression. In addition, emotional exhaustion was positively related to depression and also acts as its mediating factor with a relationship to positive affectivity and intrinsic motivation. However, no mediating effect of intrinsic motivation and positive affectivity was found on emotional exhaustion, though they tend to mitigate the effect.

Thus, it can be concluded from these studies that personality and individual characteristics have a significant impact on employee mental health. Therefore, they must be considered while measuring employee mental health and wellbeing.

**Sleep Quality** – The sleep quality of an employee is considered a significant factor in its well-being, especially in risky industries. As [76] determine the association between the sleep quality, shift system, and the health and wellbeing of the employee by using a self-administered questionnaire. The study found sleep quality has a significant effect on the mental health of an employee as they score low on the mental health survey. Also, [77] also identifies that poor sleep harms the work performance, turnover intention, and job satisfaction of an employee, which in turn increases depression,

anxiety, and stress [78]. The most commonly used scale to measure sleep quality in the literature is the Pittsburgh Sleep Quality Index (PSQI).

***Contract Type*** – The literature highlights the impact of long and short-term contracts on the mental health of an employee as identified in the study conducted by [79]. The study adopted a statistical analysis conducted at the macro level and a systematic review of the literature. The authors concluded that the non-permanent form of employment has a negative impact on the employee's mental health and wellbeing. Similarly, [80, 81] also supported the argument and concluded that Precarious employment has a significant adverse impact on the mental health of an employee.

***Work-Life balance, Spousal support*** – Work and personal life are the two main domains an individual engages in a day and throughout life. Thus, striking a balance between the two is the essential answer as any disbalance between the two can hurt the mental health and wellbeing of an employee or an individual. Several studies in the literature have emphasized the importance of the criteria and their association with mental health. As [56] investigated the relationship between flexible work systems (FWS), organizational commitment (OC), work-life balance (WLB), and job satisfaction (JS) in an academic setting by adopting confirmatory factor analysis (CFA) and structural equational modeling (SEM). A sample of 224 faculty members was targeted in UAE by using a structured questionnaire. The research developed a conceptual framework to evaluate the relationship and mediating role of different factors on employee job satisfaction which ultimately affects employee mental health and well-being as shown in Figure 2.13. The findings suggested that indeed a flexible work system has a positive impact on work-life balance and organizational commitment; a positive relationship also exists between organizational commitment and work-life balance. Also, work-life balance due acts as a mediator between FWS and OC to JS.

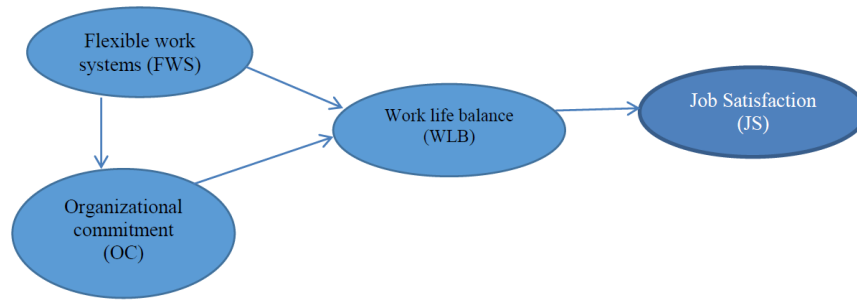


Figure 2-13 Conceptual Model Framework. Source: [57]

In addition to this, [57, 63] adopted frequency analysis and the two-step hierarchical regression model respectively; identified work-life balance and spousal support as the significant determinants of employee mental health and overall wellbeing. Likewise, [82, 83] also emphasized the importance of work-life balance and spousal support as significant determinants of employee mental health and wellbeing.

The studies have identified a significant determinant of employee mental health and wellbeing. However, the limitation of these studies was that they adopted a qualitative approach and lack any empirical analysis.

**Job demand - Control, Job satisfaction** – Other significant determinants identified through literature are job demand – control which can be defined as the physical or psychological efforts or skills required by an individual to perform the physical, social and organizational aspects of the job [84]. Whereas job control refers to the ability of an individual to effectively manage the demand of the job without stress. Thus, the ability to perform and control the requirement of the job allows the individual to develop satisfaction with the job itself. Thus, several studies [56, 72, 73] identified the criteria as the significant determinants of employee mental health and wellbeing. Similarly, in 2014, [8] reviewed the social determinants of mental health. The study categorizes the social determinates into three categories as *the life-course approach, community-level contexts, and country-level contexts*. the research also highlights the factors that affect employee wellbeing and mental health, such as unemployment, job security, short-term contracts, job control, job demand, and spousal support. Likewise, [64] investigated the empirical evidence of the relationship between job satisfaction and the intent to leave small-medium enterprises for the construction companies in the United Arab Emirates. The study found that job stress and money-related stress tend to

put more pressure and toll on the mental health of UAE employees in comparison to their global peers. In addition to these, the study reports on the factors that play a significant role in the intent to leave are job satisfaction, role clarity, role ambiguity, work-related stress, life stress, growth opportunity, and career anchor. thus, it can be concluded from these studies that job satisfaction, job demand, and control have a significant impact on employee mental health and wellbeing. the same can be proved from the longitudinal study conducted for 11 years with a sample of 439 Norwegian employees. The findings suggested that low job control and low control with high demand job (work stress, workload) have significant multiplicative interaction and buffering effect that results in a negative impact on employee wellbeing and mental health.

Thus, from the literature, several studies identified the personal factors that play a significant role in determining the well-being of an employee is summarized in Table 2.5.

Therefore, this study intends to find the significant impact of these criteria on the EMW in the UAE construction sector.

Table 2-5 Personal Factors. Source: Author

	<b>Criteria</b>	<b>Authors</b>
<b>Personal Factors</b>	Work motivation/ Intrinsic motivation, Sleep Quality, Emotional Exhaustion, Spousal support, Optimism, Level of academic achievements, Education, Experience, Age, Individual Culture, Trait Anxiety, Hostility, Job demand, Job satisfaction, Contract Type, work-life balance	[5], [11]. [51]. [53], [54], [59-61], [63-81]

Though the personal and organizational factors have a primary impact on the employee's mental health, the effect of these factors is mediated by social and environmental factors. Therefore, to define the comprehensive nature of the EMW, the social and environmental factors must be identified which the studies above fail to include in their research.

### 3. Social Factors

As an individual life is an amalgam of two domains the organizational domain and its personal domain, therefore, the social factors and support in both these domains are considered essential for a peaceful and productive life [85]. Many studies [53, 57] have found the importance of interpersonal relationships/ conflict at work, group dynamics,

peer support, Leadership style, supervisor support and acknowledgment, and organizational commitment as the significant determinants of employee mental health and wellbeing in the workplace. As [72] investigated the relationship of Social Support (frequency of receiving support or help from colleagues, supervisors, friends, and families) with employee well-being and found that social support is negatively related to depression and has a significant impact on employee’s health and wellbeing. Likewise, [86] conducted a study to investigate the relationship between the employee perception of the Emotional intelligence of the supervisor to the satisfaction and psychological well-being of individuals and groups as shown in Figure 2.14.

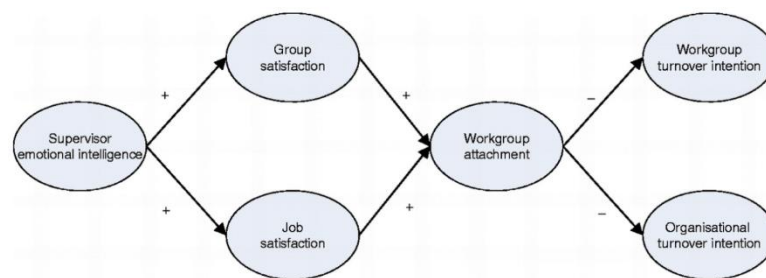


Figure 2-14 The proposed Framework. Source: [87]

The findings indicated that the perception of EI of one’s supervisor plays an important and positive role in job satisfaction and group satisfaction, which in turn affects the workgroup attachment. Moreover, [8] reviewed the social determinants of mental health. The study categorizes the social determinates into three categories as *the life-course approach, community-level contexts, and country-level contexts*. The research also highlights the factors that affect employee wellbeing and mental health, such as unemployment, job security, short-term contracts, job control, job demand, and spousal support. The research draws recommendations based on the findings that aid in taking actions to overcome and reduce the effect of social inequalities on mental health.

Besides, studies [87, 88] have suggested the adverse impact of bullying, harassment, and violence on employee mental health and wellbeing. As investigated by [89], the study showed that exposure to bullying at the workplace led to anxiety, depression and stress, and mental health problems. The studies also suggested that peer, supervisor, and organizational support can act as mediators and have a positive impact on individual mental health and wellbeing.

The findings of this section have been summarised in Table 2.6 which will be adopted to find the significant impact of these criteria on the Social Sustainability and EMW in the UAE construction sector.

Table 2-6 Social Factors. Source: Author

	Criteria	Authors
<b>Social Factors</b>	Social support, Association with supervision, Employee perception of supervisors, Interpersonal conflict with co-workers/ bullying, harassment and violence, Social Relationships, Group/Team structure/ Workgroup attachment, Leadership Style, Organizational commitment, and Demographic nature of Team	[5],[50],[54],[82-86]

It can be concluded at this point that personal, organizational along social factors have a significant impact on employee wellbeing. Though the studies have identified relevant determinants of employee wellbeing, they fail to consider the effect of external factors such as environmental, organizational arrangement, and site/off-site on the well-being of an employee. As indicated by [90], the external environment and organizational arrangement have an impact on the mood and motivation of a person and an employee.

#### 4. Environmental Factors

The literature reports on several studies that proposed the benefit and significance of the environment on employees' social sustainability. In 2012, [91] proposed that work environment such as lighting, noise, colour, and air quality has an impact on the productivity, health and wellbeing, job satisfaction, and morale of its employee. The study adopted a descriptive approach by gathering information from secondary data such as websites, journals, and books. The study concluded that the working environment indeed has an impact on the overall well-being of an employee, thus the organization should keep this factor in mind. Likewise, [92] adopted a quantitative approach to explore the effect of nature-based solutions on customer and employee morale and mental health. The research found that a green indoor and outdoor environment does play a significant impact on mental health. Moreover, [93, 94] considered organizational arrangement, culture, and working environment as the essential part of the workplace environment that affects the employee's wellbeing.

**Job Security** – Another critical criterion identified by several studies that impact employee mental health is job security. the criteria not only impact employee well-being but also define the general well-being of the organization and its market brand

image. As identified by [95], the workplace changes employee mental health. The study adopted a longitudinal approach with a sample of 5,400 UK National Health Services (NHS) employees to a self-rated mental health questionnaire (12-item version of the General Health Questionnaire (GHQ)). The results indicate that the increase in the amount of work in the previous year had a negative effect on the employee, whereas employees that received training, promotion, and job security had better mental health. The same was suggested by [96-98] that examines the association between the perception of job security and health. the studies found that job security is indeed central to subjective, physical, and psychological wellbeing.

Thus, from the discussion above the intent of this study is to find the significant impact of these criteria summarised in Table 2.7 on the EMW in the UAE construction sector.

Table 2-7 Environmental Factors. Source: Author

	<b>Criteria</b>	<b>Authors</b>
<b>Environmental Factors</b>	Organization Arrangement, Culture, Working environment and condition (Lighting, Noise, Colour, and Air Quality), Work stress/ Workload, and Job Security/Safety	[88-95]

In a nutshell, the literature reports on the number of organizational, personal, social, and environmental factors as the underpinning criteria that define employee’s social sustainability as presented through the extensive literature review in Table 2.8.

Table 2-8 Literature Review Summary

Authors	Year	Country	Title	Criteria	Methodology	Findings
(Lim YC, Hoe VCW, Darus A)	2020	Malaysia	Association between nightshifts work, sleep quality and health-related quality of life: a cross-sectional study among manufacturing workers in a middle-income setting	Nightshift work, sleep quality	A total of 494 workers from eleven manufacturing factories participated in the cross-sectional study, of whom 177 (36%) were night-shift workers and 317 (64%) are non-night-shift workers.	The findings suggested that sleep quality partially explains the association between night shift work and poorer HRQoL. Thus, organizations should treat the sleep quality of night-shift workers as a top priority area for action to improve their employees' overall wellbeing.
Dr. Anil P Sarode1, Manisha Shirsath2	2012	India	The Factors Affecting Employee Work Environment and Its Relationship with Employee Productivity	Lighting, Noise, Color, and Air quality	This is descriptive research. The source of information is secondary data from diverse sources like websites and books mentioned at the end.	The findings suggested that environmental factors such as Lighting, Noise, Color, and Air quality play a significant role in determining employee mental health and wellbeing
Luo Lu	1999	Taiwan	Work motivation, job stress, and employee Wellbeing	Occupational Stress (Job demand, discretion, and interpersonal conflicts) Strain (job satisfaction, mental health) Mediators: Work motivation and social support	Using random sampling procedures, Home-interviewed three hundred working adults living in Kaohsiung city, Taiwan  Descriptive analysis, Bivariate correlation, and Multivariate Regression Analysis	The findings suggested that the interaction between demand and extrinsic motivators could significantly predict somatic symptoms, whereas the interaction between (lack of) job discretion and intrinsic motivations could significantly predict anxiety. It did seem that the sheer quantity of work affected people reporting extrinsic motivations more severely, whereas lack of subjective control at work affected people reporting intrinsic motivations severely.

						<p>Apart from these interesting interactions, work motivations also had substantial effects on well-being.</p> <p>Intrinsic motivators contributed positively to overall job satisfaction, whereas extrinsic motivations contributed positively to depression.</p>
<p>Khalil-Ur Rahman, Waheed Akhter, and Saad Ullah Khan</p>	<p>2017</p>	<p>Pakistan</p>	<p>Factors affecting employee job satisfaction: A comparative study of conventional and Islamic insurance</p>	<p>Motivational factors and hygiene factors:            Incorporate accomplishment, job acknowledgment, work, or job itself, obligation, progression, and growth opportunities.</p> <p>Hygiene factors related to job context include “organization arrangement, supervision, association with supervision, work conditions, association with companions, compensation, individual life, association with subordinates, status, and job security.</p>	<p>Using multi-stage stratified random sampling, we received a total of 318 usable responses (185 from family <i>Takāful</i> and 133 from life insurance).</p>	<p>These research findings reveal that job satisfaction of both <i>Takāful</i>, and conventional insurance sales force triggered by motivators and hygiene factors independently while <i>Shari'ah</i> perception was not found to have any significant effect on job satisfaction of both <i>Takāful</i> and conventional insurance sales force.</p> <p>These findings show that employees' relationship at work with supervisors/peer, acknowledgment of their work, career development, career growth, rewards, working conditions, and organizational environment (work policies) have significant impact on job satisfaction of the employees.</p>
<p>Osman M. Karatepe, Ladan Zargar Tizabi</p>	<p>2010</p>	<p>UAE</p>	<p>Work-related depression in the hotel industry: a study in the United Arab Emirates</p>	<p>Positive affectivity,            Intrinsic motivation, emotional exhaustion, Work stress, Family stress,</p>	<p>Data were gathered from Arab frontline employees in the international five-star chain hotels of Dubai in the United Arab Emirates. A total number of 135</p>	<p>The results of hierarchical multiple regression analysis demonstrate that employees with positive affectivity and intrinsic</p>

				work-life balance, and Interpersonal conflict with co-workers	self-administered questionnaires were collected. hierarchical multiple regression analysis, Data were analyzed via a series of confirmatory factor analyses for the issues of dimensionality, convergent and discriminant validity	motivation experience less emotional exhaustion. The results reveal that emotional exhaustion fully mediates the impacts of positive affectivity and intrinsic motivation on depression and further indicate that the interaction of intrinsic motivation and positive affectivity alleviates depression
Md Rafiqul Islam	2019	Online Data	A Design Construct of Developing Approaches to Measure Mental Health Conditions	'Minimal risk,' 'workplace concern,' 'activity concern,' and 'emotional stresses.'	<p>In this study, we develop a construct utilizing design science research principles for outlining common vocabulary around the problem, and solution design relevant to a mental health management system.</p> <p>We used a publicly available dataset (<a href="https://www.kaggle.com/osmi/mental-health-in-tech-2016">https://www.kaggle.com/osmi/mental-health-in-tech-2016</a>) containing attributes of workers working in IT/tech workplaces. The dataset contains the number of attributes of IT/Tech workplace workers. In this dataset, the total number of records in each part is approximately 10,000. We used part 1 to analyses the situation in IT workplace and part 2 to detect the percentage of IT workplace workers who are suffering from mental stress.</p>	The findings revealed that there are four key factors that significantly contribute toward the mental health condition of tech workers. These factors include 'minimal risk,' 'workplace concern,' 'activity concern,' and 'emotional stresses.'
Vijay Kumar Gudep	2019	UAE	An empirical study of the relationships Between the flexible work systems (fws), Organizational commitment (oc), work Life balance (wlb) and job satisfaction (js) For the teaching staff in the UNITED ARAB EMIRATES (UAE)	Flexible work systems (fws), Organizational commitment (oc), work Life balance (wlb) and job satisfaction (js)	A sample size of 224 was chosen and a structured questionnaire was used for collecting the data from the respondents in UAE. The questionnaire consists of thirty-four statements, and they are rated on a Likert scale of 1 to 5. For this study, statistical tools like confirmatory factor analysis (CFA) and structural modelling equation (SME) methods have been used through SPSS (version-25) and AMOS (version-25) for assessing the nature of relationships that existed between the studied variables (34 statements in the questionnaire).	The results from the data analysis indicated that all the hypotheses are supported, and it facilitated for the acceptance of the proposed model. Thus, flexible work system (FWS) had direct effect on organizational commitment (OC), and it also had direct effect on work life balance (WLB). Similarly, organizational commitment (OC) is positively related

						to work-life balance (WLB). Consequently, the work life balance (WLB) displayed positive relationship towards job satisfaction (JS). The results of mediation analysis revealed the indirect effect of flexible work system (FWS) and organizational commitment (OC) towards job satisfaction (JS) through work-life balance (WLB).
Jessica Allen, Reuben Balfour, Ruth Bell and Michael Marmot	2014	Review	Social determinants of mental health	Unemployment, job security, short term contracts, job control, job demand and spousal support.	Review Study	The study categorizes the social determinates into three categories such as: <i>The life-course approach, Community-level contexts, and Country-level contexts.</i> The research also highlights the factors that affect the employee wellbeing and mental health, such as unemployment, job security, short term contracts, job control, job demand and spousal support.
Waleed Al-Ali et al)	2019	UAE	The mediating effect of job happiness on the relationship between job satisfaction and employee performance and turnover intentions: A case study on the oil and gas industry in the United Arab Emirates	employee satisfaction, performance and turnover intentions absenteeism, commitment, performance, and productivity Promotion Satisfaction Pay Satisfaction Supervisor Satisfaction Co-worker Satisfaction, Optimism, Social Relationships	The study utilized a total of 722 usable questionnaires that were administered to respondents in oil and gas industry in the United Arab Emirates. This study adopted structural equation modelling (SEM) approach to analyses these relationships.	The Analysis of Data revealed that job satisfaction factor has a significant direct positive relationship with both factors the employees' performance and the job happiness, while it has a negative insignificant relationship with employees' turnover intention. On the other

						hand, the Job happiness displays a significant positive direct effect on job performance, but it records a significant negative effect on employee turnover intention. Results show that job happiness plays a mediating role between job satisfaction and employee performance and turnover intention
Nabil Ailabouni et al	2009	UAE	Factors Affecting Employee Productivity in The Uae Construction Industry	Environmental envelope (Work timings and working hours, Safety and job security, Welfare schemes, Appraisal schemes, Company Brand Name, Timely Payment of Salaries, Overall Well Being of the company); Organization Work Policies (Hierarchy order, Delegation, Reward Schemes, Competencies of supervisors and Management involvement and awareness); Group Dynamics (Group/Team structure, Individual skills (talents), Nature of work, Demography of team, Nationalities and Current Wars or Political Situations) and Personal Factors (Level of academic achievements or education, Past experience, Age, Individual culture and Motivation)	A survey was conducted amongst the various levels of personnel within the construction industry. A total of 238 responses were received and the various sub factors have been ranked in terms of importance index, frequency index and the combined severity index identifying the first 8 significant factors affecting the productivity in the construction industry in the UAE	The most significant factors in their order of ranking are proper work timings giving a balance between work and time for family, leadership skills of supervisors, technical qualifications, whether they are well paid or not and on time, security of job, transparency and accountability of management, payment of overtime, whether materials are available, procedures, policies, work method statements are available, an finally personal skills, competency of supervisors and knowledge of work on an individual level.
John W. Whiteoak	2012	UAE	Emotional intelligence and its implications on individual and group performance: a study investigating employee perceptions in the United Arab Emirates	Employee perception of supervisor's EI job satisfaction group task satisfaction. Workgroup attachment. Group-level turnover intention -level turnover intention.	The data for the study were obtained via a questionnaire survey from 130 employees in a large government-run organization in the United Arab Emirates (UAE).	The results indicate that organizations in the UAE may benefit by developing EI skills in their leaders. This paper also describes specific implications for theory and practice.

Alia Al Nuaimi	2020	UAE	Low Employee Engagement in the UAE: Causes and Solutions to Overcome the Issue	Respectful treatment of all employees at all levels, Salary/compensation, trust between the employee and the management, job security, Opportunities for using the skills at work, Low salary, Lack of career opportunities, Low work–life balance, Lack of recognition and lack of training and development	This study uses thematic analysis approach to build a conceptual framework based on the findings. To achieve the objectives of the study, secondary data was collected from various sources such as news articles, HR sites, YouTube channels, published sources and official websites. The mentioned responses without percentages were subjected to qualitative analysis. The mentioned responses with percentage were subjected to quantitative analysis. The analysis was carried out by calculating the frequency of the repeated key factors to identify the most common factors	This study was able to make three contributions and findings related to employee engagement. The first finding is the relationship between the three concepts, job satisfaction, employee engagement and turnover. These concepts need to be looked together and not separately. The second finding is the common reasons for low employee engagement, which are low salary, lack of career opportunities, low work–life balance, lack of recognition and lack of training and development. The third finding is the solutions or the factors that need to be focused on to minimize low engagement: compensation plan, recognition, training and development, performance system, having supportive leaders and flexible working environment.
----------------	------	-----	---	--	--	--

Mohamed E. Ibrahim and Afaf Al Marri	2015	UAE	Role of gender and organizational support in work-family conflict for accountants in UAE (2015)	job-security, role conflict/ambiguity, role overload (No of hours spent), domestic support, attitude toward employer, work pressure, learning opportunities, supervisory support, family-to-work cooperation, life satisfaction, marital satisfaction, work schedule inflexibility, spouse employment, number of children, age of the youngest child, parents' residence with the married employee.	The authors used a questionnaire to collect data from 236 married accountants employed in service organizations in the UAE. Data were analyzed using a two-step hierarchical regression.	The results of the regression models are consistent regarding the effects of gender on total work – family conflict and WFC. Thus, the reported results support the first research hypothesis that female accountants experience more work – family conflict than male accountants while controlling for the effects of time-based sources of the conflict. The results also support the second research hypothesis that satisfaction with organizational support reduces work – family conflict while controlling for the effects of time-based sources of the conflict.
Vic Benuyenah and Barti Panhdya)	2020	UAE	Measuring employee happiness in UAE Integrating organizational data into national statistics	The study identified six dimension that need to be focused to make UAE the happiest country they include: Inclusion of all residents in the happiness drive; labour market targeting by understanding workforce; work-life balance; studying the influence of salary/inflation on happiness; reengineering the happiness goals per generation; and changing the nature of work	A Systematic Review	Based on the findings the study proposed the measurement model that should be able to capture the 'micro' information related to employee happiness.

<p>Basma Kashmoola et al</p>	<p>2017</p>	<p>UAE</p>	<p>Job Satisfaction and Intention to Leave in SME Construction Companies of United Arab Emirates (UAE)</p>	<p>The study found that the job stress and money related stress tends to put more pressure and toll on the mental health of UAE employees in comparison to their global peers. In addition to these, the study reports on the factors that plays significant role in the intent to leave are job satisfaction, Role clarity, Role ambiguity, work related stress, Life stress, Growth opp and Career anchor.</p>	<p>Investigated the empirical evidence between the relationship of job satisfaction and the intent to leave in Small-medium enterprises for the construction companies in United Arab Emirates</p>	<p>Job satisfaction represents one of the most complex areas facing today's managers when it comes to managing their employees. In this study a context of the study in SMEs of UAE and Dubai has been discussed and later a holistic review of the two important constructs has been presented 1) intention to leave, and 2) job satisfaction. Literature reviews on the two areas concluded that despite many studies have been empirically proved that job satisfaction and intention to leave are negatively associated with each other, no or extremely limited evidence are available to know that how the factors or attributes of these two are related to the construct of job satisfaction and intention to leave.</p>
<p>Elovainio et al.,</p>	<p>2000</p>	<p>USA</p>	<p>Organizational and individual factors affecting mental health and job satisfaction: A multilevel analysis of job control and personality.</p>	<p>Job control, trait anxiety and hostility</p>	<p>A multi-level analysis approach to determine the effect of job control, trait anxiety and hostility to employee mental health and wellbeing was used. The study implemented a multiple regression analysis on the questionnaire based on the General Health Questionnaire-12 with a sample size of 2,900 employee in the United States.</p>	<p>The study found that trait anxiety and hostility played significant contributors to mental health at an individual level, whereas job control plays a multilevel role.</p>

Li et al.,	2019	China	Effect of Long Working Hours on Depression and Mental Well-Being among Employees in Shanghai: The Role of Having Leisure Hobbies	long working hours	The study was conducted by adopting a cross-sectional study in Shanghai were having the long working hours up to 60h is quite common. By using the patient Health Questionnaire-9 (PHQ-9) scale and the five-item Well-Being Index (WHO-5) scale	The study found that respondents having working hour up to 60h are more prone to experience depressive episodes and poor mental health than those having working hours less or equal to 40h. thus, the study concludes that the working hour indeed have a significant effect on the mental health of the employees.
Loretto et al.,	2010	UK	Workplace Change and Employee Mental Health: Results from a Longitudinal Study	Workload Training Promotion Job Security	The study adopted a longitudinal approach with a sample of 5,400 UK National Health services employee to a self-rated mental health questionnaire (12-item version of the General Health Questionnaire (GHQ)).	The results indicate that the increase in the amount of the work in the previous year had negative affect on the employee, whereas employees that received training, promotion and job security had better mental health. Thus, no, or negligible effect of workplace change is found on the employee mental health and wellbeing
Sageer et al.,	2012	India	Identification of Variables Affecting Employee Satisfaction and Their Impact on the Organization	Organizational Factors (Organization development, Compensation policies, Leadership Style, Work Group, Relationship with supervisor, Working environment and condition, Job security, Job Satisfaction, Promotion, and career development) and Personal Factor (Personality, Gender, Age, Education and Expectation).	Review Paper	The study thus categorizes the variables into two main categories such as Organizational Factors and Personal Factor

Linh Giang Thi NGUYEN <sup>1</sup> , Huyen Thi PHAM	2020	Vietnam	Factors Affecting Employee Engagement at Not-For-Profit Organizations: A Case in Vietnam	Work design (job fit, autonomy, challenge, and job meaningfulness) and work-life balance (Workload and organizational support)	A multiple regression analysis on a sample of 205 employee in Vietnam to determine the factors that affects employee mental health in the NFPOs was conducted	The findings of the study concluded that work design (job fit, autonomy, challenge, and job meaningfulness) and work-life balance (Workload and organizational support) is positively related employee engagement. While leadership, learning, development, and recognition did not have a significant impact on employee engagement in NFPOs, they are important as a supporting factor.
Katarzyna Piwowar-Sulej and Dominika Bąk-Grabowska)	2020	Poland	Non-Permanent Employment and Employees' Health in the Context of Sustainable HRM with a Focus on Poland	Contract Form	The study adopted a statistical analysis conducted at macro level and the systematic review of literature.	The study concluded that the non-permanent form of employment has a negative impact on the employee mental health and wellbeing.

This dissertation will, therefore, adopt these criteria to prove the relationship and impact of these criteria on employees' social sustainability.

***Ha: The criteria (organizational, personal, environmental, social) have a significant impact on the employees' social sustainability.***

Furthermore, these criteria will be adopted to develop decision support tools that can be used by the organizations to enhance the employees' mental health and wellbeing in the UAE construction sector.

## **2.7. Conclusion**

The section presents the summary of chapter 2 that assist in addressing the research gap.

The construction sector has been considered a significant contributor to the economy. However alarming situations of mental health issues and lack of social sustainability have been reported. Where no or little has been reported on a set of underpinning criteria that define social sustainability and EMW in the construction sector and the adoption of a decision support tool that can be used to assist the organizations to enhance the mental health of its employees, thus indicating the research gap.

Thus, to fill the gap the chapter conducted an extensive literature review that aided the study to understand the concept of Social Sustainability and Mental Health and draw upon the history of the evolution of the concept from the mere absence of disease to the existence of something positive. The literature presents different theories and definitions presented throughout history. Due to the significance of mental health for a nation's success, several global initiatives and challenges at the global level were highlighted in the chapter. With the evolution of the concept, the measurement scales were also found to be evolved in parallel throughout the literature. However, despite these efforts and scales, the alarming statistics in general and in the industry particularly raise questions about the reliability and effectiveness of these efforts.

Though the literature looks at the number of studies and reliable scales that have been proposed to measure mental health, they work in isolation and focus on only certain aspects of mental health. Therefore, this study identifies a set of underpinning criteria

to define employee Mental health and wellbeing in a comprehensive manner that aligns with the WHO definition of mental health.

The criteria will be further adopted to prove the relationship and impact of these criteria on employees' social sustainability. Furthermore, the criteria will be adopted to develop a DST based on Multi-Criteria Decision-making (MCDM) techniques that will allow the organization to take strategic decisions to ensure employee social sustainability in the UAE construction sector.

Hence, the next chapter will focus on developing an understanding of the multi-criteria decision-making technique and how the organization can adopt MCDM techniques and technologies to enhance and ensure the successful implementation of employee social sustainability in the UAE construction sector.

### **Chapter 3. Multicriteria Decision-Making Techniques and Tools**

To ensure the employee's social sustainability in the construction industry; this chapter intends to develop an understanding of techniques of multi-criteria/ objective decision making that can be adopted by the organization to take strategic decisions. The chapter explores various MCDM techniques adopted for sustainable development and concludes the most suitable approach to develop a decision support tool. Moreover, to cater to the lack of dynamic nature of decision support tool the chapter focus on proposing technologies such as IoT and Blockchain for social sustainability management as a conceptual framework that can be adopted to ensure continuous successful implementation of social sustainability and employee mental health and wellbeing in the organization.

#### **3.1. Multi-Criteria Decision Making**

MCDM, a sub-discipline of operation research, is a process that allows the decision-makers to decide structurally. It permits decision-makers to decide according to their perception and experience by also integrating their values, systems, framework, and evaluation in the decision process. MCDM not only increases transparency and consistency in the decision-making processes but also facilitates the participation of the various stakeholders systematically. The results of MCDM can be used as a basis for the final decision or as a benchmark for further decisions and to inform stakeholders [99].

The development of the multi-criteria decisions method model involves three main aspects. Firstly, ensuring appropriate criteria for evaluation and comparison of alternatives. Secondly, assigning weights to the criteria/alternatives in terms of their relative importance. Finally, evaluate alternatives against the criteria. In evaluating the criteria, it may be more difficult to evaluate the exact weightage of the situation than to reflect their relative importance and categorize candidates into "best" and "worst" categories [100].

The MCDM allows the decision-makers to break down the complex problems into several compact and easier parts that allow them to consider conflicting criteria to be able to take an informed and better decision. MCDM aids in structuring, solving, and planning complex problems with multiple criteria. However, it should be noted here

that the interpretation of solving varies in different scenarios. Solving could correspond to either choosing the best alternative (the most preferred) from a set of alternatives or choosing a small set of good alternatives i.e., grouping alternatives in a different preference set. Where an extreme form of interpretation is to either find all efficient or nondominated alternatives which are to have a trade-off between conflicting criteria [101].

Thus, this allows the MCDM as a popular solution to be adopted for reaching an optimum decision in a group setting with multiple alternatives and conflicting criteria. The adoption of MCDM has experienced an exponential increase in the field of material selection, project selection, and supply chain management such as supplier selection; with a focus on *cost, budget, risk, compatibility with the organization's vision, return on investment, quality, efficiency, sustainability, resilience, time, reliability, features, convenience, comfort, customer experience and performance* are some of the widely adopted decision criteria to take decisions as shown in Figure 3.1 [102].



Figure 3-1 MCDM widely adopted Decision Criteria. Source: [102]. Recreated

It provides a foundation for selecting, sorting, and prioritizing alternatives. Many organizations have been adopting the MCDM techniques to take strategic decisions for day-to-day functional level problems such as deciding on investing in tools, and software, or hiring the perfect candidate by keeping the decision criteria in mind.

This study, therefore, intends to explore the application of MCDM techniques for sustainable development practices in the literature, to propose an efficient and robust technique for developing decision support tools by integrating the criteria of employee social sustainability identified from the literature as alternatives that will aid the organization to determine the optimal solution by keeping in mind the constraints/ decision criteria that have an impact on the decision to aid the organization to take strategic and informed decisions to ensure employee’s social sustainability as shown in Figure 3.2.

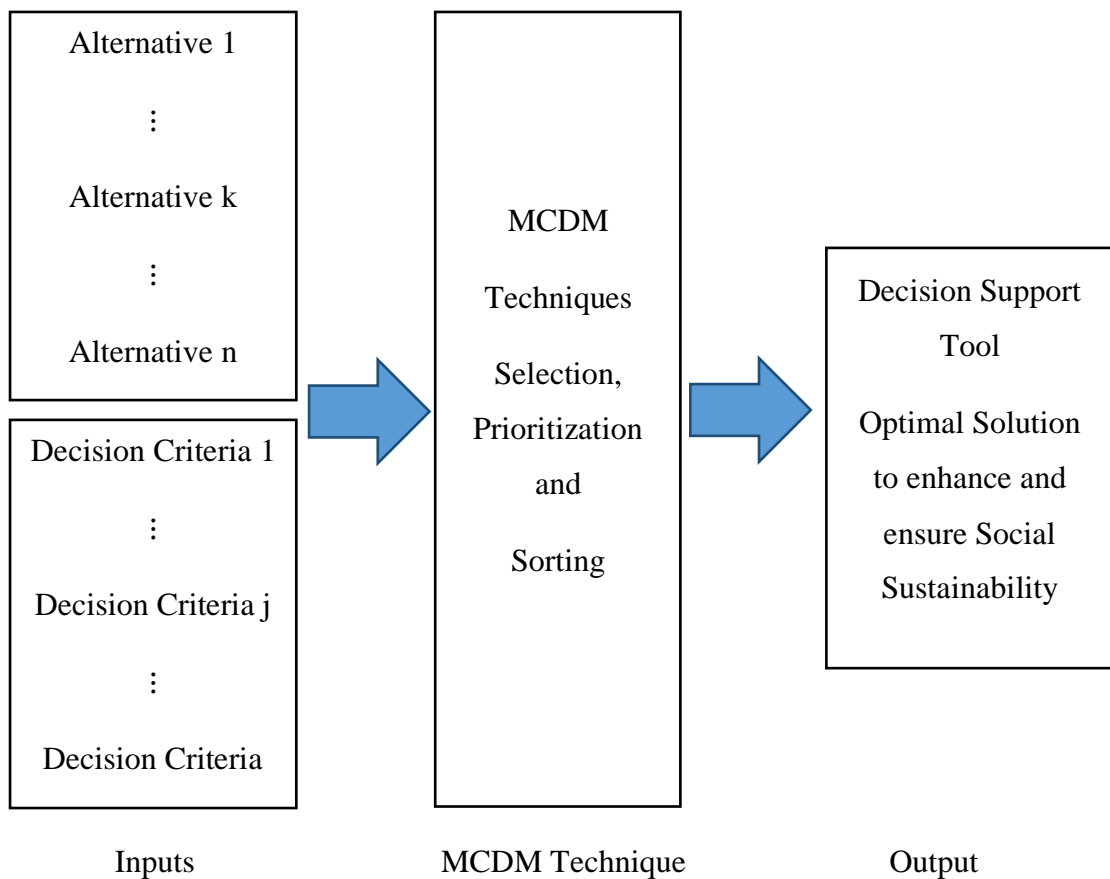


Figure 3-2 MCDM for developing DST

The adoption of MCDM techniques for developing the decision support tool will allow the integration of the findings of the literature review such as *Organizational, Personal, Social, and Environmental factors* to be evaluated in terms of their importance to the employee’s social sustainability in the construction industry by taking in account the decision criteria that can be identified through interviews; this will aid the organization to take informed decision to ensure employee’s social sustainability.

Hence, the next section focuses on identifying suitable MCDM techniques that can be adopted by the dissertation to develop a decision support tool.

### **3.2. Application of MCDM Techniques**

Several popular techniques have been adopted to solve the complex problem of sustainable development in the literature, however, little or no studies have been presented that provide decision support for social sustainability and EMW in the industry. Thus, this section focuses on presenting the application of different MCDM to conclude terms of the suitable approach for the development of the Decision Support Tool.

Their study [103], adopted a balanced scorecard technique, which is based on sustainable development standards, as a powerful and helpful mechanism for evaluating an organization's or company's long-term performance. In this study, a novel approach for evaluating the performance of oil-producing firms in Iran was created, based on a sustainability balanced scorecard (SBSC) and multi-criteria decision-making (MCDM) approach. Analytical network process (ANP), a branch of MCDM approaches, is used to reflect the interdependent links among components influencing the topic under investigation. However, because calculating the preference ratings of alternatives using the ANP method is a time-consuming and inconvenient operation, the COPRAS (Complex PROportional ASsessment) technique was used to prioritize the feasible alternatives in terms of linguistic variables. The findings of this investigation show the effectiveness of the approach in helping authorities to try for achieving a competitive advantage.

Likewise, the study by [104] identifies maritime transport and ports as vital links between global economies, processing more than 90% of all goods transported worldwide. The economic importance of maritime transportation has a substantial impact on port regions' social and environmental performance. Thus, the study proposes a composite index as a relevant approach for evaluating and monitoring various elements of sustainability across 37 seaport regions in seven European nations from 2014 to 2018, spanning a five-year timeframe. The model uses annual NUTS2 level data from Eurostat and the OECD to include economic, social, and environmental aspects of sustainability. Where the collection of economic indicators includes two significant measures of maritime transport activity: maritime freight transport and

maritime passenger transport. The multicriteria decision-making (MCDM) framework was employed in the weighting segment as an integrated technique of entropy, and the Preference Ranking Organization METHod for Enrichment of Evaluations (PROMETHEE) was adopted as an aggregation method to build composite indices. The findings of the study show that GDP per capita and population density are the most important variables. Even though Attica is the best-ranked region in terms of overall sustainability, the ranking results show that Italy, Spain, and France have the top-rated port regions.

Moreover, due to the potential of biofuel to become a promising sustainable energy supply in India. And the constraints of technical, economic, social, and legal in its successful implementation. The study by [105] investigated thirty-eight barriers to the long-term development of biofuels by using an integrated approach that combined "Interpretive Structural Modelling (ISM)" and "Decision Making Trial and Evaluation Laboratory (DEMATEL)" methodology. The study established a mutual relationship between the challenges and the intensity of this interrelationship to identify the most significant ones. The "Matriced Impacts Croisés Multiplication Appliquée á un Classement (MICMAC)" analysis was also adopted to cluster these obstacles. The findings showed that the biggest obstacles are "lack of governmental support for sustainable supply chain solutions (B31), lack of subsidies/incentives for creating competition among bio-energy producers (B30), lack of entrepreneurship support (B21), and lack of biomass supply chain standards (B19)."

Similarly, the study conducted by [106] proposes the adoption of a multi-criteria/objective decision-making approach for treatment planning. Where initially, an "Input Process and Output" IPO model is used to analyze the treatment of resources and environmental emissions. Secondly, given the complex interaction between traditional indicators and environmental impact indicators, integrated weights are proposed to account for subjective and objective weights, and the importance of criteria is determined using the AHP and the 'Criterion Interaction Method' (CRITIC). Thirdly, the 'Total Order of Solution Similarity Prioritization' (TOPSIS) method was used to determine the positive and negative sample proportions, and grey correlation and Euclidean distance were used to classify each experimental group (treatment parameters). Finally, optimal machining parameters were determined to optimize

resource consumption, machining quality, and productivity at the same time [100]. Thus, it shows the decision problem was transformed into a hierarchy with the complex research problem divided into smaller parts for a systematic decision process by adopting AHP, CRITIC, and TOPSIS methods.

Moreover, the study by [107] adopts a hybrid fuzzy multi-attribute decision-making approach (fuzzy entropy-TOPSIS) for choosing the best green supplier in China. Due to an increased global awareness of environmental protection and sustainable development, green purchasing has become a critical problem for businesses seeking to achieve environmental and developmental sustainability. Where thermal power is a primary source of energy for China, therefore, selecting green suppliers is critical to the efficient and long-term development of thermal power plants. The study determined the subjective criteria weights by combining superiority linguistic ratings and the fuzzy-entropy weighting method, while the objective criteria weights were determined by combining superiority linguistic ratings and the fuzzy-entropy weighting method. Finally, to create an overall performance score for each green provider, the fuzzy TOPSIS was used that allows to choose the appropriate green thermal power equipment provider, which aids to promote the company's long-term development and the long-term viability of China's electric power industry.

Similarly, the study by [108] adopted SBSC (sustainability-balanced scorecard) to assess the performance of airports to ensure sustainable development. The study adopted Decision-Making Trial and Evaluation Laboratory (DEMATEL) method to create a complicated system depicted as an influential-network-relationship-map. DEMATEL based on Analytical Network Process (DANP) was employed to confirm the influential weights. Finally, a hybrid modified VIKOR was adopted to choose and enhance the performance gaps between the aspiration values and the current state.

Likewise, the study by [109] adopts the fuzzy and fuzzy-AHP method to determine the importance of various criteria for sustainability in a smart city where a smart city is defined as a sustainable and efficient city center providing a high quality of life by optimally using its resources. The study identifies the sustainability indicators for designing a smart city in a developing country, thus, to determine the relative efficiency of each of the sustainability indicators for a smart city in the context of input and output criteria a DEA:AR-CCR model was adopted. The model integrates the identified

criteria as inputs and based on the relevance of the input criteria to obtain the intended outputs, the decomposition efficiency metrics identify which sustainability indicator the country should focus on. It was discovered that policymakers and administrators must design policies for economic development (0.85) and energy (0.82) to achieve the nation's economic success.

Moreover, the study by [110] adopts a goal programming model to incorporate effective labour resource allocation to meet sustainability targets related to the UAE's economic, energy, and environmental goals by 2030. The proposed solution provides mathematical and economic reasoning that allows the decision-makers to prioritize strategic planning and resource allocation to build and implement sustainable strategies.

Similarly, another study [111] adopts, a fuzzy MOORA to evaluate the supplier's overall performance which is crucial to ensuring a sustainable supply chain. The study presented a case study of the evaporative cooler in-home appliance industry. The model considers supplier's sustainability and order allocation simultaneously thus the model not only aids in increasing the total profit but also decreases the number of risks which imposes on the sustainability.

It follows that several MCDM, and a combination of these techniques have been adopted for sustainable development and sustainability practices in the organization. Thus, it can be concluded at this point that the application of MCDM techniques varies over a wide range i.e., selection, sorting, and prioritizing. Though several techniques can be adopted for developing the decision support tool, however, to allow the decision-makers to make informed and better decisions the proposed solution must be simple to adopt and computationally easy.

Where techniques like COPRAS, TOPSIS, and VIKOR methods are more efficient when dealing with tangible attributes, but none of them can deal well with qualitative criteria, whereas AHP can deal with both tangible and non-tangible attributes, especially when subjective judgments of different individuals play a significant role in the decision-making process. Though the AHP and ANP techniques are widely adopted as suitable methods to weigh the decision criteria for the alternatives, as the number increase the number of calculations also rises at a rapid rate, and computing techniques become increasingly complex. Where the adoption of highly complex techniques like

AHP and ANP with a lack of transparency will make it tough for the decision-maker to spot any errors in the computation procedure which can result in an extremely high degree of risk involvement by misleading the entire selection process.

Thus, the section summarizes the comparison findings of these MCDM identified in the literature [112-114] in Table 3.1 to conclude the efficient and robust technique.

Table 3-1 MCDM Comparison

	<b>Simplicity</b>	<b>Calculation</b>	<b>Stability</b>	<b>Transparency</b>	<b>Computational Time</b>	<b>Features</b>	<b>Output</b>
<b>AHP</b>	Critical	Max	Poor	Low	Very High	“Analytical Hierarchy Process” AHP converts assessments into numerical values (weights or priorities) and calculates a score for each alternative.	Consistency indices measure the consistency of decision-makers responses; AHP is one of them.
<b>ANP</b>	Critical	Max	Poor	Low	Very High	ANP approach divides the decision problem into a situation of objectives, decision circumstances, and alternatives, the “Analytical Network Process”	ANP approach divides the decision problem into networks.
<b>TOPSIS</b>	Moderate Critical	Moderate	Medium	High	Moderate	TOPSIS assumes that a low score in one criterion can be compensated by a high score in another criterion, allowing trade-offs between criteria.	This allows for a more appropriate approach to modelling than non-compensation approaches that include or exclude alternatives depending upon strict threshold criteria.
<b>ELECTREE</b>	Moderate Critical	Moderate	Medium	Low	High	The chosen method is usually used to rule out an alternative solution to an unacceptable problem.	The chosen method is usually used to rule out an alternative solution to an unacceptable problem.
<b>VIKOR</b>	Simple	Moderate	Medium	Moderate	Less	The VIKOR method was developed to optimize complex multi-object systems. It uses an ordered list of trade-offs and obtains solutions to the trade-offs using initial weights (data).	It assumes that conflicting trade-offs are possible and that the decision-maker searches for alternatives that are as close as possible to the ideal solution and evaluates the alternatives against all specified criteria.
<b>DEA</b>	Moderate Critical	Moderate	Medium	Moderate	High	DEA models for classification and comparing the results with multivariate models.	DEA model input and output data were analysed in addition to an extensive literature review.
<b>MOORA</b>	Simple	Min	Good	Very High	Very Less	The MOORA method was introduced, which analyses the overall suitability of each option as the difference between the sum of costs and benefits.	A weight is assigned to each criterion according to the importance given by the decision-maker. The pairwise comparison matrix of the AHP method is employed for the weight determination and finally, alternatives are ranked by the MULTIMOORA method.

The Table compares the performance of AHP, ANP, DEA, MOORA, TOPSIS, VIKOR, and ELECTREE on *Simplicity, Calculations, Stability, Transparency, and Computational Time*.

The results have shown that in terms of simplicity, MCDM techniques such as AHP, ANP, ELECTREE, and TOPSIS are identified as critical to moderately critical with DEA, VIKOR, and MOORA considered to be simple. Moreover, the calculation time for the other techniques

Where the results indicate that MOORA is the most efficient and robust technique that can be adopted to develop a decision support tool as its least impacted by altering weights of the most essential and critical criteria. Moreover, other MCDM techniques fail to distinguish between benefit and cost criteria which results in the transformation of cost criteria into benefit criteria during the normalization process. In contrast to which MOORA considers the cost and benefit criteria while calculating the optimal solution.

Additionally, the adoption of Fuzzy logic is its resemblance to human reasoning, where no precise inputs are required. Thus, this allows for addressing the uncertainty in the decision-making process.

This study, therefore, proposes the adoption of a Hybrid framework based on the AHP and the Fuzzy MOORA method as an efficient and robust technique to develop a decision support tool that will enable the organization to take strategic decisions to ensure employee’s social sustainability as shown in Figure 3.3.

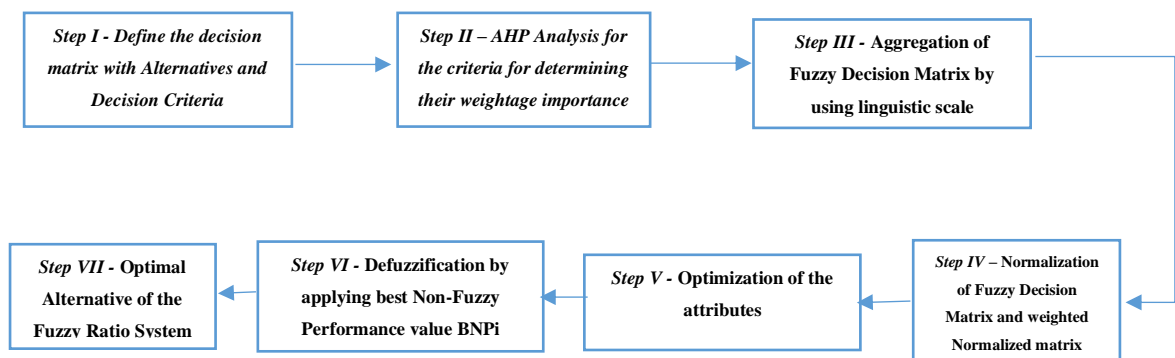


Figure 3-3 Hybrid Conceptual Framework

### 3.3. Analytical Hierarchy Process (AHP)

The AHP method has been developed in the 1970s by Thomas Saaty [115], it has been adopted in multiple scenarios where individual or group decisions, perceptions, and judgment are deemed important with consequences. The analysis begins by decomposition of the problem into hierarchies of criteria to allow for easy analysis and comparison of criteria as shown in Figure 3.4.

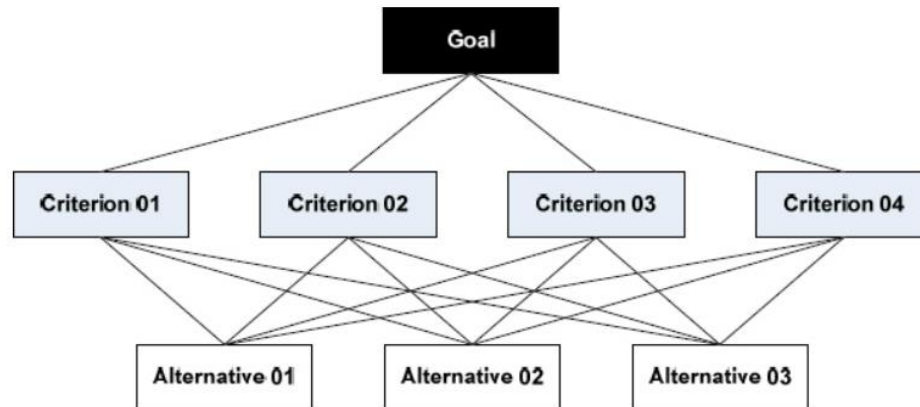


Figure 3-4 Analytical Hierarchy Process (AHP)

After the logical structure of hierarchies is formed, the decision-maker makes a systematic pairwise comparison of each chosen criteria. The analysis allows the decision-makers to decide on the prioritization and selection of alternatives or projects [116]. The advantage of the AHP method is that it allows group decision-making to achieve consensus and make the best and optimal decision rather than the ‘correct’ decision for their problem. AHP offers multiple applications such as prioritization, resource allocation, choice-making, and ranking.

The method has been widely used in operation strategy, process, and product design, planning, and scheduling of resources, supply chain management, and project management. In addition, the application of AHP has also been found in the selection of location, material and equipment, conflict resolution, and team selection [117].

This study, therefore, adopts the AHP method to determine the perception of employees regarding the most important criteria that have an impact on employees’ social sustainability in the organization, which can be used as a reference for the organization and decision-makers to take a strategic decision regarding the measure to enhance

employee’s social sustainability. Moreover, adopting AHP as a part of DST allows the decision-makers to weigh the most significant decision criteria for their organization.

### 3.3.1 AHP – steps and process

This subsection presents the process of the AHP method that will be adopted for conducting AHP analysis with the employees in the construction sector to determine their perception of the most important criteria that have an impact on the employee’s social sustainability in the organization and with decision-makers to weigh the most significant decision criteria for their organization. The AHP analysis can be conducted by adopting the following steps.

#### *Step I – Decision/ Comparison Matrix*

The analysis begins with defining the comparison matrix, which in this case allows determining the perception of the employees in terms most important underpinning criteria of Employees’ Social Sustainability, and for decision-makers, it allows to determine the most significant decision criteria for their organization for the decision-making process. The comparison matrix is a result of aggregation of pairwise comparison by following the Saaty’s AHP scale [115] as shown in Figure 3.5.

Intensity of importance	Definition
1	Equal importance
3	Somewhat more important
5	Much more important
7	Very much more important
9	Absolutely more important
2, 4, 6, 8	Intermediate values

Figure 3-5 Saaty’s AHP scale. Source: [115]

The pairwise comparison matrix established by adopting Saaty’s scale is represented by Matrix A.

$$A = \begin{bmatrix} 1 & \dots & a_{1n} \\ \vdots & \ddots & \vdots \\ a_{n1} & \dots & 1 \end{bmatrix} \quad (1)$$

Where  $a_{ij}$  defines the relative importance of criteria  $i$  in comparison with  $j$  and  $a_{ji} = \frac{1}{a_{ij}}$  is the relative importance of criteria  $j$  in comparison with  $i$ .

#### *Step II – Aggregation of Decision Matrix*

This stage allows aggregating the individual judgment of each decision-maker in one decision matrix for further analysis.

Let's suppose there are  $n$  alternatives/elements ( $A_i, i = 1, \dots, n$ ) and  $r$  number of decision-makers  $D_k, (k = 1, \dots, r)$ , were invited. In this case, let  $A^{[k]} = (a_{ij}^{[k]})$  be the judgment matrix provided by the  $k$ th number of decision-makers when comparing  $n$  elements so that  $\beta_k$  will be the weight assigned that the  $k$ -th decision-maker has in forming the group decision. For this study, the weight of the  $k$ th decision-maker was considered equal. Therefore, for the aggregation of the judgments of the decision makers the equation 2 will be adopted.

$$a_{ij}^{[G]} = \prod_{k=1}^r (a_{ij}^{[k]})^{\beta_k} \quad (2)$$

where,  $a_{ij} = 1/a_{ji}$ , for  $i \neq j$ , and  $a_{ii} = 1$ , all  $i$ .

### ***Step III – Normalization***

This step involves the normalization of the aggregated pairwise comparison matrix by adopting the equation below.

$$a_{ij} = a_{ij} / \sum_{i=1}^n a_{ij}, \text{ n-dimensional column vector} \quad (3)$$

### ***Step IV – Weighting Coefficient***

This step allows determining the weights of each criterion given by the decision-makers by calculating the principal eigenvectors of the decision comparison matrix as shown in the equation below

$$\begin{bmatrix} 1 & \dots & a_{1n} \\ \vdots & \ddots & \vdots \\ a_{n1} & \dots & 1 \end{bmatrix} \begin{bmatrix} w_1 \\ \vdots \\ w_n \end{bmatrix} = \lambda_{max} \begin{bmatrix} w_1 \\ \vdots \\ w_n \end{bmatrix} \quad (4)$$

Where  $(w_1, w_2, \dots, w_n)^T$  is the maximum eigenvector of matrix  $A$  and  $\lambda_{max}$  is the maximum eigen value of comparison matrix  $A$ . The weights of each criterion can be determined.

### ***Step V – Consistency of Judgement***

Finally, to validate the consistency and reliability of the judgments the consistency ratio is measured by using the equation below and the Random Index as shown in Figure 3.6.

$$CR = \frac{CI}{RI} \text{ and } CI = \frac{\lambda_{MAX} - n}{n-1} \quad (5)$$

Where  $n$  is the number of elements/criteria adopted by AHP analysis to conduct comparison and the RI is the random index that can be selected from Figure 3.6 as defined by Saaty. For the results to be consistent and acceptable the Consistency ratio must be less than 0.1.

Matrix size	Random consistency index (RI)
1	0.00
2	0.00
3	0.58
4	0.90
5	1.12
6	1.24
7	1.32
8	1.41
9	1.45
10	1.49

Figure 3-6 Consistency Ratio

The AHP allows the decision-makers to determine the most significant criteria. In this case, it allows the employees to rank the most significant underpinning criteria of employees' social sustainability. Moreover, AHP analysis will be adopted as part of DST to allow the decision-maker to rank the most major decision criteria as per their organization. Followed by adopting Fuzzy MOORA to determine the optimal solution for the organization to enhance employees' social sustainability.

### 3.4. Multi-Objective Optimization based on Ratio Analysis (MOORA)

The MOORA, an MCDM or MADM technique has been proposed by Brauers and Zavadskas, which acts as the efficient and robust method for simultaneously optimizing two or more conflicting alternatives in case of certain constraints such as maximizing profits and minimizing the cost of maximizing the performance and minimizing of fuel consumption of a vehicle [118].

The MOORA method is popularly adopted in real scenarios in presence of conflicting criteria such as beneficial (those needs to be maximized) and non-beneficial (those needs to be minimized). The method has been adopted in several fields as the earliest application was by Brauers and Zavadskas in project management. In addition to this due to its simplicity and comprehensive nature, it has been adopted in fields such as

economics and manufacturing. This approach relates a matrix of alternative responses to the objective using ratios [118].

The use of this method is a case of privatization in a transition economy, where MOORA was originally used in a production "welfare" economy but has become more important in a consumer "welfare" economy [119]. Similarly, the method has been widely adopted for material selection as the importance of materials in product design and operation is well known. Choosing the wrong material for a product can lead to premature failure of the final product. Choosing the right materials is essential for successful and competitive production. In the past, researchers have tried to solve the material selection problem using various mathematical tools and methods. Interestingly, most of these methods differ in the importance of the selection criteria and standardized procedures used to ensure the comparability of the decision matrix elements [120]. Thus, there is an urgent need to develop a method for material selection that is independent of the importance of the criteria and the standardization process. The study by [121] adopts a multi-objective optimization based on factor analysis (MOORA) to solve several typical material selection problems. The effectiveness of both the comparative and the fully multivariate MOORA method is also tested for the problems under study. It should be noted that all three methods are very easy to understand and apply and can be used to classify alternative materials almost correctly [122]. Moreover, the method was adopted by [123] for the personnel selection process to choose the best candidate by considering eight qualitative attributes expressed in linguistic variables. The method allows the integration of the subjective assessment of the decision-makers to be able to propose a more robust personnel selection procedure. The method aids in the improvement of human resource management. Likewise, the study by [124] adopted the MOORA method for the procurement selection process for the students by aiding the decision-makers intake the right decision by performing calculations on the value of criteria of attributes in the form of students who enter into the category of prospective students superior.

Furthermore, the method was adopted by [125] for the selection of key supply chain strategies such as warehouse location selection, Vendor selection, and supplier selection due to its ability to be able to easily applied in a fuzzy environment considering both the qualitative and quantitative criteria. In addition, Computationally

the MOORA method is very simple and easily comprehensible which can handle a large number of selection criteria. Thus, the application of the MOORA method has been identified in a wider range of selection problems in a supply chain.

### 3.4.1 MOORA computation

The subsection, therefore, presents the Fuzzy MOORA method, which will be adopted to develop DST to evaluate the performance and influence of underpinning criteria identified from literature on the social sustainability of the employees. The Fuzzy MOORA method includes the following steps and computations.

#### *Step I – Decision Matrix*

The first step includes defining the decision matrix that comprises of  $m$  alternatives ( $A_1, \dots, A_i \dots A_m$ ) with  $n$  decision criteria ( $C_1, \dots, C_j \dots C_n$ ) by classifying the decision criteria in terms of its *objective function (maximize or minimize)* for optimization at a later stage this results in producing  $m \times n$  performance rating ( $x_{ij1}, \dots, x_{ijk} \dots x_{mnk}$ ) as shown in the equation below:

$$[DM]_{m \times n} = \begin{matrix} & \begin{matrix} \max & \dots & \min & \dots & \max \\ C_1 & \dots & C_j & \dots & C_n \end{matrix} \\ \begin{matrix} A_1 \\ \vdots \\ A_m \end{matrix} & \begin{bmatrix} x_{11k} & \dots & x_{1jk} & \dots & x_{1nk} \\ \vdots & & \vdots & & \vdots \\ x_{m1k} & & x_{mjk} & & x_{mnk} \end{bmatrix} \end{matrix} \quad (6)$$

Where  $x_{ijk}$  represents the performance rating of  $i^{\text{th}}$  alternative with respect to  $j^{\text{th}}$  criteria by  $k^{\text{th}}$  decision-makers and expressed as  $x_{ij} = (x_{ij1}, x_{ij2}, x_{ij3})$ . For this case study, The DST includes.

- $m=7$  alternatives (Organizational Support, Work-Life Balance, Equity Factor, Work Control, Work Environment, Training and Development, Contract Type),
- $n=5$  decision criteria (*Cost of improvement/Budget, Risk, Compatibility with Organization, Return on Investment, and Degree of Difficulty*) and,
- $k=3$  decision-makers.

#### *Step II – AHP analysis - To determine the weights of decision criteria.*

The decision-makers were asked to do a pairwise comparison by ranking the decision criteria based on their perception and policies of the organization which decision

criteria are the most important for decision making by using AHP analysis as shown in the previous section.

**Step III – Alternatives Performance/ Influence Evaluation**

The step allows the decision-makers to evaluate the *performance measure and influence of alternatives on enhancing and ensuring Employees’ Social Sustainability with respect to the decision criteria (objectives)*. Where the decision matrix represents the Where the performance value adopted for the decision criteria are crisp adopted by AHP analysis and the performance value adopted for alternatives are through linguistic scale that allows the decision-makers to use natural language as shown in Table 3.2.

Table 3-2 Linguistic Scale

VP	Very Poor	1,1,1	1
P	Poor	1,3,5	3
M	Moderate	3,5,7	5
G	Good	5,7,9	7
VG	Very Good	7,9,11	9

The decision-makers are, therefore, asked to evaluate the performance or significance of the influence of the alternative on social sustainability such that in their perception and from their experience investing in the alternative in terms of the decision criteria is a reasonable decision to ensure social sustainability. By way of example, is the decision-maker perceive investing in organizational support as a reasonable decision in terms of the cost of the improvement. The decision-makers choose **Very Poor** if they believe the influence of Organizational support on social sustainability and EMW is *Very Poor* in regard to its Cost of Improvement and choose **Very Good** if they perceive the influence of Organizational support on social sustainability and EMW is a *Good and reasonable* approach in regard to its Cost of Improvement.

The responses of the decision-makers are aggregated into the decision matrix by adopting Fuzzy weighted averaging (FWA).

$$x_{ij}^{\sim} = \frac{\sum_{k=1}^K w_k^{\sim} x_{ij}^{\sim k}}{\sum_{k=1}^K w_k^{\sim}} \tag{7}$$

Where  $w_k^{\sim}$  represents the fuzzy coefficient of the significance of the **kth decision-makers**. The aggregated response of alternatives is calculated as  $x_{ij}^{\sim} = (x_{ij1}^{\sim}, x_{ij2}^{\sim}, x_{ij3}^{\sim})$

**Step IV - Normalization of Fuzzy Decision Matrix**

The next step involves the normalization and weighted normalization of the fuzzy decision matrix using the following equation, as shown in Table 35.

$$\begin{aligned} \tilde{x}_{ij} * \tilde{w}_{ij} &= \tilde{r}_{ij} \\ \tilde{r}_{ij} = r_{ij1}, r_{ij2}, r_{ij3} &= \left( \frac{r_{ij1}}{\sqrt{\sum_{i=1}^m r_{ij1}^2}}, \frac{r_{ij2}}{\sqrt{\sum_{i=1}^m r_{ij2}^2}}, \frac{r_{ij3}}{\sqrt{\sum_{i=1}^m r_{ij3}^2}} \right) \text{ for all } i,j \end{aligned} \quad (8)$$

Where  $r_{ij}$  is the weighted normalized performance index ith alternative with respect to jth criteria  $i=1, 2, \dots, m$  and  $j=1, 2, \dots, n$ .

**Step V - Optimization of the attributes**

Moreover, the next step allows for optimizing the fuzzy normalized performance indices added in case of maximization and subtracted in case of minimization. According to the equation

$$y_i \tilde{=} \sum_{j=1}^g r_{ij} \theta \sum_{j=g+1}^n r_{ij} \quad (9)$$

Where  $g$  represents the objective being maximized and  $(n-g)$  represents the objective being minimized and  $y_i \tilde{}$  is the total fuzzy assessment of the alternative  $i$  which can be either positive or negative.

**Step VI - Defuzzification by applying the best Non-Fuzzy Performance value  $BNP_i$  –**

The last step in Stage III allows for the defuzzification of  $y_i \tilde{=} = (y_{i1}, y_{i2}, y_{i3})$  by using the formula below that calculates the performance value.

$$BNP_{y_i \tilde{}} = \left( \frac{(y_{i3} - y_{i1}) + (y_{i2} - y_{i1})}{3} + y_{i1} \right) \quad (10)$$

Finally, the alternative ranking by using the Fuzzy Ratio system is calculated as the ordinal ranking of  $BNP_{y_i \tilde{}}$  that has the highest and maximum assessment value by using the equation.

$$A_{FRS}^* = [A_i | \max_i BNP_{y_i \tilde{}}] \quad (11)$$

This allows the organization to determine the optimal solution of significant influence and performance of alternatives on social sustainability keeping in mind the decision criteria and objectives to enhance the employee’s social sustainability.

In conclusion, the decision support tool adopts Hybrid AHP and Fuzzy MOORA technique; where AHP will be adopted to calculate the weights of the decision criteria identified from the literature and determined through interviews and case studies, with Fuzzy MOORA adopted to allow the decision-makers to evaluate the performance and influence of alternatives or underpinning criteria of employee’s social sustainability in the organization in terms of the conflicting decision criteria by taking in account the benefit and non-benefit nature of these decision criteria as shown in Figure 3.7 below

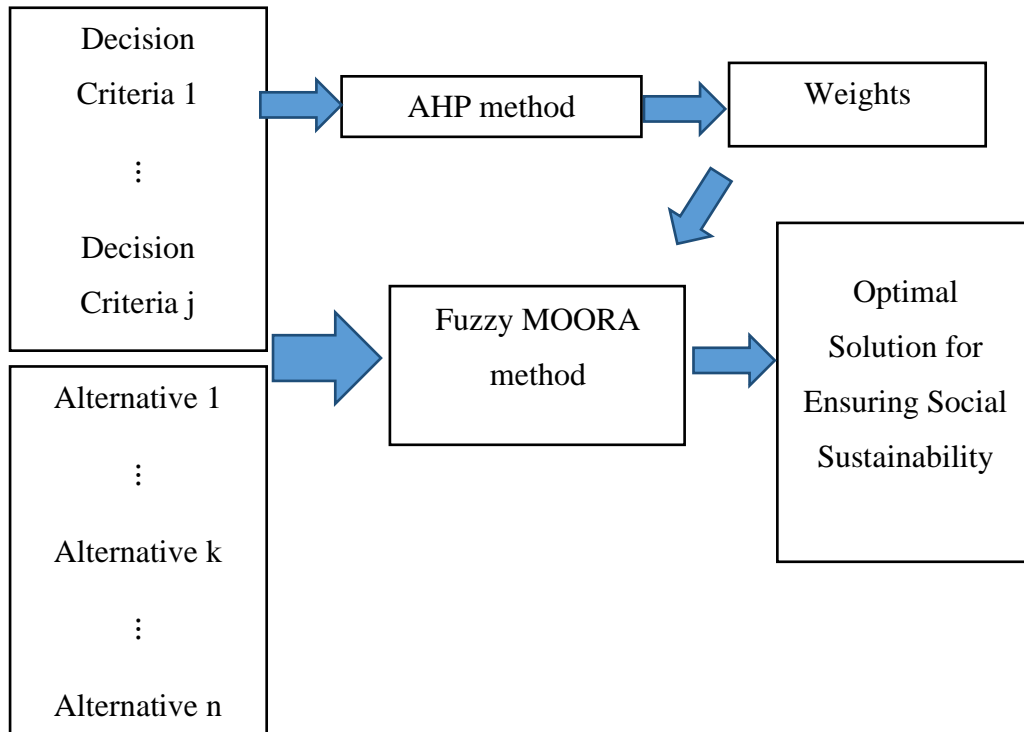


Figure 3-7 Proposed Decision Support Tool

This process will thus allow the organization to reach an optimal solution to ensure employee social sustainability.

However, social sustainability in the organization is a dynamic construct that changes over time where the lack of dynamic nature of the classic decision support tool will only allow the organization to reevaluate their decision either quarterly or annually [126]. Therefore, to be able to monitor and ensure the successful implementation of employee’s social sustainability practices continuously, the study proposed the adoption of technologies such as IoT and Blockchain to complement the DST.

### **3.5. Blockchain and IOT for Social Sustainability**

As one of the world's key issues, sustainable development has piqued the interest of many experts and policymakers [127]. Today, due to increased regulatory obligations placed by shareholders and existing industrial processes, sustainable development is critical to corporate survival [128]. Where corporate sustainability may be defined as serving the demands of the company's immediate and indirect stakeholders, such as shareholders, workers, consumers, regulatory agencies, and members of society, such that the needs of future stakeholders are not jeopardized [129]. Harding's (1968) research was one of the first in the field of sustainability, in which the notion of sustainability was linked to the principles of management of environmental depletion. Subsequent research applied the triple-bottom-line method to sustainability, introducing three elements of sustainability: economic, environmental, and social [130]

Sustainability can be viewed as a strategic resource that allows a firm to gain a competitive edge and improve its performance. Organizations nowadays attempt to obtain a competitive advantage by incorporating sustainability into their business strategies [131]. Sustainability is achieved by integrating three economic, ecological, and social factors. However, a large portion of the corporate effort is devoted to economic and environmental concerns. Individuals' influence on the construction of sustainability and the concept of social sustainability, on the other hand, should not be disregarded [132]. Given the importance of human resources in a company and the role of customers in a business, the social aspect of sustainability is critical. The ability of organizations to enhance value by promoting human and social capital in the communities in which they operate is known as social sustainability [133]. According to the findings of several studies, social sustainability has a significant and positive association with organizational strategy [134] [135]. Work conditions, workplace culture, occupational safety, and competence are all aspects of socially sustainable development in the workplace.

Mani et al. in [136] investigated the supply chain's social sustainability in developing countries. Society, workplace safety, ethics, equity, labour rights, philanthropy, child and bonded labour, wages, education, and housing were identified as supply chain social sustainability components. According to [137], concentrating on consumer complaints as external stakeholders impacts a company's social sustainability.

Consumer attention is influenced by proper market knowledge, accurate understanding of consumer wants, and the product or service provider's capabilities

Companies today recognize that economic success necessitates concurrent attention to social concerns and environmental conservation. Where Corporate Social Responsibility (CSR), also known as social sustainability, is a responsible and voluntary activity in which social concerns are interwoven with organizational operations and shareholder engagement [138]. As a result, social sustainability deals with the management of social challenges along the value chain while also ensuring the organization's long-term survival. These social elements encompass not just the organization's internal characteristics, but also how it interacts with other companies, external stakeholders, and the general public [136].

The advancement of information technology infrastructure and the capacity to analyze environmental data enable an organization or business to gain a competitive edge. Although the aspects of digital transformation are various, those components that influence businesses and different sectors and have been addressed by academics and organizational managers are known as industry 4.0, which was introduced in 2011 [139]. Moreover, they defined "the notion of 'Industry 4.0' is closely tied to the deployment of sophisticated instrumentation for optimal resource control, as well as enhancing efficiency and flexibility". Thus, it calls for integrating IoT with the latest technology that can overcome the limitation and integrity issues of IoT.

The use of a blockchain-based system design improves supply chain transparency and sustainability. Because of the blockchain's decentralization and disreputability, a new structure of communication and data transfer emerges in the organization, which has an impact on people's interactions and organizational relationships. Furthermore, the blockchain system's lack of concentration of power can be effective in creating democracy and boosting transparency, as the organization's director and senior officials can no longer deny others the right to discuss and make judgments by accumulating knowledge [140].

Moreover, at the network level, blockchain technology allows for tracking product information and business transactions. Some of the mechanisms through which blockchain can be utilized to enhance social sustainability include (1) incentives to

encourage green consumerism, (2) proper monitoring and follow-up audits during the life cycle of the products, (3) reduction in operation and development costs by ensuring enhanced productivity of the system, and (4) bolstering of the supply chains networks to ensure performance audit and sustainability monitoring [141].

Furthermore, Leng et al. (2020) in [142] analyzed the two views of the product life cycle and the production system and how the blockchain overcomes the constraints to sustainability. The study identifies lack of information sharing, consumer knowledge, and voice are all variables that affect the adoption of a sustainable supply chain. Thus, adopting blockchain technology on a distributed system can assist share information and promote transparency at the network level.

Therefore, it can be highlighted here that the adoption of a Blockchain – IoT-based solution ensures social sustainability management by monitoring the organization's practices. Thus, this study proposes the adoption of a Blockchain – IoT-based framework as a complementary solution to the DST to allow the organization to ensure the social sustainability management for employees in the construction sector as shown in Figure 3.8.

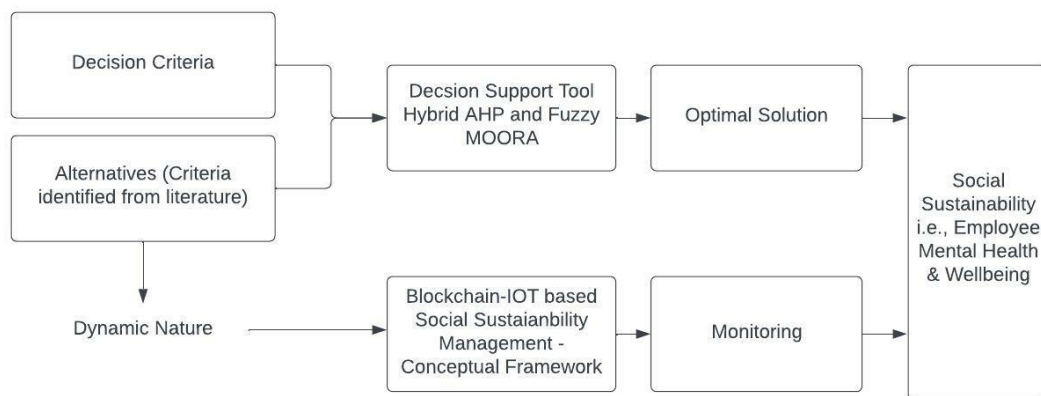


Figure 3-8 Integration of DST and BOTSSOM as a Proposed Solution

As can be seen from the figure above, the DST will allow the organization to take the strategic decision to ensure the employee’s social sustainability. Whereas the BOTSSM conceptual framework allows to monitor the social sustainability management of the organization to ensure continuous successful implementation of employee social sustainability in the construction organization.

Thus, to propose a conceptual framework of Blockchain and IoT-based social sustainability management for the construction industry, the next section intends to develop an understanding of IoT, Blockchain, and their adoption for the construction sector.

### **3.5.1 Internet of Things (IoT)**

The fast advancement in downsizing, electronics, and wireless communication technologies has resulted in unparalleled breakthroughs in our civilization which leads to a rise in acceptance of electronic devices for numerous applications due to their ability to decrease production costs and bring massive change from the physical to the digital world. As a result, the way people interact with one another and with their surroundings has changed, as we use modern technology such as the IoT to obtain a deeper knowledge of the world [143].

The internet of things, or IoT, is a network of interconnected computing devices, mechanical and digital machinery, items, animals, or people that have unique identities and the capacity to send data over a network without the need for human-to-human or human-to-computer contact.

Where the IoT has arisen as a set of technologies ranging from Wireless Sensor Networks (WSN) to Radio Frequency Identification (RFID) that enable devices to perceive, act on, and communicate with one another over the Internet [144]. The IoT envisions a completely linked world in which things can transmit quantitative measurements and interact with one another. Currently, an IoT device may be anything from a wristwatch to a computer development platform, and the applications it can be utilized for cover a wide variety of societal domains. The IoT is playing a critical role in transforming contemporary cities into smart buildings, electrical grids into smart grids, and dwellings into home automation, and this is only the beginning as shown in Fig 3.9.

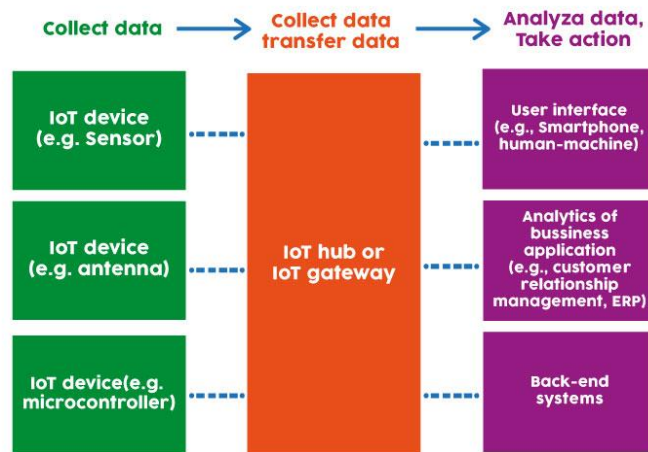


Figure 3-9 IOT Functionality. Source: [138], Recreated: Author

IoT devices exchange sensor data by linking to an access point or other edge device, where data is either transferred to the cloud for analysis or examined locally. These gadgets occasionally connect with other devices connected and respond to information they receive from one another. The gadgets conduct most of the work without human interaction, while individuals may engage with them to line them up, give them instructions, or view the data. The connection, networking, and communication protocols utilized with these internet devices are heavily influenced by the IoT applications that are implemented [145].

According to several research studies, the number of linked devices is expected to range between 20 and 50 billion by 2025 [146], due to the large number of devices that the IoT may deploy. This allows for the creation of a graphical signal of the actual environment, from which various smart products in several sectors may be created. Smart homes, wearables, smart cities, healthcare, automotive, the environment, smart water, smart grid, and so on are examples. IoT solutions are also being applied in a variety of fields to optimize production and digitize industries, especially in the construction sector an exponential adoption of IoT solutions has been seen.

As [147] proposes an IOT-based construction worker physiological data monitoring platform. The monitoring platform uses an off-shelf wearable smart band to monitor overall heat assessment (OHS) and a personal management system (PMS) for the workers working in adverse conditions such as high temperatures as per the threshold

set by Korea Meteorological Administration. The monitoring platform allows the management to assess the individual health risk level, and environmental conditions by using the Thermal comfort index (TCI), the current position of the individual and manages the shift system effectively as shown in Figure 3.10.

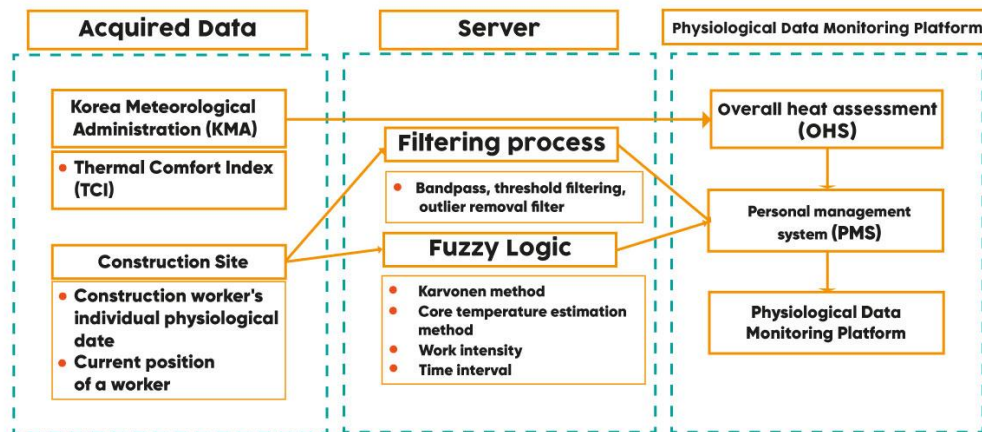


Figure 3-10 IOT-based construction worker physiological data monitoring platform. Source: [147], Recreated: Author

Likewise, [148] in India transforms the ordinary and traditional helmets into Smart helmets by adopting IoT solutions such as Work Mode (ON/OFF), GPS System, Emergency Alert sensors, and task completion Button at the construction site. The Smart Helmet update and log in the information of the workers in work mode when the individual wears it and automatically alert the supervisor in case of any emergencies such as smoke detection and Fall. The GPS allows the management to have the real-time location of the workers that can be useful in case of any emergency.

In addition, to this, the study conducted by [149], proposes a framework for Worker 4.0 based on nine integrated processes. The framework proposes the adoption of various from of sensors ranging from Portable, wearable devices, Image devices, and Automated systems to Sensor devices. Some of the examples of the above are RFID (radio-frequency identification), GPS (global positioning system), Barcode/ OR code, Physiological sensors, Smartwatches, wristbands, Mixed vision glasses, Boy movement monitors, CCTV systems, photographic and film cameras, drones, motion capture systems; Sensors for measuring temperature, humidity and noise level or automated

sensors that are embedded in the machinery and tools used at the construction site as shown in the Figure 3.11.

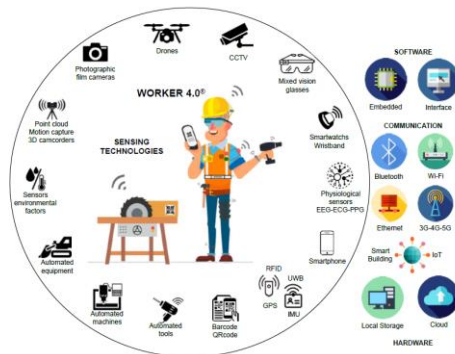


Figure 2. Worker 4.0: Sensored construction sites.

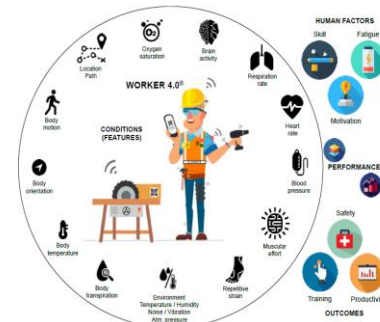


Figure 3. Worker 4.0: Human data generated.

Figure 3-11 Worker 4.0. Source: [149], Readapted: Author

Therefore, it can be seen from the figure that the adoption of such an IoT solution allows the management to have an insight into human factors (skills, fatigue, motivation), thus, allowing them to monitor the performance of the workers and able to achieve the optimal outcomes in form of productivity, training, and safety of the workers.

Moreover, [150] also proposes the adoption of an IoT solution in a form of a Smart Helmet – HeadgearX to real-time monitor and improve personnel safety as shown in Figure 3.12.

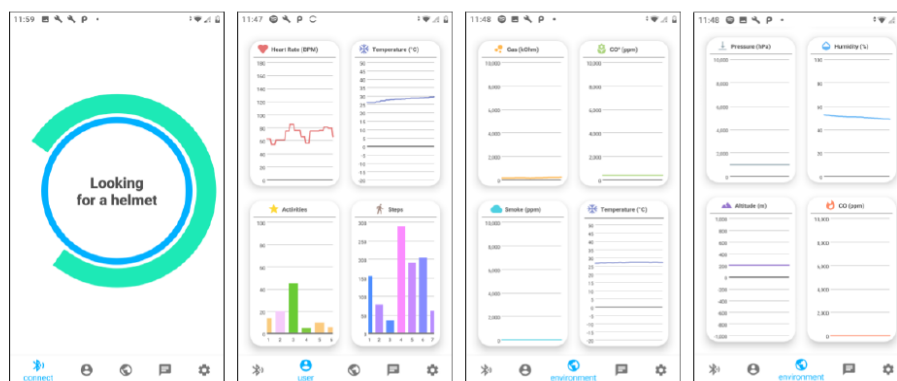


Figure 3-12 HeadgearX. Source: [150], Readapted: Author

As it can be seen from the figure, the HeadgearX allows monitoring of the heart rate, temperature, steps taken, and activity of the worker. In addition, it also allows for monitoring the surrounding environment such as air pressure, humidity, and presence of toxic gasses. The proposed IoT solution can be adopted to alert the management in

case of any emergency through smoke detection and temperature beyond the threshold value. This results in producing an environment safe for the worker to perform their duties which ultimately increases their productivity [150].

The adoption of IoT-based solutions for Occupational safety and health has been accepted by the workers as a promising step [151]. However, privacy concerns and security issues regarding wearables have been a bigger concern by many.

Therefore, for the successful implementation of IoT solutions in the construction sector, the acceptance and trust of the workers are the major components. IoT applications have unique characteristics in that they create significant amounts of data and demand connections and electricity for extended periods. This, along with memory, computer capability, network constraints, and a restricted power supply are some of the downsides of the IoT.

To eliminate the present heterogeneity in the field, the massive development of the IoT must be supported by standard procedures and protocols. This heterogeneity creates vertical silos and slows IoT adoption. Aside from the diversity and integration challenges that the IoT presents, the integrity of its data is also a crucial consideration. We now place our faith in the information supplied by financial institutions and the government, among others, but how can we be certain that the data supplied by them and other external organizations, such as IoT firms, has not been meddled in any way? In centralized designs, this is a challenging question to answer. Untrusted entities can change information to suit their purposes, thus the information they supply may not be entirely accurate. This necessitates the need to ensure that the material has not been altered in any way.

### **3.5.2 Blockchain**

Blockchain is the technique that permits transactions to be verified by an untrustworthy set of participants. It provides a distributed ledger that is immutable, transparent, secure, and auditable. The blockchain may be examined openly and completely, enabling access to all transactions in the block since the system's first transaction, and it can be checked and collated at any moment by any institution. As the name implies the blockchain system organizes information into a chain of blocks, with each block storing

a collection of Bitcoin transactions that occurred at a specific time. A chain is formed when blocks are coupled together by a relation to the original block [152].

The blockchain comprises *Network peers* that must provide the following functions to maintain and operate the blockchain: *routing, storage, wallet services, and mining* [153]. A typical structure of blockchain is displayed in figure 3.13 below:

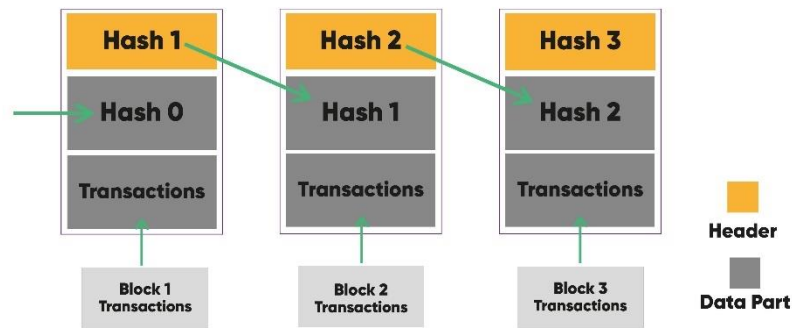


Figure 3-13 Blockchain. Source: Recreated: Author

Blockchain comprises a different form of nodes that acts as a part of the network depending on the functions they provide. The routing function, which comprises transaction and block propagation, is required to participate in the P2P network. The storage function oversees storing a copy of the chain in the node (the entire chain for full nodes, and only a part of it for light nodes). Wallet services give security keys that enable users to order transactions, i.e., to conduct transactions with their Bitcoins. Finally, the mining function oversees generating new blocks by resolving the proof of work as shown in Figure 3.14.

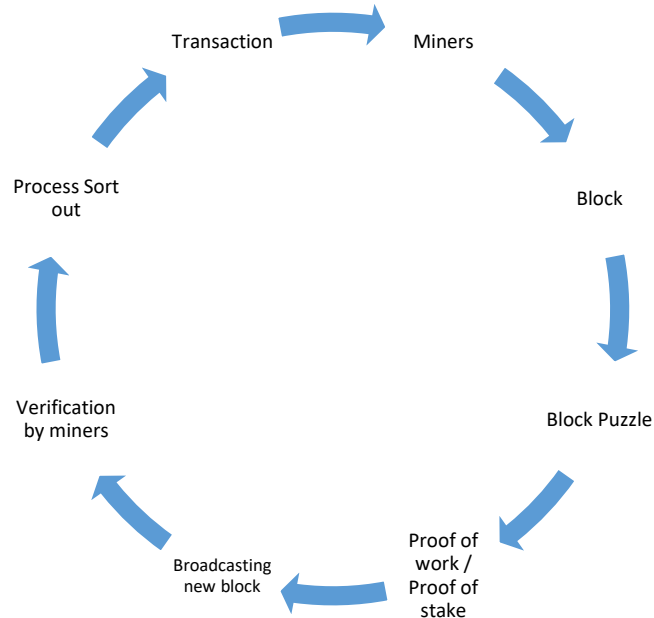


Figure 3-14 Mechanism of Blockchain. Source: Recreated: Author

Miners are nodes that do proof of work (or mining), and they are rewarded with freshly created bitcoins and fees. One of the elements to enable trust less consensus in a blockchain network is the notion of consensus protocol. The consensus protocol comprises of a computationally hard job required for block formation. This assignment must be difficult to solve yet be easily verifiable once accomplished. When a miner accomplishes the formal verification, the new block is published in the network, and the entire network confirms its legitimacy before including it in the network. Because block generation occurs simultaneously in the subnet, the block chain may momentarily split into different branches (generated by different miners). This mismatch is resolved by assuming that the longest branch of blocks would be considered genuine. This, in conjunction with the intensive nature of the block production process, results in a novel, distributed-trust less-consensus method [153].

In addition to this, the transparency, distributed architecture of the blockchain, and the inclusion of date stamps throughout the blockchain framework prevent the information from being distorted or falsified without the awareness of stakeholders. As a result, this collaborative accountability improves data security and dependability [154]. It is also exceedingly resourced intensive for a malicious attacker to change a block and damage the block chain because the remaining trusted miners will outrun the attacker in the block production process, invalidating the one generated by the attacker. In technical

terms, for a manipulated block to be effectively incorporated into the chain, the proof of work must be solved faster than the rest of the network, which is computationally prohibitively expensive — it necessitates control of at least 51 percent of the data processing network elements. The manipulation of the blockchain's nodes is practically impossible due to the massive processing resources required to modify it. It implies that, even though the contributors are not entirely truthful about their usage of Bitcoin, an agreement is always established in the system as long as the majority of the network is made up of truthful individuals [155]. Thus, the solution described by Nakamoto represented a significant breakthrough in the dependability of untrustworthy actors in decentralized networks as shown in Figure 3.15.

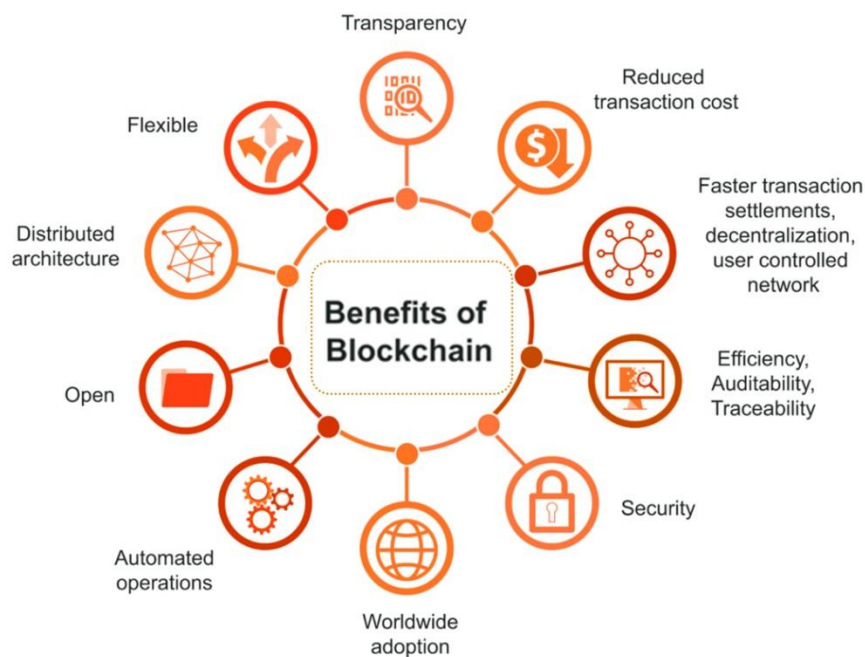


Figure 3-15 Benefits of Blockchain. Source: Recreated: Author

Blockchain technology has also made it possible to actualize the notion of smart contracts. A smart contract, in general, refers to computer protocols or programs that allow a contract to be automatically executed/enforced based on a set of predetermined circumstances. Smart contracts, for example, establish the application logic that will be implemented whenever a bitcoin transaction occurs. Smart contracts allow for the definition of functions and conditions that go beyond the exchange of cryptocurrencies, such as the validation of assets in a certain range of transactions with non-monetary aspects, making it an ideal component for expanding blockchain technology to other areas [154]. Ethereum was a forerunner in incorporating smart contracts with

blockchains. Today, smart contracts are incorporated in several current blockchain networks, including Hyperledger, a blockchain constructed for businesses that allow constituents to be launched based on user needs (smart contracts, services, or consultations, for example), with the support of large corporations such as IBM, JP Morgan, Intel, and BBVA. All of this has led to the growth of blockchain technology in a wide range of domains where the capabilities provided by this technology are required, such as dependability, immutability, and auditability [156].

Thus, due to the ability to generate cleaner economic processes as well as balance and harmony between the economy, society, and the environment by utilizing decentralized, open-source, peer-to-peer technologies and the way information is distributed in the blockchain network the technology is considered as the ideal match to the IoT.

Moreover, given the importance of digital transformation in organizations, as well as the importance of sustainability, this study aims to propose a framework based on the integration of Blockchain and the IoT for social sustainability in the construction sector.

### **3.5.3 BOT for the construction sector**

Several studies have been published regarding the application of blockchain and IoT in the industry where the trends of the adoption of both technologies in the construction sector are relatively new.

The study by [157] presents the seven main areas of application of the integration of Blockchain and IOT (BCOT or BOT) for the construction sector. The area of the fields is presented in Figure 3.16.

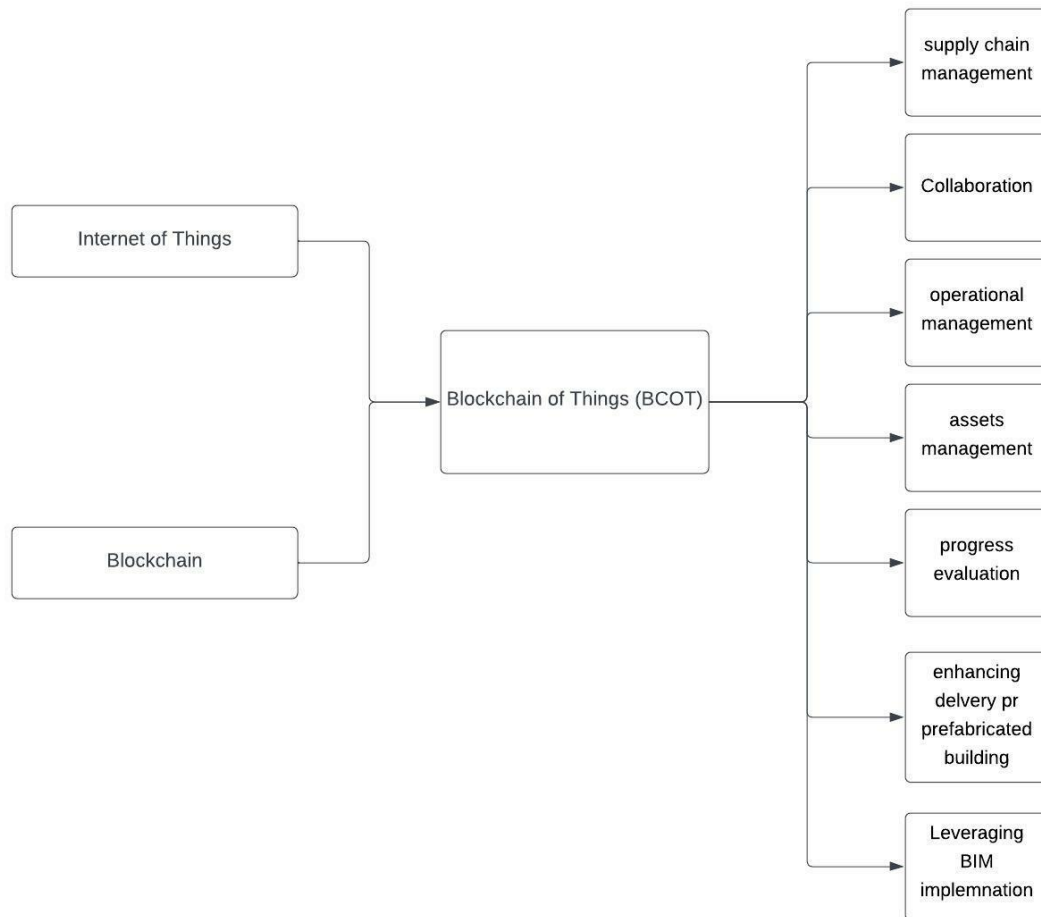


Figure 3-16 Blockchain and IoT for the construction sector. Source: Author

It can be seen from the figure, that the BCOT/ BOT can be adopted to enhance the entire construction process that includes supply chain management, collaboration, operational, assets management, progress evaluation, leveraging BIM implementation, and enhancing the delivery of prefabricated buildings. However, for this study, we focused on only one aspect that relates to the operational management of the employees in the construction sector.

Some other examples in the construction sector are the integration of BIMchim as proof of integration of blockchain with BIM and IoT. The adoption of smart contracts has also been reported to be adopted in the industry for a variety of purposes, including delivering agreed contracts automatically while allowing parties to update any variations, enhancing copyright for project documentation, automating payments among project parties, and serving as an acclaim submission platform [157].

Moreover, [158] highlighted the potential of blockchain in construction management by also providing a map to help potential users choose the right type of Blockchain based on the nature of the data and the organization's hierarchy. Likewise [159] defends the value of intelligent contracts (smart contracts) in the construction business by reducing the cost of hiring a third party and the time it takes to complete new transactions. In addition, it highlights the need of incorporating smart contracts into BIM to automate the entire construction process is highlighted. Similarly, [160] presented a vision for using blockchain to solve long-standing problems in supply chain management, contract management, and resource management, particularly in the leasing of equipment.

Likewise, [161] identifies the significance of decentralized technology for strengthening, protection, accountability, and a shift from present centralized systems to a decentralized system in any industry, which is essential in the construction industry. Where the construction sector is considered critical to the economic progress. In the construction business, Blockchain and IoT applications play a critical role. The decentralized ledger of data obtained from sources in the construction business contains transactions and accounts via a linked network and is based on an agreement between node points, enhancing Blockchain's transparency, traceability, and collaborative existence.

Where the IoT aids in altering and refining manual processes to bring them into the digital era, acquiring massive amounts of data that supply knowledge at previously unimaginable levels. This understanding is assisting in the creation of smart technologies such as improving city administration and citizens' quality of life through the automation of services. The IoT remarkable growth has created new community opportunities, such as ways for accessing and sharing information. The open data framework is at the forefront of these efforts. However, as has happened in many cases, one of the most significant vulnerabilities of these projects is a lack of faith. The development of IoT has been aided by centralized systems. However, they act as black boxes when it comes to data openness, and network participants have no idea where or how the information they contribute will be used.

Thus, the integration of Blockchain can improve the IoT by providing a trustworthy sharing service that is both reliable and traceable. Data sources may be identified at any

time, and data is immutable throughout time, enhancing security. This integration would be a game-changer in scenarios when IoT data needs to be securely shared among many people.

At this point, it can be stated that the integration of IoT and Blockchain and the adoption of this combined concept has a significant advantage for the social sustainability management in the construction sector as shown in Figure 3.17.

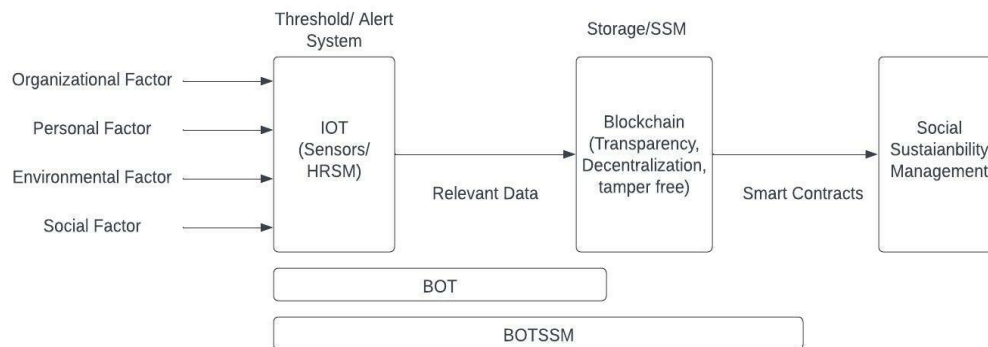


Figure 3-17 Integration of Blockchain and IOT for SSM in the construction sector. Source: Author

Where the figure shows the adoption of IoT sensors and the HRSM tool of the organization to determine and measure the underpinning criteria of employee social sustainability. Where the IoT sensors aid in alerting the management if the value of any criteria goes out of range from the threshold, with only the relevant information being transferred between IoT and Blockchain to ensure the privacy of the organization. The Blockchain layer assists in storing and processing smart contracts to allow for transparent, decentralized, and tamper-free information sharing of social sustainability practices of the organization to the concerned stakeholder. The system thus ensures social sustainability management.

### 3.6. Conceptual Framework Blockchain and IoT-Based Social Sustainability Management

This section, therefore, proposes a comprehensive conceptual framework for *Blockchain and IoT-based social sustainability management* (BOTSSM) based on multi-level Blockchain with specific roles in the hierarchical framework. The proposed solution intends to allow the organization real-time monitoring of criteria that contribute to the social sustainability of their employees such as health and safety, stress level, work environment, and work-life balance in real-time; and criteria such as

contract type, organizational support, and training, and development through the use of HRMS system. Moreover, the proposed solution also allows the authorities and governments to monitor the performance of these organizations by adopting a multi-layer blockchain framework. The framework ensures the organizations participating in the blockchain network safeguard the social sustainability of their employees as per the legislation and policies set by the government as shown in Figure 3.18

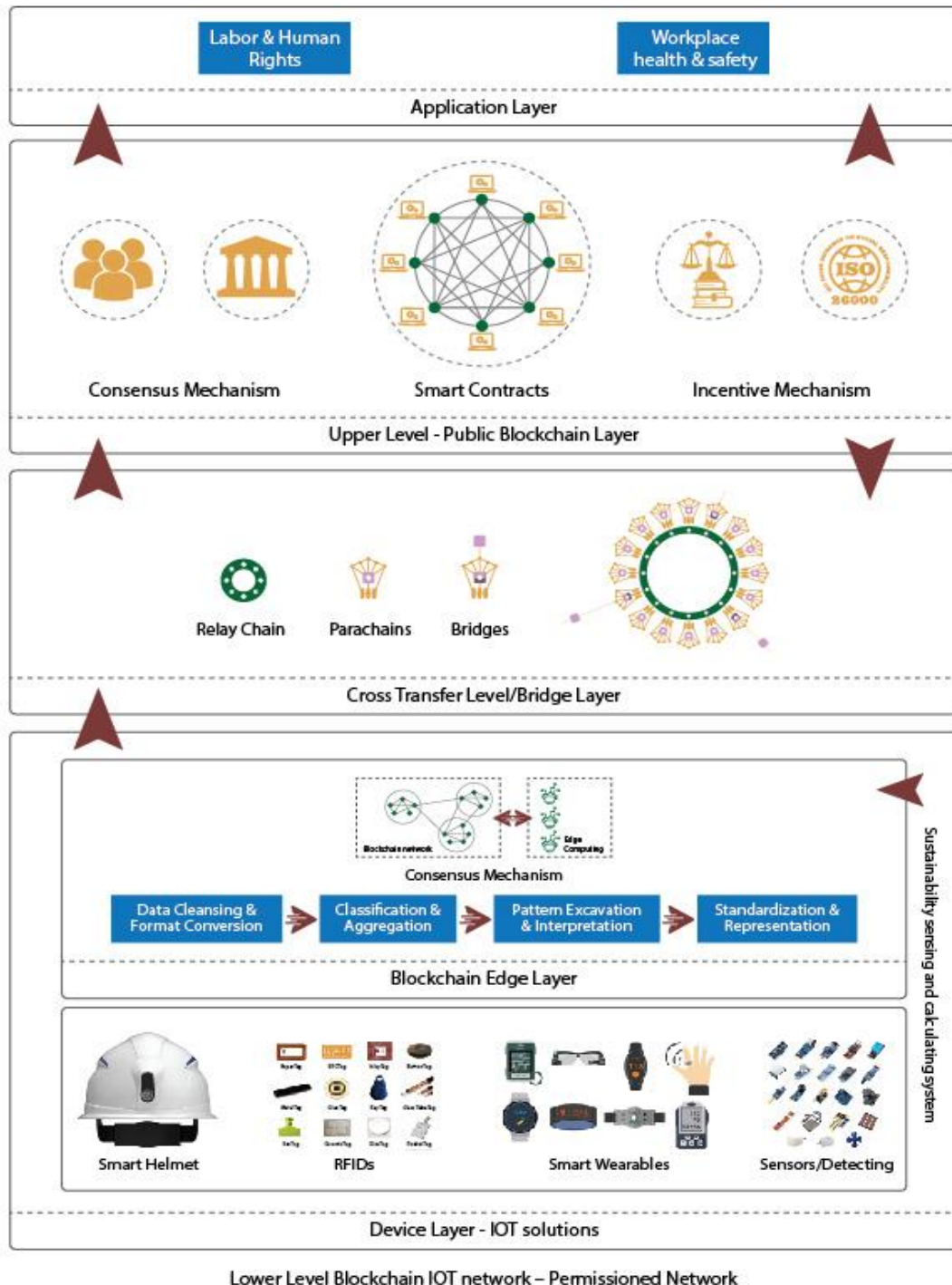


Figure 3-18 Proposed Framework – BOTSSM. Source: Author

The framework adopts the IoT solution smart devices such as RFIDs; Smart Helmets equipped with GPS, Barcode/ OR code, or Physiological sensors; Automatic attendance and timesheet logged cameras and cards; Smartwatches, wristbands, Mixed vision glasses, movement monitors, CCTV systems and Sensors for measuring temperature, humidity, and noise level to monitor the factors of social sustainability of employees in the organization. Whereas any data that cannot be captured using smart devices can be obtained by using the organization's HRMS (Human resources management system). It entails the organization willing to participate in the network must inform their employees and upon consent introduce the system. Though sharing such personal information is considered a major concern. However, the framework proposes multi-layer and adoption of the lower level or consortium BOT network at the organizational level to share only the relevant information required by the government and entities to monitor the SSM of the organization. the organizations Thus, the multi-level framework allows to maintain an equilibrium between the organization's privacy and transparency in the social sustainability management system (SSMS). The purpose of adopting a multi-level blockchain network that comprises of Public Blockchain - permissionless involves (government, stakeholders, ministry of human resources and labour rights, iso certification authorities) and Private or consortium Blockchain – Permissioned Layer includes (organization participating in CSR and social sustainability management) is to ensure the privacy of the management style, policies, internal matters and issues of the participating organization from the competitors. The public blockchain, on the other hand, is introduced to allow transparency, immutability, and decentralization of the information on social sustainability management and the standings of the organization to the concerned parties. The information which can be gathered as points allows the government and the concerned entities to offer allowances and rewards to the participating organization as offered by *Taqdeer* in the United Arab Emirates, which is the event that takes part annually and provides employees and employers a well-deserved recognition and competitive advantage for local, regional, and international business opportunities. This framework, therefore, proposes BOT (Integration of Blockchain and IoT-based social sustainability management system) to ensure transparency, immutability, and digitalizing of the factors data used to offer rewards.

Some more benefits of adopting a multi-level Blockchain network are to save GAS which is an execution fee and the incentive to nodes to perform the smart contracts. The value of GAS depends on the amount of computational power used by the Blockchain network. Therefore, adopting multi-level Blockchain networks reduced the need for unwanted nodes to execute smart contracts. Moreover, the computational speed and time are also reduced by adopting multi-level as with the time the Blockchain network tends to grow bigger, thus the nodes require more time for execution thus causing the delay. Finally, the bigger the Blockchain network the more difficult it becomes the implementation of consensus mechanism. Hence, having multi-level Blockchain networks guarantees the adoption of a different form of consensus algorithm for each Blockchain network based on their needs. The consensus mechanism allows for validating the entries in the distributed network and keeping them secure. Thus, the larger network can adopt algorithms such as Proof of Work (POW) or Proof of Stake (POS), and smaller networks such as Lower Level can adopt lighter mechanisms such as PBFT (Practical Byzantine Fault Tolerance).

Moreover, the framework ensures social sustainability management by adopting a sustainability sensing and calculating system. However, to ensure the organization takes part in the SSM the role of the government is considered to be the key contributor. Thus, to ensure the organizations follow CSR, legislation, and human rights policies; the government needs to monitor and reward the organization for the same. The concepts align with the vision of UAE which has evolved into a leading economic hub with the rapid pace of development, mega construction projects, events such as EXPO2020, and an influx of expatriate workers in the construction sector from the Asian region being the most desirable city for working and living. Thus, this necessitated the government to ensure laws and regulations are followed to safeguard the rights of both employees and their employers.

The social sustainability management system which is a lower-level consortium blockchain adopts sustainability calculating and sensing system that is connected to the IoT smart devices. The smart devices such as RFIDs, Smart Helmets, GPS, Automatic attendance, and timesheet logged cameras and cards, sensors for measuring temperature, humidity, smoke, and noise level ensure the measurement of criteria found in this study that is significant for the social sustainability of employees in the

organization. Thus, the lower-level layer based on BOT ensures the measurement, detection, and storing of information for criteria such as work-life balance, job demand, health and safety, and work environment to enhance social sustainability management. This results in transparency, consensus, tamper-proof recording, and no single point of failure and attack.

The novelty of the proposed framework is that it fills the gap and need of industry to monitor and manage the social sustainability or corporate social responsibility of the organizations, especially in the construction sector. In addition, it is the first among other frameworks that proposes a multi-level blockchain level which on one hand keeps the privacy of the participating organization, produces transparent and tamper-proof records, and on the other hand integrates the role of governments and stakeholders as part of the upper level blockchain to monitor and incentivize the organization.

The upper level blockchain adopts another set of smart contracts executed based on the records or points generated as per the sustainability sensing and calculating system. Which ensures the standings of the organization on criteria identified in the study as per the standards and legislation set by the government. There are several ways the blockchain network can be designed either by adopting platforms such as IBM Blockchain, Corda, Bitcoin Core software, Multichain, or Ethereum.

However, after the initial success of the framework on the following platform: the study suggests for the successful implementation of the framework the government should invest in creating a new Blockchain network dedicated to sustainability management that offers points and currency to organizations for conducting business, applying tenders by using a new establish currency called as *HapCoin (Happiness Coin)*.

The proposed framework is a continuous process where the monitoring, reporting, and rewarding processes are carried out in the multi-level hierarchical blockchain based on BOT for social sustainability management.

### **3.6.1 Framework architecture**

This section intends to discuss the architecture and function of the framework proposed for social sustainability management by adopting a multi-level hierarchical blockchain. The section discusses in detail the purpose and role of the application layer, Upper-level public blockchain layer, Cross Transfer level Bridge Layer, and Lower level

private or consortium blockchain Layer (Device Layer) which follows a bottom-up approach.

#### ***A. Lower level private or consortium blockchain Layer (Device Layer)***

The lower level private or consortium layer comprises of device layer (IoT solutions) and blockchain edge cloud computing layer, where the following procedures take place:

- The layer performs a sustainability sensing and a calculating system where the information and measurement data on the identified criteria of social sustainability such as *mental health, temperature, humidity, productivity, stress level, blood pressure, time sheet, attendance, detection of smoke, harmful gasses, location of employee, motion detection was obtained through sensors and organization's Human resources management system (HRMS)*. Thus, this allows the organization to monitor in real-time the criteria that have an impact on the social sustainability of their employees such as the mental health (stress level), the physical condition of employees, the environmental condition, number of working hours, productivity hours using sensors and IoT wearables; and information such as development and growth, contract type and its impact on their level of satisfaction from organization's HRMS system.
- The information is then transferred to the Blockchain edge layer that handles the computation and securely storing of the information to ensure transparency and immutability. The layer performs data cleansing, format conversion, classification and aggregation of information, pattern detection and interpretation, standardization, and representations. Moreover, the relevant information is stored in the blockchain to ensure immutability. To implement the following steps the framework adopts protocol such as JSON-RPC (remote procedure call) to request the initiation of data from the IoT devices to the blockchain edge layer.

#### ***B. Cross Transfer level Bridge Layer***

The transfer level and Bridge layer share the relevant data between the lower level to upper level blockchain layer where the distribution of points and reward system takes place. Several different types of protocols and cross-chain bridge layers are present. Where some of the popular protocols identified in the literature are as follows:

**Polka dot protocol:** The Polka dot Protocol allows any sort of data, asset, or token to be moved between different blockchains in the Polka dot network, allowing them to connect and operate seamlessly. The network enables the chains to stay autonomous in terms of governance while remaining together in terms of security.

**Interledger protocol:** The protocol offers the flexibility of transmitting cryptographically linked information between numerous chains and refers to interoperability between different distributed ledgers (Blockchains).

**Relays:** They work on a chain-by-chain basis, eliminating the need for distributed nodes, and allowing a single contract to act as a central client for nodes across many chains. Relays can validate the entire history of transactions as well as certain central headers on demand in this fashion. Some relay alternatives, such as BTC Relay, do, however, require a large investment to run and maintain operational security.

**Merged Consensus:** the merged consensus techniques are robust and offer two-way interoperability between chains. Merged consensus is used by the Cosmos and Ethereum projects. Merged consensus is a strong tool, but it must usually be built into a chain from the beginning.

The proposed framework suggests adopting Sidechain Blockchain such as the relays and merged consensus that instead of connecting to an entirely different blockchain connects the parent blockchain to a child blockchain which is the case in our framework. The benefit of adopting the sidechain is interoperability, scalability, and efficiency.

### *C. Upper-Level Public Blockchain Layer*

The upper-level public blockchain layer comprises government, stakeholders, the ministry of human resources and labour rights, and ISO certification authorities as a key player to ensure the organization participates in CSR and social sustainability management of their employees according to the legislation and policies.

- In the public blockchain layer smart contracts, consensus, and incentive mechanism takes place where the points and data generated through sustainability sensing and the calculating system are transformed in a form of

reward and incentives to the organization fulfilling their corporate social responsibility and social sustainability management.

- The allocation process of rewards such as the Happ Coin as proposed by the framework is automatically allocated by using smart contracts which allow for to prevention of corruption within the system. It certifies the organization a well-deserved recognition and competitive advantage for local, regional, and international business opportunities.

#### ***D. Application Layer***

The application layer is adopted to provide users such as ministries and organizations with a user-friendly frontend application. The application layer proposed by the framework comprises information on Labour and human rights, workplace health, and safety thus maintaining the social sustainability of the employees. The study proposes a GUI for a user-friendly experience as shown in Figure 3.19.

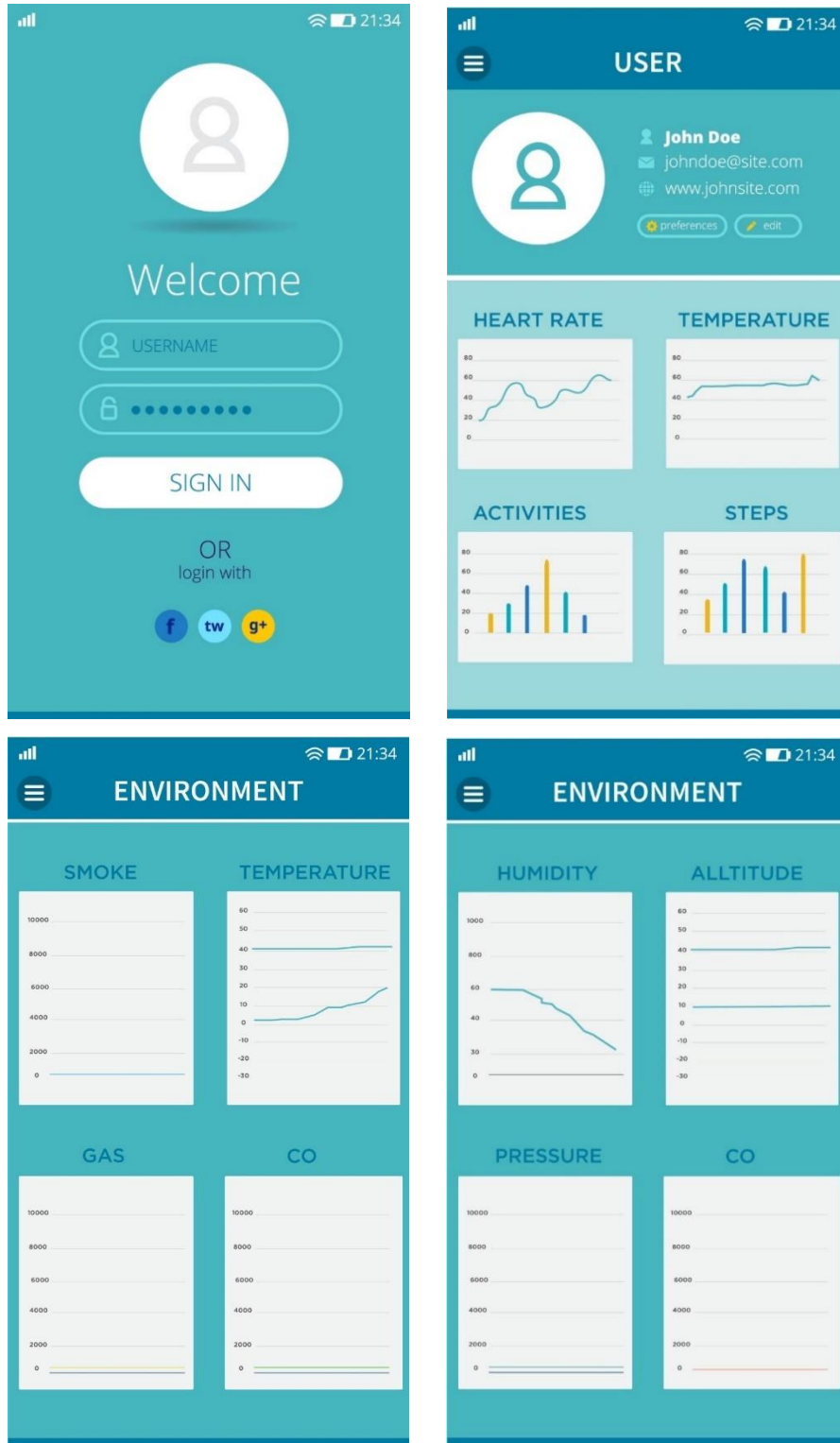


Figure 3-19 Proposed Graphical User Interface. Source: Author

Thus, to ensure the successful implementation of social sustainability in the construction sector, this study recommends the adoption of BOTSSM. Where for

allowing the end-user to easily adopt the concept, the study proposes the adoption of a user-friendly GUI-based system as can be seen in Figure 3.20.



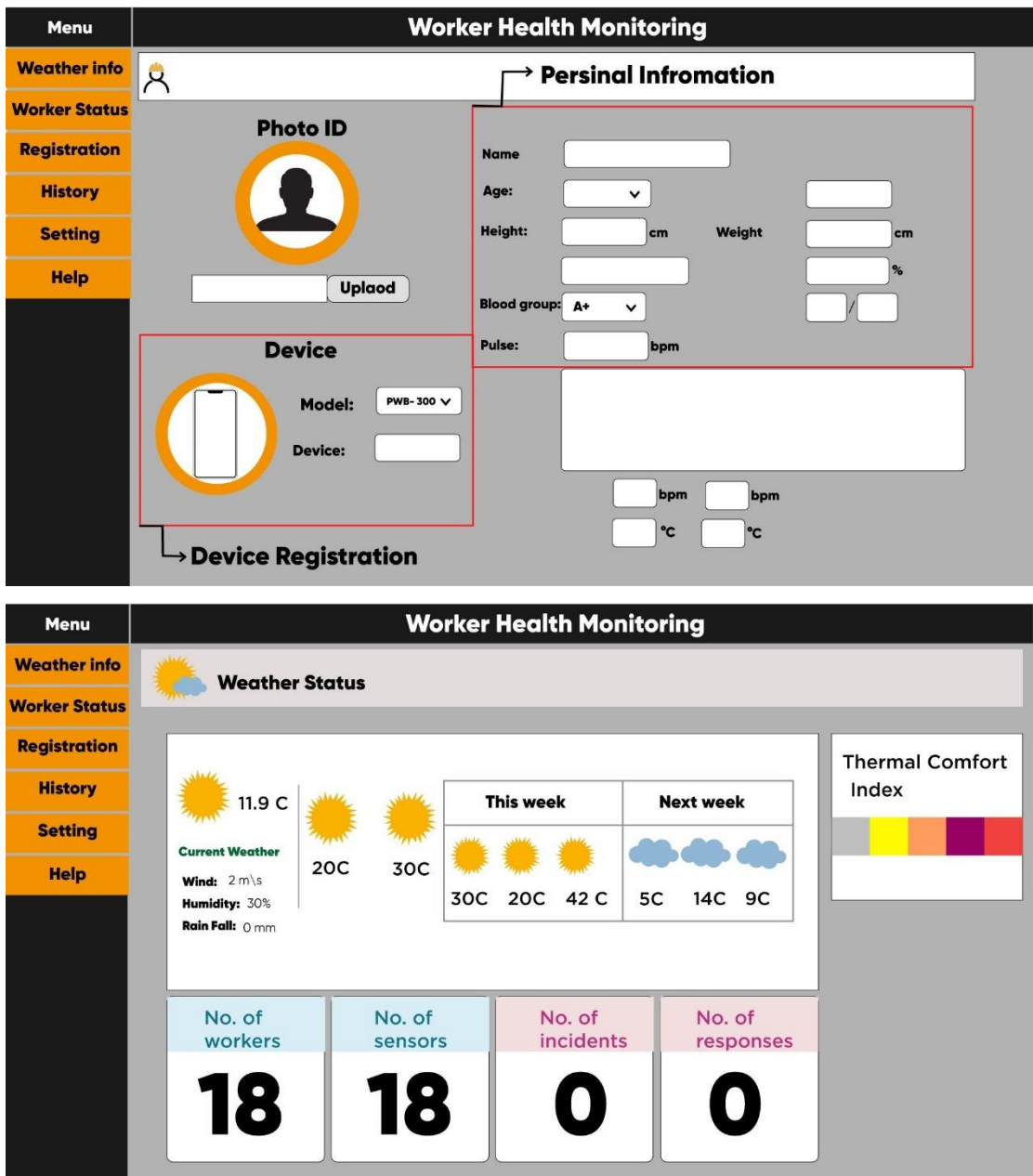


Figure 3-20 Proposed User-Friendly Interface for BOTSSM. Source: Author

### 3.6.2 The cost implication of the proposed solution

The major cost of the proposed framework includes the hardware cost and the software cost. Where mainly the hardware cost comprises the cost of wearable technologies such as smart helmets, and wristbands; sensors such as temperature, humidity, and smoke detectors; installation and maintenance cost of the hardware. However, having outsourced these technologies and hardware from companies like WakeCap technology that provide IoT solutions on the lease greatly reduces the cost of the adoption and maintenance of the system even by small and middle-scale construction organizations

also [140]. Moreover, the framework proposes the adoption of private and consortium blockchain with edge layer cloud computing for the organization that allow them to reduce the cost of GAS as the transaction fee are extremely low and unlike public blockchain increase in the number of requests does not necessarily increase the transaction fee. Therefore, no matter how many requests are generated the transaction fee remains low. In addition, the adoption of Cloud computing with a blockchain network allows for storage of the relevant information extracted from the sensors on the virtual servers instead of the organization deploying on-premises servers thus resulting in reducing the cost of the system for the organizations. Thus, this results in the cost-effectiveness of the system to be adopted by small to large-scale construction organizations [162].

Furthermore, the Public Blockchain comprises stakeholders such as the Government, ISO Authorities, and Ministries of Labour and Human Resources. Thus, to reduce the cost of Blockchain Network at this layer, the proposed framework adopts consensus mechanism of Proof of Stake (POS) instead of Proof of Work (POW) which is a better method in terms of energy efficiency, computation speed, and transaction cost.

Finally, according to [154], the value of a Blockchain of things-based system ensures 70 percent cost reduction and income generation in the longer run.

### **3.7. Conclusion**

Employee's social sustainability has been identified as a crucial element for the construction organization to gain a competitive advantage over their competitors. This chapter, therefore, investigates literature to identify an efficient and robust method i.e., Hybrid AHP and Fuzzy MOORA to develop a DST that will aid the organization intake informed and right decisions in terms of the optimal solution to ensure employee social sustainability in the organization. Furthermore, to complement the non-dynamic nature of the DST, the chapter proposes the adoption of BOTSSM to ensure continuous monitoring and successful implementation of social sustainability practices by the organization. Where the development of the DST will be guided by following the methodology laid down in the next chapter.

## Chapter 4. Methodology

The literature review identifies a set of underpinning criteria for employees' social sustainability. Moreover, the literature aids in demonstrating the suitable techniques such as Hybrid AHP and Fuzzy MOORA that can be adopted to develop a decision support tool for the organization to make strategic decisions to enhance the employees' social sustainability. This chapter, therefore, intends to sketch the methodology that will guide this study to validate, tailor and integrate the findings of the literature to develop a DST to ensure employees' social sustainability in the UAE constructions sector.

### 4.1. Research Design

Several research design models have been reported in the literature that can be adopted as guidance to lay down the methodology of the research. Some of the most widely accepted models are Research design elements by Crotty (1998), the Nested Research model by Kagioglou et. al (2000), and the Ring onion model by Saunders et. al (2003) [163]. Though all these models present an effective way of putting the research methodology; however, this dissertation adopts the principles of Saunders et al. (2009) 'Ring onion' model [164] to design the methodology elements as described in the subsequent sections. Where the beauty of the research onion is that it allows the researchers to work through the methodology layer by layer in an effective way. Where each layer consists of multiple choices that the researchers can select from depending upon the type of research problem [165]. The following subsections will discuss in detail each element and layer of Saunders et. al (2003) 'Ring Onion' model.

### 4.2. Philosophy

Research philosophy is the outermost layer of the 'Ring Onion' model by Saunders et al. (2003). The philosophy refers to the set of beliefs of the researcher for the problem and reality in question as it defines the nature of the knowledge. The philosophy can be presented in three ways as **Ontology** (the study of reality and how it affects society), **Epistemology** (refers to the study of commonly accepted facts and knowledge), and **Axiology** (refers to the study of opinions and their effects on the research). However, to define the research philosophy of the study, these philosophies are linked with different philosophical positions as Ontology is often linked with objectivism,

constructivism, and pragmatism, and Epistemology is linked with positivism, realism, and interpretivism [166].

Therefore, as guided by Saunders et al. (2003) 'Ring Onion' model, the study adopts a *Pragmatism* philosophical position that combines an *Interpretivism approach* that refers to the research of human actions and how they are interpreted by the individuals, is adopted by this study. The approach aids to explore the underpinning criteria that define EMW, social sustainability, the current practices and challenges faced by the industry; and the *Positivism approach* which helps in proving the relationships among the constructs. The study, therefore, gets the benefit of both the approach by using the quantitative and qualitative data to understand the nature of the problem as perceived by both those interviewed and surveyed. However, to address the aim of the study is to develop a decision support tool based on the Hybrid AHP and Fuzzy MOORA method for the organizations to be able to take a strategic decision a pragmatism philosophical position will be adopted.

#### **4.3. Research Approach**

The research approach forms the second layer of the research 'Ring Onion' where Saunders et al. (2003) classify them into two categories as Deductive Approach and Inductive Approach.

However, most researchers define the research approach in terms of the type of data required to address the research question such as *quantitative, qualitative, or a mixed-method approach* [167, 168]. Where qualitative data refers to developing an understanding of the theory and collected data that contributes to building a new theory whereas the quantitative approach is adopted to analyze the cause-effect relationship between the factors. Finally, the mixed-method approach is the triangulation of both kinds of data to address the research question. Similarly, the deductive approach and inductive approach carry the same definition where the *deductive approach* - refers to testing the existing theory by developing the hypothesis, and the *inductive approach* refers to theory building [166].

Therefore, as this study is adopting a Pragmatism philosophical position, thus the related approach adopted by this study will be inductive (to explore the underpinning

criteria of EMW) and deductive approach (to validate the relationship between the construct by adopting the SEM method). The adopted research approach develops the ground for the researcher to lay down their research strategies as shown in Figure 4.1.

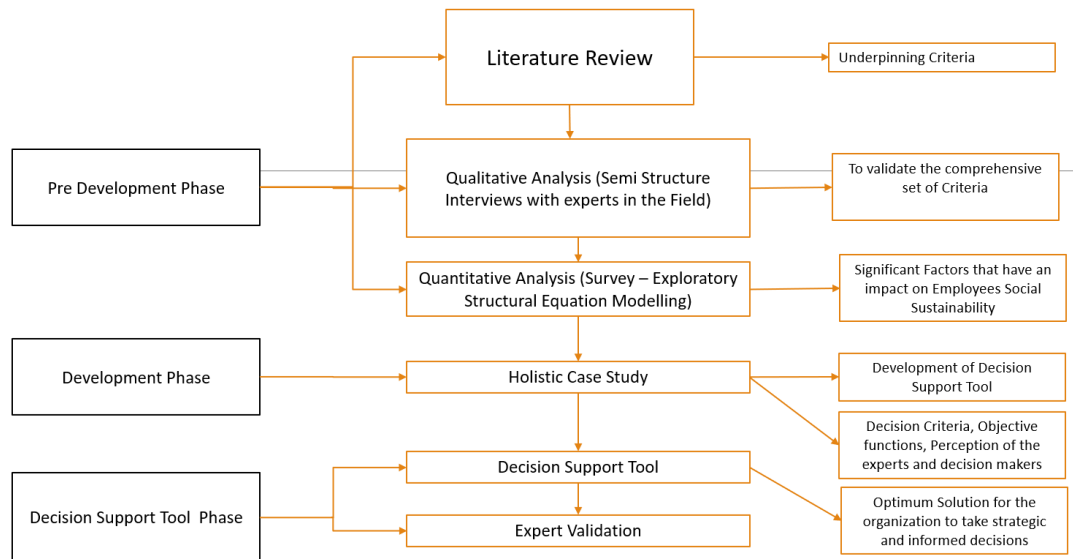


Figure 4-1 Methodological Steps Flowchart. Source: Author

The figure presents the methodological steps that guide setting the methodology research strategy and methods.

#### 4.4. Research Strategy and Method

The research strategy forms the third layer of the research ‘Ring Onion’. This section, therefore, presents the research strategies adopted as guided through the research approach and Figure 23 in the previous section.

As the research aims to identify the set of underpinning criteria that provide a comprehensive definition of employee’s social sustainability to develop a decision support tool; and to propose a conceptual framework based on IoT and Blockchain technologies as a complementary approach to ensure continuous successful implementation of social sustainability in the construction organizations. This study, therefore, adopts a mixed-method approach based on qualitative and quantitative methods.

##### 4.4.1 Qualitative method

Where to address the *Exploratory part* of the research, the study adopts qualitative methods such as literature review, interviews, and case studies as research strategies [165].

Firstly, the ***Literature Review*** aids in developing an understanding of social sustainability, Mental health, and well-being and how the construct and its scales have evolved over the years. Additionally, it aids in exploring the identifying the set of underpinning criteria that define the comprehensiveness of the concept in the industry particularly and the construction sector especially. Moreover, the literature aids in developing an understanding of multi-Criteria decision-making methods and demonstrated the effectiveness and robust nature of Hybrid AHP and F-MOORA as suitable techniques to be used for developing a DST for an organization to take strategic decisions to ensure employees' social sustainability. Finally, to complement the non-dynamic nature of the DST, the literature supports the adoption of technologies such as IoT and Blockchain to ensure continuous successful implementation of employees' social sustainability in the UAE construction sector.

Secondly, ***Semi Structured Interviews*** were conducted to validate and tailor the criteria according to the construction sector that was used to develop the questionnaire survey. Moreover, the interviews aid in understanding the current practices and challenges related to the successful implementation of employees' social sustainability in the industry. Moreover, the interviews aid in identifying the decision criteria that play a significant role in taking strategic decisions.

Thirdly, the ***Case Study*** conducted by targeting private construction organizations aids the research to integrate and validate the decision criteria(identified from the literature and validated through semi-structured interviews) and alternatives (underpinning criteria identified from SEM) to be adopted for the proposed DST based on Hybrid AHP and Fuzzy MOORA technique as a suitable tool that aid the organization to identify the optimal solution by taking into account the effect of their decision criteria (constraints) and objectives to enhance the employee's social sustainability.

Finally, a ***Focus Group*** with WakeCap Technologies and experts from the construction sector was conducted to validate the effectiveness of the adoption of the decision

support tool and the proposed conceptual framework BOTSSM for ensuring social sustainability in the construction sector organization.

The development of the tool was supported by the qualitative and quantitative methods of this study.

#### 4.4.2 Quantitative method

The *Explanatory Analysis* of the research aim was guided by the quantitative or deductive approach by adopting the following research strategies [165]:

Firstly, the *Questionnaire Survey* adopted by targeting the employees from the construction organization aids in identifying the factors/criteria that have a significant relationship and impact on employees' social sustainability by using structural equation modeling. Finally, the significant criteria (alternatives) identified from quantitative analysis and decision criteria identified from the qualitative analysis were integrated to develop a DST based on Hybrid AHP and Fuzzy MOORA to assist the organization to make strategic decisions to enhance the wellbeing of their employees. The research strategies adopted by this study are illustrated in Figure 4.2.

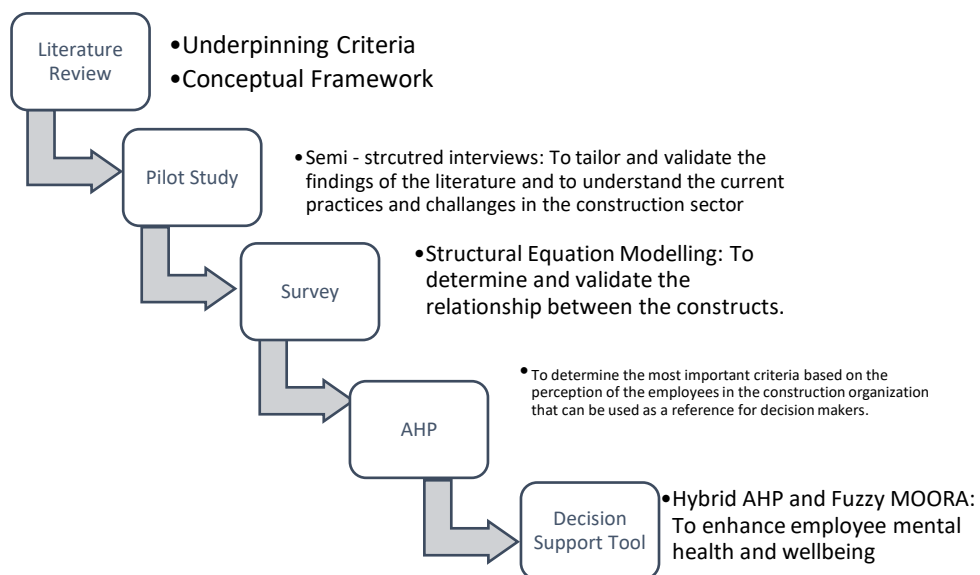


Figure 4-2 Research Strategies. Source: Authors

Moreover, the adoption of the latest technologies such as the integration of Blockchain and IoT for social sustainability management identified from the literature and supported by the interviews aids the research in proposing a conceptual framework that allows the stakeholders and government to monitor and incentivize the organization that works towards ensuring the employees' social sustainability.

Thus, the methodological steps in Figure 4-3 aid the research to develop its methodology and adopting suitable research strategies and methods.

#### 4.5. Time Horizon

The time horizon forms the fourth layer of the research 'Ring Onion'. The research can be either termed a cross-sectional or a longitudinal study. Research investigating a certain problem in a particular period is defined as cross-sectional whereas research investigating a change or development of a problem over a while is known as a longitudinal study [163]. This study will adopt the cross-sectional time horizon due to the limitation of the time frame for the completion of Ph.D. research.

#### 4.6. Data Collection Choices and Methods

The data collection choice and methods form the fifth and sixth layers of the research 'Ring Onion'. The fifth layer refers to the choice of the research as a mono, mixed and multi-method [164]. Thus, to address the aim and purpose of this study, a mixed-method approach and triangulation of qualitative and quantitative data collection methods were adopted by using interviews, questionnaire surveys, and a single Case study as the data collection methods as shown in Table 4.1.

Table 4-1 Data Collection and Methods

Methods	Purpose	Unit of Analysis	Sampling	Number
Semi-Structured Interviews	The main aim of this step is to validate the findings of the literature and tailor the criteria to the construction sector.	UAE Construction sector	Purposive Sampling	10 Interviews
Survey (Questionnaire)	This step aimed to prove the relationship of the underpinning criteria to EMW by using Structural Equation Modelling	UAE Construction sector	Convenience Sampling	306 responses
Case Study	This step aimed to develop and validate the proposed DST based on Hybrid Analytical Hierarchy Process (AHP) and the Fuzzy MOORA technique.	Construction Organization	Purposive Sampling	3 Decision Makers

Expert Validation – Focus Group	Focus Group was conducted with WakeCap Technologies and experts from the construction sector to validate the effectiveness of the adoption of the Decision Support Tool and the proposed Conceptual Framework (BOTSSM) for ensuring social sustainability in the construction sector and organization.	WakeCap technologies and Experts from the UAE construction sector	Purposive Sampling	6 Experts
---------------------------------	--	---	--------------------	-----------

#### 4.7. Validity and Reliability

The quality of any research can be defined by the concepts of Validity and reliability. This subsection will define the validity and reliability test that will be adopted by this study.

**Validity** – refers to the accuracy of the measurement instrument. The literature reposts several types of validity such as *Face validity*, *Content Validity*, *Criterion Validity*, and *Construct Validity*. As the study adopts a mixed-method approach based on qualitative and quantitative data collection and analysis [163]. The type of validity adopted by the study to ensure the accuracy of the measurement instrument will be as follows:

The study adopts *Face Validity* – a simplistic approach that validates the test or the survey at the face value and measures what it claims according to the expert opinions. Therefore, the face validity technique was used to validate the factors deduce from the literature and with the aid of a pilot study i.e., semi-structured interviews and focus groups. In addition, to validate the proposed framework, Expert validation i.e., WakeCap Technologies expert in providing IoT solutions to the construction sector was targeted to validate the proposed framework.

Furthermore, *Content and Criterion Validity* - refers to the extent to which the items on the test measure the construct or how the criteria correlate with one another. This study adopts the content and criterion validity to validate the questionnaire (survey) developed to collect data.

Finally, *Construct Validity* – that measures the extent the instrument observes/measures the construct that cannot be directly observed but is based on people’s behavior. Therefore, this study adopts the construct validity by using

Confirmatory Factor analysis (Structural Equational Modelling) to validate the underpinning criteria that define the EMW.

**Reliability** - defines the consistency of the measurement. Several statistical methods can be adopted to estimate different types of reliability such as Test-retest, Inter-rater, and internal consistency. This study adopts the following reliability methods.

The study adopts **Inter-rater Reliability** to evaluate the responses of experts about the significant factors deduce from literature collected through semi-structured interviews and focus groups. Furthermore, **Internal Consistency** was used to determine the internal consistency of the measurement instrument by using Cronbach's Alpha.

The validity and reliability methods adopted aid to improve the quality and validity of the study and the tool proposed.

#### **4.8. Ethical Approach**

To carry out the research, ethical considerations must be set in place and approval from the AUS Institutional Review Board will be secured before the data collection phase[165].

For primary data collection, the following condition was considered.

- A confidentiality and consent form were given to the participants to ensure no harm or misuse of information.
- Participants in the interviews had no obligation to participate, they were given free consent.
- Interviews and Questionnaires were done at times convenient to the participants.
- Participants were informed about the nature of the research beforehand.

For secondary data collection, the sources and authors were properly acknowledged and well referenced. This was done to ensure the validity and reliability of the collection of data, interpretation, and analysis of it is done.

#### **4.9. Conclusion**

The chapter has helped to define and justify the research methodology that was used to achieve the aim and objective of the research. The chapter acts as a guideline for the research to proceed with the data collection and analysis stage.

## **Chapter 5. Data Collection and Analysis**

This chapter presents the findings of the mixed-method approach by adopting qualitative analysis to identify the underpinning criteria of employees' social sustainability through literature review, validated by adopting semi-structured interviews with experts in the construction industry. Furthermore, the chapter presents findings of quantitative analysis which include survey development that paves way for identifying significant criteria that have an impact on employee mental health and wellbeing by adopting SEM which will be adopted to develop the decision support tool for the organization to take informed and strategic decision.

### **5.1. Qualitative Analysis**

This section describes the results of the qualitative analysis by adopting the semi-structured interviews conducted with 10 experts in the construction sector to validate and tailor the findings of the literature in terms of the construction sector. Moreover, the interviews aid to determine the current practices and challenges in the implementation of policies to enhance the social sustainability of employees.

#### **5.1.1 Semi structure interviews**

Following the COVID 19 protocols, the interviewees were targeted based on purposive sampling by using social media platforms such as LinkedIn. They were sent an official invite and consent form to take part in the interview process. Upon their acceptance and consent for the interviews. The interviewees were sent Google Meet links for the suitable time they mentioned. The semi-structured interview questions were divided into five sections (a copy of which is presented in Appendix A). The set of questions in Section I intends to inquire about the interviewees' profiles and backgrounds. Section II asked the participants about their organizational profiles. Section III was intended to determine their role, responsibility, and the experience they have gained as an expert. Where Section IV focuses on determining their knowledge of social sustainability, current practices, and challenges they faced in its implementation. Finally, Section V aimed to present the list of underpinning criteria of employee mental health and wellbeing identified from literature to the interviewees to gain their insights for validating and tailoring the criteria to the construction sector. At the beginning of the interview, the participants were explained the confidentiality requirements and area of

research. The interviewees in Sections I and II discussed their profiles and role in the construction organization.

**Profile of Interviewees** - A set of 10 interviews were conducted with participants having experience as Head of HR Department, CFO (Chief Financial Officer), and General Manager with experience ranging from 5 to 32 years in the construction sector as shown in Table 5.1.

Table 5-1 Participant’s Profile

Code	Title	Years of Experience
P1	Chief Financial Officer (CFO)	24
P2	Director of National Capabilities	20
P3	Head of HR Department	20
P4	Head of HR Department	13
P5	Head of HR Department	19
P6	Head of Quality and Materials Management	15
P7	General Manager	21
P8	HR Executive	5
P9	Regional CHO	32
P10	Senior Group Human Resources Manager	15

Furthermore, the participants were asked about their organization and ***do their organization has an Occupational Health/Organizational Health department?***

All the interviewees responded positively to the question where participant 3 highlighted that *“Though we don’t have dedicated Health dept, we have a program, call it Mariah. It’s for coaching and the purpose is to.... make good health for the employees or to solve the problems.”*

Moreover, one asked the interviewees ***What services your organization offers as part of social sustainability?*** The response of all the participants was similar where they highlighted the common practices of offering medical insurance and wellness program. As evident from the response of interviewee P1 stated *“We take care of the health of each one we are giving medical insurance to families also. So, all the colleagues are comfortable, they are not worried about their families. Also, whenever they are sick. We pushed them to take kids or family, wife, to hospital..... As only happy people can be a good employee”*. Moreover, Interviewee P9 also stressed the benefits of organization services by saying *“Yeah, we do have only medical insurance and we try to organize sports league to tune and so we the team can participate and take care of their health. This all is offered to maintain employee relations.”*

Thus, it may be interpreted here that organizational support plays an important role in social sustainability and EMW.

Moreover, to gain insight from their experience, the interviewees were asked: ***What has been the most difficult challenge you have faced in your entire experience as a Supervisor/HR manager?*** The interviewees highlighted several challenges they have faced. As discussed by interviewee P4 *“I think probably the most difficult challenge is that sometimes...well often you must be nimble. It’s a diverse environment and you don’t always get to see a lot of long-range plans and you must be nimble and able to react quickly.”* Moreover, Interviewee P8 also highlighted *“Being in HR and being in the construction industry, I would say that change management... Anywhere when you try to bring the change so that’s very difficult for us.”*

The construction sector especially in UAE comprises a diverse workforce and the sector itself is dynamic. Thus, from the view of interviewees, the major challenge is changing management and the response to the dynamic nature must be quick.

Furthermore, to understand their knowledge of mental health and experience with the concept. The interviewees were asked ***if they have experienced issues of mental health and wellbeing during their professional career and what are the current practices their organization adopts for the social sustainability of employees.*** All the participants agreed that though they came across such cases, however, there has been a fear in employees to share such information with their employer that ultimately harms the employee health. As highlighted by P8 who stressed that *“Almost all of my career, the organizations I have worked had a closed environment. So, you know people would not approach you for their problems or the issues that they probably would be facing personally, or professionally, so I have not come across any such case. You know mental health... we used to have training for them. We used to have sessions or seminars. You know actually to deal with these issues. There used to be regular updates and everything. We used to have training for them because you know mental safety is very important in our industry. if they're not mentally satisfied anymore, it's very difficult for them to perform their job. so, for them by rules, we had to plan their CRM, so they take a training program which they have to undergo for yearly renewal.”* The same was supported by Interviewee P1 who said *“Like two to three people can express these things, not all our so much expressive to talk about their personality, but I know*

*I can observe also because I'm from this team like social. Social issues I know even I know the melting issues also even sometimes I'm able to understand so I am sometimes self-initiated. I understand and I talk to people. Otherwise, people come even though I know some of the psychiatrists here. I immediately refer to those psychiatrists also and people take advice and feel comfortable.”*

Thus, to conclude the findings of the interviews are similar to the literature review that reports that employees are afraid to share the issues related to mental health and wellbeing. Thus, it is the organization's responsibility to ensure employees' social sustainability.

Furthermore, to understand the gap and issues of successful implementation of social sustainability in construction. The interviewees were asked *their opinion, what are the challenges and enablers of social sustainability in the industry.*

From the responses, a lot of similarities were found, where the major issue highlighted was *lack of Budget, Organizational culture for acceptance, conflict with organization vision, Risk, and Return of investment.* As can be seen from the response by Interviewee P3 that states “*Well, no doubt the budget is the 1st. We don't have a lot of budgets for Training courses and everything*”. Moreover, Interviewee P4 agreed by saying “*I think probably you know one of the challenges we face is that it is resources.... We have a very diverse population that we serve in several areas, so it's not just the...The dependence of the staff and so we cover a broad range of clientele, and you know, the people that we Bring to serve that population.... They may not always have the necessary expertise that you know that may be needed with such a diverse population, so I would say, yeah, one of the challenges is when you have such a diverse population is being able to match it up with a diversity of resources that's appropriate for the challenges*”. Where P8 and P6 had similar responses that highlighted change management and acceptance of organizational culture. Interviewee P7 highlighted the lack of risk-taking due to fear of budget limitation and change management.

Thus, to summarise the findings of the interviewees regarding the challenges faced for the successful implementation of social sustainability. The study uses an online Word Cloud generator to identify the challenges discussed by the interviewees as shown in Fig 5.1.



Figure 5-1 Interview Response Word Cloud. Source: Author

The word cloud generated shows words with the highest frequency of adoption by interviewing during their discussion. Where, as can be seen, the words in large size such as monitoring, budget, organization, employees, health insurance, social sustainability, ROI, and Budget are bigger. This shows the interviewees emphasized these terms during their discussion.

Moreover, to explore the current practices of social sustainability by government and organization. The interviewees were first asked *What are the initiatives and policies (if any) by the government that commits your organization to social sustainability?*

All the interviewees agreed that though there are policies by the Ministry of Labour such as WPS, Health insurance, fixed hours per week, and annual leaves that the organization must be obliged to; however, often there are reports on the organizations that have been misusing and manipulating the timesheets, WPS system. Thus, they highlighted the biggest issue is the *'Lack of Monitoring'* and proposed that the need for the industry is to have a monitoring framework available that allows the Ministry of Labour to ensure the organizations follow their CSR and works toward the social sustainability of its employees; and incentivize to the organization that fulfils their responsibilities. The findings can be seen from the response of interviewee P2

*“Actually, the law is existing there in UAE also, but the implementation and the justification is a separate thing.... MOHRE has started to educate the labours about the basic laws and their rights.... but the gap which I feel is that with between that system and MOHRE, I don't know whether it is interconnected or not connected that should be connected that once the employee arrives within UAE, he should be entitled to monitoring his time and attendance.....there should be a system..... So, there should be a monitoring system by the government.”* In addition, interviewee P4 stated *“Well, there I mean, I think that the government certainly sets what is the floor of what we, you know at least how we offer it. Making sure that people are qualified for their positions and so forth, and then what we offer... I don't know that there is a lot. Intervention, monitoring, or prescription.... You know, concerning the government, I think we have a lot of flexibility in what we can offer overall and so we wouldn't find you know anything presently that the government has asked us to do that would serve as an impediment to what we want to do.”*

Thus, it can be concluded here that the government has policies in place for social sustainability. However, there lacks monitoring to ensure the successful implementation of social sustainability.

Finally, to understand the role of an organization for social sustainability, the interviewees were asked ***Does your organization considers ‘Social Sustainability’ factors in its five-year plan and budget planning? If yes, then, how?***

All the interviewees stated that they indeed consider social sustainability as an important factor but still it’s a long way to integrate social sustainability as an integral part of planning due to risk, organizational culture to change management, lack of resources and budget, and non-economic statistics of return on investment.

The interview responses align with the findings of the literature review that discuss the decision criteria and constraints faced by the organization for the successful implementation of social sustainability. In addition, from the interviews, the major relevant keywords generated were shown in Table 5.2.

Table 5-2 Relevant Keywords

Keywords	Relevance
Monitoring	0.866
Employees	0.866
Budget	0.766
Social sustainability	0.998
Mental health	0.770
Organizational culture	0.666
Building loyalty	0.670
Kind of conflict	0.609

It can be seen from the table that the most relevant words deduced from the interviews were *social sustainability, employees, budget planning, mental health, and monitoring*. Where relevance shows the frequency of adoption of these keywords by the interviewees in their responses. Where the highest is social sustainability at 0.999.

Finally, the interviewees have presented the list of underpinning criteria for employees' social sustainability identified from the literature. They were asked to choose the criteria that they perceived to be relevant to the mental health and social sustainability of the employees.

**Face/Content Validity** – this section of the interview asked about the perception of the interviewees as experts regarding the validity of the criteria of employees' social sustainability found in the literature. It calculates the content validity of the findings to proceed further with the survey development.

To validate the criteria from the literature the experts were asked to choose the criteria they perceive to be relevant to the social sustainability, mental health, and well-being of employees from their experience. The results were then used to determine the content validity of these criteria by using the equation below as shown in Table X.

$$CVR = \frac{n_e - \frac{N}{2}}{\frac{N}{2}}$$

Where,  $n_e$  is the number of experts rating the criteria as relevant and N is the total number of experts which in our case was 10. Content validity of 0.5 and above was set as a threshold value to be included for further analysis. The interviewees who selected the criteria as relevant for social sustainability in the construction sector were given value 1, where 0 shows the interviewee who perceived the criteria to be non-relevant. The content validity is thus calculated by adopting the equation where all those

underpinning criteria of EMW under 0.5 were removed from the analysis as shown in Table 5.3.

Table 5-3 Content Validity

Criteria	P1	P2	P3	P4	P5	P6	P7	P8	P9	P10	Sum	CVR
Personality Type (introvert, Extrovert)	1	0	1	1	1	0	1	1	1	1	8	0.6
Marital Status (Married, Single, Divorced, Widowed)	1	0	0	1	1	0	0	1	0	1	5	0
Family Type	1	0	1	1	1	1	0	1	0	1	7	0.4
Organization Structure	1	0	1	1	1	1	1	1	1	1	9	0.8
Management involvement and awareness	1	1	1	1	1	1	1	1	1	1	10	1
Flexible or Fixed work systems	1	1	1	0	1	1	0	1	1	1	8	0.6
Work Design (Job control) – How much control they have over project, team, resources, and time selection	1	1	1	1	1	1	0	1	1	1	9	0.8
Person - Job fit (the job meets the goals and skills set of the employee)	1	0	1	1	1	1	1	1	1	1	9	0.8
Timely Payment of Salaries	1	1	1	1	1	1	0	1	1	1	9	0.8
Role ambiguity/ Role clarity	1	0	1	1	1	1	1	1	1	0	8	0.6
Role Conflict – Working different roles that requires different outcome	1	0	1	1	1	1	1	1	1	1	9	0.8
Training and Development	1	1	1	1	1	1	1	1	1	1	10	1
Salary Satisfaction	1	1	0	1	1	1	1	1	1	1	9	0.8
Self-Efficacy	1	0	1	0	1	1	1	1	1	0	7	0.4
Work motivation	1	1	1	1	1	1	0	1	1	1	9	0.8
Burnout - How the job made them feel in the past few weeks	1	0	1	1	1	1	1	1	1	1	9	0.8
Emotional Exhaustion	1	0	1	1	1	1	1	1	1	1	9	0.8
Personal accomplishment/ Depersonalize	1	1	1	1	1	1	1	1	1	0	9	0.8
Sleep Quality	1	1	0	1	1	1	0	1	1	1	7	0.6
Contract Type	1	1	1	1	1	1	0	1	1	0	8	0.6
Work-Life balance	1	1	1	1	1	1	0	1	1	1	9	0.8
Spousal support	0	1	1	1	1	1	1	1	0	1	8	0.6
Job demand - Physical and psychological demand of the job	1	0	1	1	1	1	0	1	1	1	8	0.6
Social support	1	1	1	1	1	1	1	1	0	1	9	0.8
Association with supervision/ Employee perception of supervisor's/ Leadership Style/ Competencies of supervisors	1	1	1	1	1	1	1	1	1	1	10	1
Self-Organizational Commitment	1	1	0	1	1	1	0	1	1	1	8	0.6
Organizational Culture	1	1	1	1	1	1	1	1	1	1	10	1
Working environment and condition (Lighting, Noise, Colour, and Air Quality)	1	1	1	1	1	1	1	1	1	1	10	1
Work stress/ Workload	1	0	1	1	1	1	0	1	1	1	8	0.6
Job Security/Safety	1	0	1	1	1	1	1	1	1	1	9	0.8
Pay Equity	1	0	0	1	1	1	1	1	1	1	8	0.6
Gender Equality	1	1	1	1	1	1	1	1	1	1	10	1

It can be therefore concluded from the table that most of the criteria found in the literature were perceived to be relevant by the experts. Moreover, the *interviewees were asked to tailor the criteria to the construction sector*, where all the interviewees agreed that the criteria presented are suitable for the construction sector and suggested merging

a few of the criteria such as Self-Efficacy (Personal accomplishment/ Depersonalize) and Burnout/ Emotional Exhaustion. Thus, the criteria with content validity of 0.5 and above were further used for the survey development.

Thus, the main findings from the interviews were challenges (decision criteria) such as *lack of budget or cost of improvement, organizational culture for acceptance (compatibility with organization culture), conflict with organization vision (degree of difficulty), risk associated and return of investment* that the organization faces while taking decision. Which can be adopted as part of developing the decision support tool. In addition, the interviews aid the study by validating and tailoring the criteria of EMW that were adopted for the survey development and to develop DST.

## **5.2. Quantitative Analysis**

This section discusses the findings of the quantitative analysis with the aid of surveys by adopting SEM to determine the significant criteria of employee's social sustainability in the targeted audience i.e., employees in the construction sector. This allows the study to develop the decision support tool by integrating the significant criteria of employees' social sustainability for the development of DST that can aid organizations to intake strategic and informed decisions to ensure employees' social sustainability.

### **5.2.1 Survey development**

The survey aimed to identify the factors that have an impact on the employee's social sustainability in organizations in the UAE. A ten-minute survey was designed using *Google Forms* and distributed online to a wide range of participants from the construction sector by adopting social media websites such as LinkedIn and WhatsApp in the UAE using snowballing and convenience sampling. The online survey comprises a consent form approved by the Institutional review board (IRB) of the American University of Sharjah (AUS) that allow the participants to withdraw their participation at any time without any liability.

The survey (as presented in Appendix A) was divided into three sections: *Section I* was about the participant's profile that ask about the participant's background relevant to the subject such as position, the total number of experiences, marital status, and contract type, and income. *Section II* asks the participants to rank their satisfaction, social

sustainability, mental health, and wellbeing on a 5 Level Likert scale that accounts for their social sustainability in the organization. Followed by *Section III* which asks the participants to rank their level of agreement on 27 criteria of social sustainability by using a 5-level Likert scale.

The 27 criteria are further divided into indicators/items that aim to determine the participant level of agreement with the impact of criteria on their social sustainability by removing any bias as shown in Table 5.4. In addition, the survey question was arranged in a positive tone to allow the participant to respond without any prejudice towards the organization.

Table 5-4 Criteria and indicators for employee’s social sustainability. Source: Authors

Dimensions	Indicators/Items	Label
Organization Structure	Choose the statement that defines the structure of your organization.	OS1
	Choose the statement that defines the 'Managerial Style' of your organization	OS2
	Choose the statement that defines the 'Environment' of your organization	OS3
Management involvement and awareness	The management is often involved and aware of any changes/activities going on in the organization at the functional level (employer level)	MI1
	The management often intervenes to promote Social Sustainability (employee health and wellbeing).	MI2
	The management address any issues the employee is facing.	MI3
Flexible or Fixed work systems	My supervisor seeks my opinions while planning my shifts/work schedules.	FW1
	I am allowed to reschedule my tasks, meetings, and other work-related involvements.	FW2
	Work requirements are not rigid, and flexibility is displayed to accommodate the requests.	FW3
Work Design (Job control)	I have full control over my project selection	WD1
	I have full control over my over setting the timeline and milestones of your project.	WD2
	I have full control over selecting the team and resources for your project.	WD3
Person - Job fit	All things considered, this job suits me, and it is what I like to do.	JF1
	I feel that my needs and goals are met in this job.	JF2
	I can use my skills, knowledge, and competencies in this job.	JF3
Timely Payment of Salaries	My organization pays me in a timely manner	TP1
	Overtime payments are given as per policy and in a timely manner.	TP2
	Benefits and bonuses are given as per the policy	TP3
Role ambiguity/ Role clarity	I have clear and well-defined goals and objectives for my job	RA1
	I feel certain how much authority I have on the job	RA2
	Job description and explanation is clear what has to be done.	RA3
Role Conflict	I must do things that should be done differently under different situation.	RC1
	I work with two or more group who operates differently.	RC2
	I do things that apt to be accepted by one person and not the others.	RC3
Training and Development	My Organisation ensures possibilities for employees to develop professional competences	TD1
	My Organisation constantly encourages the employees to enhance their competences to meet the changing market	TD2
	My Organisation develop and train employees’ personal competencies such as leadership skills, communication skills etc.	TD3
Salary Satisfaction	I am satisfied with my salary in terms of the market.	SS1
	I am satisfied with the benefits provided to me by my organization in comparison to the others in the market.	SS2
	My organization increases pay to depend upon the economic conditions such as inflation or induction of VAT or addition of job demand.	SS3

Self-Efficacy (Personal accomplishment/ Depersonalize)	I can always manage to solve the difficult problem If I try hard enough by remaining calm.	SE1
	It is easy for me to stick to my aims and accomplish my goals.	SE2
	I feel satisfied with how I perform and with my accomplishments.	SE3
Work motivation	How would you describe your type of motivation for your work and organization?	WM1
	My organization ensures the employees are well motivated.	WM2
Burnout/ Emotional Exhaustion	I do not feel burnout or fatigue due to my job at the end of the week	B1
	I generally feel Relaxed and optimistic	B2
	I do not feel emotionally drained due to my job at the end of the week.	B3
Sleep Quality	How would you rate your sleep quality?	SQ1
	During the past month how long, has it taken you to fall asleep?	SQ2
	Sleep Duration	SQ3
Contract Type	I am satisfied with the contract I have with my organization	CT1
	My contract type does not affect my performance	CT2
	My contract type does not affect my commitment and loyalty to my organization.	CT3
Work-Life balance	My job does not harm my family and social life.	WLB1
	My job does not require me to think about the work requirements while I am at home.	WLB2
	I can balance both work and family requirements successfully.	WLB3
Spousal support	My family members understand my work pressure and offer support while I work on my office work from home.	S1
	Members of my family or spouse always seem to make time for me if I need to discuss my stress about work	S2
	If my job gets very demanding, someone in my family or my spouse will take on extra household responsibilities and childcare.	S3
Job demand	My job is not Physically very demanding	JD1
	My job is not Psychologically very demanding	JD2
	I don't feel burden due to the requirements of my job.	JD3
Social support	My supervisor has my back and support me in any way possible.	SO1
	My colleagues have my back and support me in any way possible.	SO2
	My organization values my contribution and appreciate any extra effort from me.	SO3
Association with supervision/ Employee perception of supervisor/s/ Leadership Style/ Competencies of supervisors	Morale building: My supervisor behaves in ways that gain respect, trust, and confidence of others and transmit a strong sense of mission to them.	AS1
	Inspirational motivation: My supervisor provides meaning and challenge to others' work, communicate a vision with fluency and confidence, increase others' optimism and enthusiasm, and give pep talks to energise others.	AS2
	Individualized consideration: My supervisor pays special attention to each individual's needs and abilities for achievement and growth by acting as coach or mentor and make each individual feel valued.	AS3
Self-Organizational Commitment	I am emotionally attached to this institution and have no intentions to switch over to another organization at the moment.	SOC1
	I recommend this institution to my friends and all other prospective aspirants.	SOC2
	My continuance with this organization is not based on my current necessities and needs only.	SOC3
Organizational Culture	My organization culture values diversity.	C1
	Bullying/Harassment/Discrimination are not welcomed in my organization	C2
	Social Cohesion - sense of belonging is common in my organization.	C3
Working environment and condition (Lighting, Noise, Colour, and Air Quality)	There is sufficient green space (e.g., trees/plants) in my organization	WE1
	Perceived air pollution - My organization ensures clean air.	WE2
	Perceived noise - My organization ensures noise level are maintained to increase productivity	WE3
Work stress/ Workload	My manager ensures employees are given appropriate amount of work that don't puts them under a lot of stress/pressure?.	WW1
	My supervisor assigns me task after discussing with me the workload I have?	WW2
	My manager ensures I am not given more workload than my job description?	WW3
Job Security/Safety	My Organisation provides the necessary working equipment for the employees and ensures the workplaces fulfil all the safety requirements	JSS1
	My organization environment gives me a feeling of safety and security and I feel satisfied with the future prospects within the organizations are good	JSS2

	My organization ensure market condition such as inflation or COVID pandemic does not affect the employees' job and morale by taking strategic measures.	JSS3
Pay Equity	I am paid equally in comparison to others holding similar jobs in the organization.	PE1
	I am paid equally in comparison to others with similar skills in the market.	PE2
	I am given similar incentives and benefits in comparison to others with similar skills in the market.	PE3
Gender Equality	My Organisation ensures equal personal development opportunities for employees without any gender bias.	GE1
	My Organisation ensures equal opportunities for all candidates during the selection process without any gender bias.	GE2
	My Organisation ensures equal benefits for all candidates during the selection process without any gender bias.	GE3

### 5.2.2 Demographic profile

The survey intended to target employees working in the construction sector including blue- and white-collar employees. The assumption behind the selection of participants was the dynamic nature of the sector that has an impact on the mental health and social sustainability of employees working in the construction sector. A sample of 339 responses was collected from which 306 responses were retained after removing missing values and outliers from the sample data. The demographic profile of the 306 participants was summarized and tabulated in Table 5.5.

Table 5-5 Demographic Profile. Source: Authors

Demographic characteristics		%
Gender	Female	43.8
	Male	56.2
Position	Entry Level	21.1
	Mid-level	24.6
	Senior Level	32.3
	Managerial Position	22
Years of experience	1 – 5	13.7
	5 -10	30.06
	10- 15	26.1
	15 and above	30.0
Education Level	Diploma/ High School	13.7
	Graduate	42.5
	Postgraduate	37.4
	Doctoral	6.4
Marital Status	Single	40.9
	Married	56.9
	Divorced	1.3
	Widowed	01
Self-Income	2,000 – 4,999 AED	30.4
	5,000 – 9,999 AED	17.3
	10,000 – 14,999 AED	13.4
	15,000 – 19,999 AED	7.7
	20,000 - 24,999 AED	9.3
	24,999 and above	22
Contract Type	Open-ended contract (Permanent)	52.1
	Limited-duration contract	24.6
	Contract to perform a specified task.	18.5

	No formal employment contract	4.8
Working Style	Shift system	14.4
	Fixed hours	57.5
	Flexible timings	18.8
	Work from home (Flexible option)	9.3
Sleep Duration	>7 hours	19.4
	6-7 hours	42.3
	5-6 hours	28.1
	<5 hours	10.3

It can be seen from the table that the data represents mostly the employees working at the middle to senior level at the site and office space in the construction sector. The sample data mostly captures the workers having a supervisory role, line managers, and onsite and off-site office employees due to the limitation caused by COVID 19 pandemic. Though an equal distribution of population on the demographic criteria such as gender, position, years of experience, education level, income, etc without any extreme skewness was found

In addition, the participants were asked to rank their satisfaction and subjective well-being (mental health) on a scale from 1 (Extremely Dissatisfied) to 5 (Extremely Satisfied) as shown in Figure 5.2.

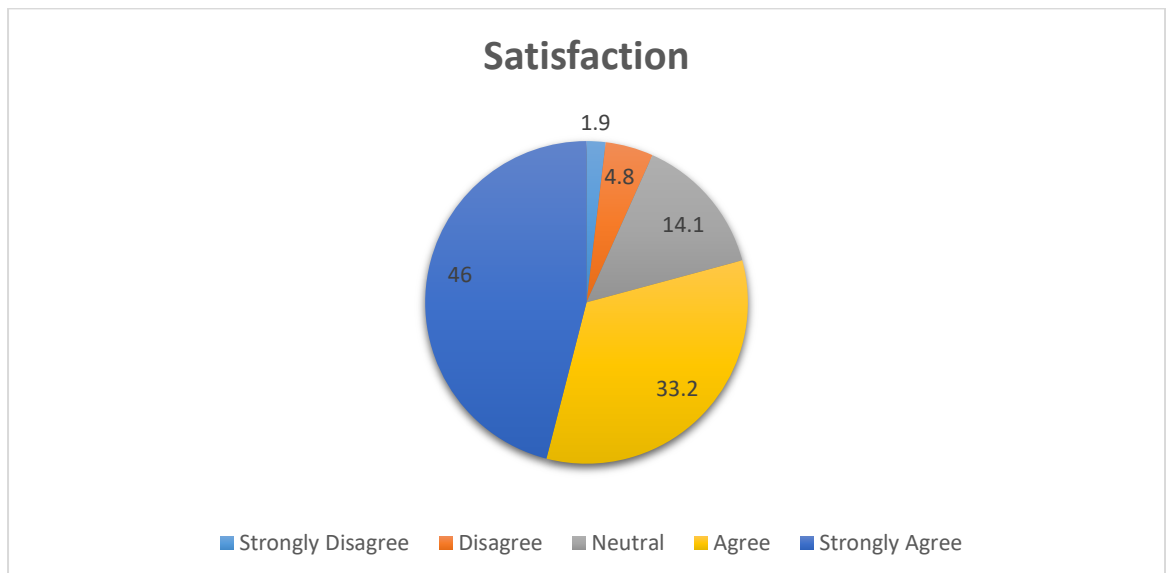


Figure 5-2 Level of Satisfaction in employees. Source: Authors

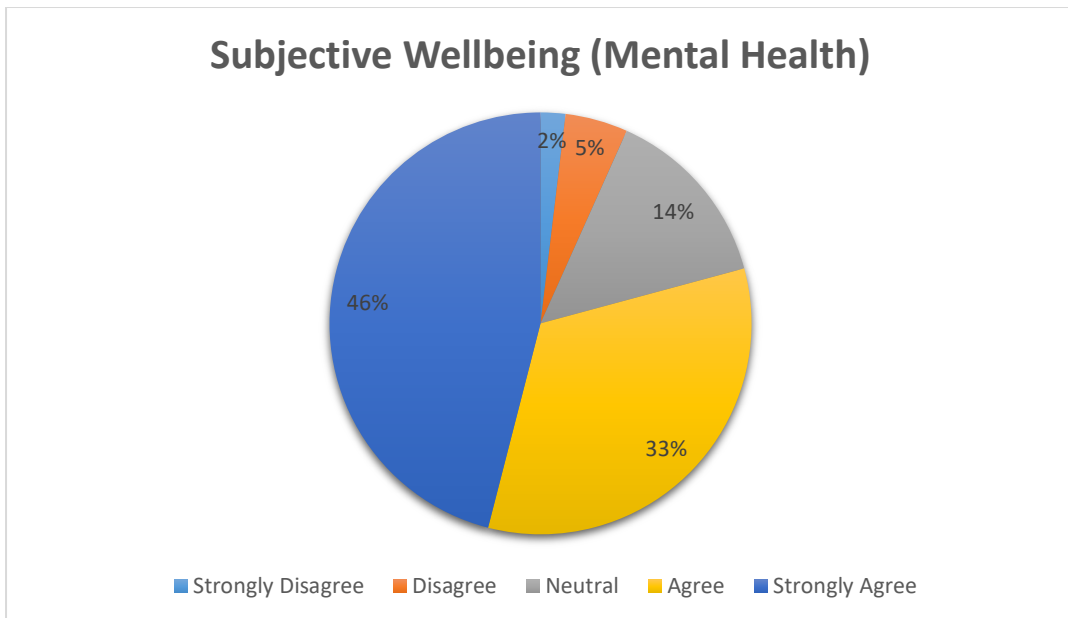


Figure 5-3 Self-evaluation of Subjective Wellbeing. Source: Authors

The findings from Figures 5.2 and 5.3 suggest that most of the participants were satisfied with their job and organization and self-evaluated their subjective well-being as ‘Good’. Thus, this study aims to determine the criteria that have an impact on the satisfaction and subjective wellbeing (social sustainability and EMW) of employees in construction sector organizations, therefore ensuring their social sustainability in the organization. For this purpose, this study adopts SEM due to non-ignorable cross-loadings between the criteria.

### 5.2.3 Structural equation modelling

This sub-section presents the results of the Exploratory Factor analysis (EFA) and SEM approach conducted on the data collected through the survey. The combination of both techniques aids this study to identifies the criteria that have an impact on satisfaction, mental health, and wellbeing of employees thus ensuring their social sustainability in the organization.

Exploratory structural equation modeling (ESEM) is an alternative approach that creates synergy and adopts the advantage of both techniques such as the traditional EFA which aids in identifying the realistic presentation and structure of the data in terms of the factor loading, and CFA to evaluate and validate the measurement model. The approach is recommended by several authors such as [169] when the criteria under analysis have non-ignorable cross-factor loadings as shown in Figure 5.4 below.

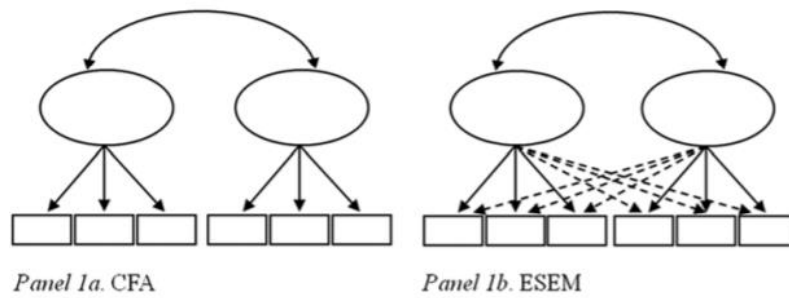


Figure 5-4 Diff b/w CFA and ESEM. Source: [169]

The sub-section comprises two parts that include the findings of exploratory factor analysis conducted to determine the structure of the criteria, followed by validating the measurement model.

Firstly, to identify the appropriateness of data collected for factor analysis; the study focuses on two determinants such as sample size and Kaiser-Meyer-Olkin (KMO) and Bartlett's Sphericity Test as suggested by [170]. Where according to [171] the sample size must be 100 or greater, which the study fulfils the requirements of sample size. Furthermore, Table 5.6 shows the Kaiser-Meyer-Olkin (KMO) and Bartlett's Sphericity Test results.

Table 5-6 KMO and Bartlett's Test. Source: Authors

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.943
Bartlett's Test of Sphericity	Approx. Chi-Square	17414.093
	df	2926
	Sig.	.000

The results indicated a perfectly adequate KMO sampling of 0.943 which is greater than the minimum acceptance value of 0.5 as suggested by [172]. In addition, the Bartlett's test is significant (chi-square with degree of freedom (df) 2926= 17414.093 with a significance value = 0.000). These findings present a reasonable basis for proceeding to the next stage as it indicates that the data is suitable for factor analysis and dimension reduction.

**a. Exploratory factor analysis**

This section presents the findings of dimension reduction and identifies the relationship between the social sustainability criteria to interpret factors that have an impact on satisfaction, mental health, and wellbeing of the employees thus ensuring their social sustainability. The exploratory factor analysis was conducted with Principal

Component Analysis (PCA) used as an extraction method with Varimax rotation. The factor loading of 0.50 was set as a threshold value, thus the criteria with a lower factor loading than 0.5 were removed from the analysis. The analysis thus aids in reducing the social sustainability criteria into 11 factors as shown in Table 5.7.

Table 5-7 Exploratory Factor analysis

Factors	Initial Eigenvalues			Rotation Sums of Squared Loadings		
	Total	% Of Variance	Cumulative %	Total	% Of Variance	Cumulative %
1	18.959	37.174	37.174	5.561	10.904	10.904
2	2.890	5.667	42.842	5.182	10.161	21.064
3	2.591	5.079	47.921	4.476	8.777	29.841
4	1.959	3.841	51.762	4.254	8.342	38.183
5	1.808	3.546	55.308	2.953	5.790	43.973
6	1.741	3.413	58.721	2.719	5.332	49.306
7	1.425	2.794	61.515	2.516	4.933	54.239
8	1.272	2.495	64.010	2.445	4.793	59.032
9	1.205	2.363	66.372	2.378	4.662	63.694
10	1.177	2.308	68.681	2.296	4.503	68.197
11	1.053	2.065	70.746	1.300	2.549	70.746
12	.898	1.760	72.506			
13	.814	1.596	74.102			
14	.767	1.503	75.605			

As can be seen from Table 5.8 the criteria can be interpreted using 11 factors that explain about 70.746 percent of the variance for the data. The study interpreted those 11 factors as follows.

Table 5-8 Factor Interpreted. Source: Author

Factors Interpretation	Criteria	Component										
		1	2	3	4	5	6	7	8	9	10	11
<b>Organizational Support</b>	AS1	.744										
	AS3	.718										
	SC1	.696										
	AS2	.683										
	SC2	.659										
	SC3	.637										
	WW2	.552										
	WW3	.550										
<b>Work Life Balance</b>	WW1	.549										
	WLB3		.706									
	JD3		.689									
	B3		.688									
	WLB1		.653									
	SQ1		.644									
	WLB2		.636									
	B2		.632									

	B1	.617			
<b>Equity Factor</b>	SS1	.753			
	PE2	.689			
	SS3	.682			
	PE3	.674			
	SS2	.656			
	PE1	.591			
<b>Work Control</b>	CT1	.517			
	WD2	.747			
	FW2	.717			
	WD1	.709			
	WD3	.706			
	FW1	.681			
<b>Gender Equality</b>	FW3	.666			
	GE1		.799		
	GE2		.783		
<b>Work Environment</b>	GE3		.750		
	WE2		.795		
	WE1		.726		
<b>Spousal Support</b>	WE3		.673		
	SO1			.804	
	SO2			.794	
<b>Training and Development</b>	SO3			.789	
	TD3			.755	
	TD1			.725	
<b>Contract Type</b>	TD2			.669	
	CT3			.681	
	CT2			.600	
<b>Role Conflict</b>	MI1			.573	
	TP1			.530	
	RC3				.774
<b>Job Demand</b>	RC1				.754
	RC2				.728
	JD1				.907
	JD2				.518

The factors identified from the exploratory factor analysis are interpreted as organizational and social factors that have an impact on employees' social sustainability in the organization. Whereas personal factors were removed from the analysis as they were not perceived as important by the employees to impact their satisfaction, mental health, and wellbeing in the organization.

Finally, the analysis aids in the measurement of the data validation on each dimension to calculate the validity and reliability of the collected data, to determine the goodness of fit of the model, and the path analysis.

#### **b. Validation of Measurement Model**

This section presents the goodness of fit for the model as shown in Table 5.9. However, to reach acceptable goodness of fit, modification has been carried out in the SEM model thus removing factors not suitable such as Role Conflict, Spousal Support, Job demand, and Gender equality was removed.

Table 5-9 Goodness of Fit. Source: Author

<b>Fit Summary</b>		
Absolute Index	Chi-Square	2328.1808
	Pr > Chi-Square	<.0001
	Standardized RMR (SRMR)	0.0547
	Goodness of Fit Index (GFI)	0.7350
Parsimony Index	Adjusted GFI (AGFI)	0.6946
	RMSEA Estimate	0.0711
Incremental Index	Bentler Comparative Fit Index	0.8510

After the modifications, the analysis conducted was able to achieve an acceptable goodness of fit values with standardized root mean square error (SRMSR) = 0.0547, goodness of fit index (GFI) = 0.7350, the adjusted goodness of fit index (AGFI) = 0.6946 and Bentler comparative fit index (CFI) = 0.8510. In addition, the result of fit in terms of indicators and constructs is shown in Table 5.10.

Table 5-10 SEM Path List

Path		Estimate	Standard Error	Pr >  t	
OS_Factor	====>	AS1	0.83350	0.01924	<.0001
OS_Factor	====>	AS3	0.84275	0.01837	<.0001
OS_Factor	====>	SC1	0.80169	0.02215	<.0001
OS_Factor	====>	AS2	0.81336	0.02110	<.0001
OS_Factor	====>	SC2	0.64379	0.03509	<.0001
OS_Factor	====>	SC3	0.77830	0.02424	<.0001
OS_Factor	====>	WW1	0.80149	0.02217	<.0001
OS_Factor	====>	WW2	0.79960	0.02234	<.0001
OS_Factor	====>	WW3	0.79513	0.02274	<.0001
WLB_Factor	====>	WLB1	0.78088	0.02531	<.0001
WLB_Factor	====>	WLB2	0.61665	0.03810	<.0001
WLB_Factor	====>	WLB3	0.72671	0.02981	<.0001
WLB_Factor	====>	B1	0.73839	0.02886	<.0001
WLB_Factor	====>	B2	0.76235	0.02688	<.0001
WLB_Factor	====>	B3	0.78794	0.02470	<.0001
WLB_Factor	====>	SQ1	0.63972	0.03647	<.0001
Equity_Factor	====>	SS1	0.74940	0.02822	<.0001
Equity_Factor	====>	SS2	0.78647	0.02512	<.0001
Equity_Factor	====>	SS3	0.71756	0.03080	<.0001
Equity_Factor	====>	PE1	0.76091	0.02727	<.0001
Equity_Factor	====>	PE2	0.77895	0.02575	<.0001
Equity_Factor	====>	PE3	0.80516	0.02352	<.0001
WC_Factor	====>	WD1	0.81986	0.02219	<.0001
WC_Factor	====>	WD2	0.87500	0.01751	<.0001
WC_Factor	====>	WD3	0.75594	0.02761	<.0001
WC_Factor	====>	FW1	0.69651	0.03238	<.0001
WC_Factor	====>	FW2	0.73639	0.02921	<.0001
WC_Factor	====>	FW3	0.67813	0.03379	<.0001
WE_Factor	====>	WE1	0.66840	0.03694	<.0001
WE_Factor	====>	WE2	0.80691	0.02751	<.0001
WE_Factor	====>	WE3	0.85402	0.02487	<.0001
TD_Factor	====>	TD1	0.90200	0.01586	<.0001
TD_Factor	====>	TD2	0.87481	0.01779	<.0001
TD_Factor	====>	TD3	0.83761	0.02071	<.0001
CT_Factor	====>	CT1	0.86021	0.02299	<.0001
CT_Factor	====>	CT2	0.72507	0.03185	<.0001
CT_Factor	====>	CT3	0.61854	0.03952	<.0001
Satisfaction	====>	ST1	0.71951	0.03417	<.0001
Satisfaction	====>	ST2	0.77215	0.03062	<.0001

Satisfaction	====>	ST3	0.62697	0.04050	<.0001
OS_Factor	====>	Satisfaction	0.72982	0.03701	<.0001
WLB_Factor	====>	Satisfaction	0.71952	0.03984	<.0001
Equity_Factor	====>	Satisfaction	0.67295	0.04307	<.0001
WC_Factor	====>	Satisfaction	0.68366	0.04194	<.0001
WE_Factor	====>	Satisfaction	0.50101	0.05643	<.0001
TD_Factor	====>	Satisfaction	0.64036	0.04494	<.0001
CT_Factor	====>	Satisfaction	0.74707	0.04157	<.0001
MHealth and Wellbeing	====>	MH1	0.76869	0.03189	<.0001
MHealth and Wellbeing	====>	MH2	0.76853	0.03190	<.0001
MHealth and Wellbeing	====>	MH3	0.80167	0.03008	<.0001
Satisfaction	====>	MHealth and Wellbeing	0.65443	0.04539	<.0001

The results indicate that all the indicators are significant with a value (p-value < 0.05) and significant factor loading as presented in Tables 20 and 21. Thus, from the SEM analysis, it was shown that the satisfaction of employees is dependent on the social sustainability factors (*Organizational Support, Work-Life Balance, Equity Factor, Work Control, Work Environment, Training and Development, and Contract Type*). In addition, the SEM also allows for investigating the relationship between the endogenous dimensions (satisfaction) on the exogenous (mental health and wellbeing). Moreover, to determine the Construct validity, Criterion validity, and reliability of data collected, the internal consistency was measured by using Cronbach's  $\alpha$ , AVE, and composite reliability (CR) scores as measured in Table 5.11.

Table 5-11 Cronbach's  $\alpha$ , AVE, and composite reliability (CR) scores

Path	Correlation with Total	Cronbach's $\alpha$	CR	AVE	Estimate
<b>OS_Factor</b>		0.937282	0.938	0.627	
AS1	0.812131	0.927047			0.8335
AS3	0.811009	0.927113			0.84275
SC1	0.783343	0.928738			0.80169
AS2	0.774801	0.929237			0.81336
SC2	0.635945	0.937201			0.64379
SC3	0.746378	0.930891			0.7783
WW1	0.764836	0.929819			0.80149
WW2	0.767629	0.929656			0.7996
WW3	0.763844	0.929876			0.79513
<b>WLB_Factor</b>		0.883798	0.885	0.525	
WLB1	0.721527	0.860745			0.78088
WLB2	0.576956	0.878694			0.61665
WLB3	0.699861	0.863493			0.72671
B1	0.666911	0.867633			0.73839
B2	0.723411	0.860505			0.76235
B3	0.721563	0.86074			0.78794
SQ1	0.597826	0.876159			0.63972
<b>Equity_Factor</b>		0.895115	0.895	0.588	
SS1	0.713608	0.877327			0.7494
SS2	0.729672	0.87483			0.78647
SS3	0.673369	0.883516			0.71756
PE1	0.70348	0.878894			0.76091
PE2	0.731053	0.874614			0.77895
PE3	0.754649	0.870916			0.80516
<b>WC_Factor</b>		0.891903	0.893	0.583	
WD1	0.745093	0.867612			0.81986

WD2	0.799756	0.858788			0.875
WD3	0.675178	0.87863			0.75594
FW1	0.677558	0.87826			0.69651
FW2	0.720279	0.871557			0.73639
FW3	0.651264	0.88233			0.67813
<b>WE_Factor</b>		0.817733	0.822	0.609	
WE1	0.595499	0.823416			0.6684
WE2	0.726765	0.690701			0.80691
WE3	0.692545	0.726487			0.85402
<b>TD_Factor</b>		0.904625	0.905	0.76	
TD1	0.834037	0.842885			0.902
TD2	0.802074	0.870074			0.87481
TD3	0.794035	0.876827			0.83761
<b>CT_Factor</b>		0.804328	0.782	0.55	
CT1	0.592301	0.792468			0.86021
CT2	0.721637	0.656793			0.72507
CT3	0.642416	0.741377			0.61854
<b>Satisfaction</b>		0.741613	0.75	0.502	
ST1	0.566578	0.656876			0.71951
ST2	0.660012	0.543422			0.77215
ST3	0.481252	0.753643			0.62697
<b>MHealth &amp; Wellbeing</b>		0.822749	0.823	0.608	
MH1	0.647843	0.785376			0.76869
MH2	0.690478	0.742682			0.76853
MH3	0.694938	0.738142			0.80167

The values for Cronbach's  $\alpha$ , AVE, and composite reliability (CR) scores were in an acceptable range thus proving the Construct and Criterion validity. The variables that result in lowering the  $\alpha$  were removed from the analysis. Furthermore, Table 5.12 shows the discriminant validity of the factors.

Table 5-12 Discriminant Validity

	OS_Factor r	WLB_Factor r	Equity_Factor r	WC_Factor r	WE_Factor r	TD_Factor r	CT_Factor r	JD_Factor r
OS_Factor	1.00000	0.65061 <.0001	0.67071 <.0001	0.61044 <.0001	0.64318 <.0001	0.66264 <.0001	0.62891 <.0001	0.47585 <.0001
WLB_Factor	0.65061 <.0001	1.00000	0.59296 <.0001	0.62243 <.0001	0.46176 <.0001	0.53540 <.0001	0.58139 <.0001	0.59160 <.0001
Equity_Factor r	0.67071 <.0001	0.59296 <.0001	1.00000	0.55247 <.0001	0.46076 <.0001	0.56565 <.0001	0.62665 <.0001	0.40539 <.0001
WC_Factor	0.61044 <.0001	0.62243 <.0001	0.55247 <.0001	1.00000	0.43766 <.0001	0.46478 <.0001	0.54393 <.0001	0.38463 <.0001
WE_Factor	0.64318 <.0001	0.46176 <.0001	0.46076 <.0001	0.43766 <.0001	1.00000	0.46072 <.0001	0.50852 <.0001	0.31519 <.0001
TD_Factor	0.66264 <.0001	0.53540 <.0001	0.56565 <.0001	0.46478 <.0001	0.46072 <.0001	1.00000	0.49950 <.0001	0.40502 <.0001
CT_Factor	0.62891 <.0001	0.58139 <.0001	0.62665 <.0001	0.54393 <.0001	0.50852 <.0001	0.49950 <.0001	1.00000	0.42119 <.0001
JD_Factor	0.47585 <.0001	0.59160 <.0001	0.40539 <.0001	0.38463 <.0001	0.31519 <.0001	0.40502 <.0001	0.42119 <.0001	1.00000

Thus, the ESEM analysis aid this study to identify the accurate presentation and structure of the data concerning the factor loading, and to evaluate and validate the measurement model as shown in Figure 5.5.

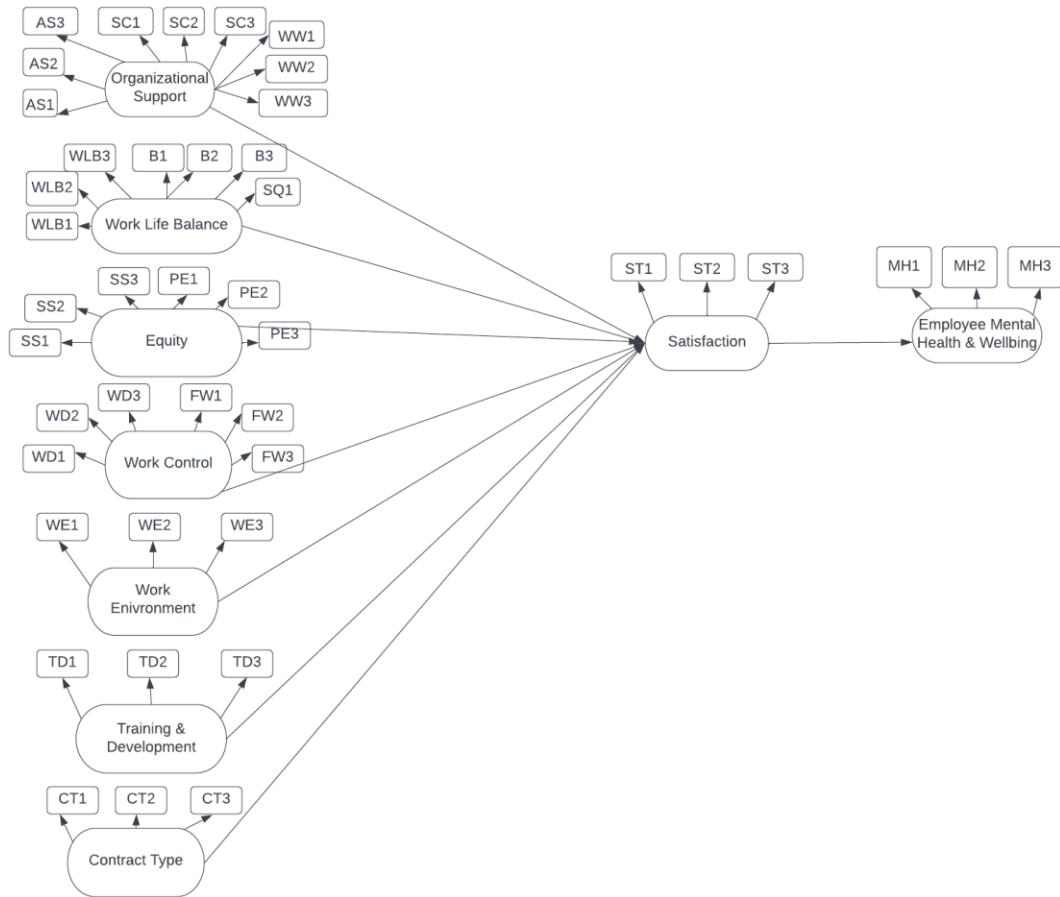


Figure 5-5 ESEM Model

Finally, the SEM aids the study to identify the significant criteria that have an impact on employee’s social sustainability in the construction sector to be adopted for the development of a decision support tool for the organization to make an informed decision in terms of employee’s social sustainability criteria to ensure and enhance social sustainability of their employees.

Where to aid in the development and validation of the decision support tool a case study of a private construction organization was adopted.

### 5.3. Case Study

A single case study of a private construction organization employing over 400 employees in UAE was targeted to assist the study in the development and validation of the decision support tool. The organization takes part in developing major projects. Therefore, its involvement in both private and government projects makes it suitable for this study. Moreover, the intent to adopt the case study was for the development of

a decision support tool. Therefore, having one case study was assumed significant. Initially, to determine the perception of employees in the organization regarding the most important criteria that have an impact on employees' social sustainability. An online AHP-based survey developed using BMPSG.COM solutions has been shared with the employees of the organization, where a response rate of 42.5 percent has been received. The purpose of this step is to determine the most important criteria that can be used as a reference for the decision-makers while taking strategic decisions.

Finally, the decision-makers including the financial, human resources, and line managers have proposed the DST based on the Hybrid AHP and Fuzzy MOORA method to evaluate the performance and influence of alternatives on employee social sustainability in terms of the decision criteria. Thus, this allows the organization to determine the optimal solution in presence of the conflicting criteria and constraints at hand. The solution will allow them to take a strategic decision on which element to invest in to enhance employees' social sustainability.

### **5.3.1 Employees preference**

This sub section, therefore, presents the findings of the AHP method conducted with the employees of the organization to determine the perception of employees regarding the most important underpinning criteria of employee's social sustainability (identified from the literature and validated through SEM) that have an impact on employee's social sustainability in the organization as shown in Figure 5.6.



Figure 5-6 AHP Hierarchy Framework

The AHP hierarchy framework consists of a Goal Layer: prioritization of social sustainability criteria with Organizational Support, Work-Life Balance, Equity Factor, Work Control, Work Environment, Training and Development, Contract Type on the criteria layer, and sub-criteria of each criterion on the lower level as shown in Figure 5.7. Thus, providing the employees with the hierarchical structure, the employees were asked to rank the most significant criteria that have an impact on their social sustainability by following the steps of AHP mentioned in Chapter 3. The AHP analysis with the employees' aids in identifying the most significant criteria that have a significant impact on the social sustainability and EMW as shown in the table below.

Table 5-13 Prioritization

Level 0	Level 1	Weight	Rank	Level 2	Weight	Rank
Prioritization	Organizational Support	0.093	4	Association with Supervisor	0.60	5
				Social Support	0.23	10

	Work-Life Balance	0.171	3	Workload	0.17	12
				Time Management	0.42	6
				Burnout at job	0.24	9
				Sleep Quality	0.33	8
	Equity Factor	0.073	6	Salary Satisfaction	0.890	2
				Pay Equity	0.11	13
	Contract Type	0.058	7	Satisfaction with contract	0.68	3
				Self-commitment	0.33	8
	Training and Development	0.204	2	Employee Empowerment	0.20	11
				Development	0.42	6
				Career Growth	0.38	7
	Work Environment	0.32	1	Health & Safety	0.89	1
				Air/ Noise quality	0.11	13
	Work Control	0.081	5	Flexible work	0.67	4
				Work Design (Job Control)	0.33	8

From the AHP analysis, the employees in the organization from the case study, perceive **Work Environment** and **Training and Development** as the most important criteria that impact employees' social sustainability. In addition, for the sub-criteria **Health and Safety** were perceived to be the most important.

The results of the perception of the important criteria for employee social sustainability in the construction sector also align with the results of SEM conducted on generic employees as shown in Table 5.19, where the estimate of **Work Environment, Training and Development**, and **Contract Type** are the highest that impact social sustainability of employees.

The results can be used as a benchmark and reference for the organization. The case study thus aids this research to understand the perception of employees in construction organizations by adopting the AHP and identifying the optimal solution in presence of constraints to enhance the employee's social sustainability in the organization by adopting decision support tools based on Hybrid AHP - Fuzzy - MOORA.

#### 5.4. Conclusion

To conclude, this chapter looks into the findings of the mixed-method approach based on semi-structured interviews, surveys, and a single case study. The semi-structured interviews aid this study to understand the knowledge and current practices of social sustainability in the construction sector. The interviews also helped in understanding the issues and challenges of the successful implementation of social sustainability in the construction organization such as Cost/Budget, Risk, Compatibility with the Organization, Return on Investment, and Degree of Difficulty as the major challenges and criteria for decision making. In addition, semi-structured interviews were adopted

to validate the 32 criteria identified from the literature. Finally, the interviewees highlight the need for a monitoring system to ensure the employee's social sustainability is held.

Moreover, the findings of the survey questionnaire aid the study to determine the significant criteria of employees' social sustainability by conducting SEM, which reduces the 27 criteria of social sustainability into 11 factors by further adopting confirmatory factor analysis/ structural equation modeling to determine the significant factor. The measurement model shows a good fit and 7 factors such as *Organizational Support, Work-Life Balance, Equity Factor, Work Control, Work Environment, Training and Development, and Contract Type* were found to be significant to the employees' social sustainability in the construction organization.

The findings of the chapters aid the study to integrate decisions criteria identified in the literature and supported by interviews such as Cost/Budget, Risk, Compatibility with Organization, Return on Investment and Degree of Difficulty, and significant factors of employee's social sustainability identified from the literature, validate by interviews and identify from SEM such as Organizational Support, Work-Life Balance, Equity Factor, Work Control, Work Environment, Training and Development, Contract Type as alternatives to aid in the development of the decision support tool for the organization to decide on ensuring and enhancing EMW which is discussed in the next chapter.

## Chapter 6. Decision Support Tool for Social Sustainability

Having identified decision criteria from interviews and alternatives (7 factors) of social sustainability through ESEM. This chapter presents the development process of decision support tool by integrating the findings of the previous chapter based on the Hybrid AHP and Fuzzy MOORA method for the organization to take strategic decisions to enhance the employee’s social sustainability with aid of a case study.

### 6.1. Decision Support Tool Development

This section discusses the phases of development of the DST by adopting the Hybrid AHP and Fuzzy MOORA approach to determine the best and optimal alternative for the organization to enhance the social sustainability of its employee.

**Pre-Development Phase** – The phase includes the identification of underpinning criteria of employees’ social sustainability from the literature. A set of 32 underpinning criteria was identified from the literature. Secondly, the semi-structured interviews were conducted to validate this set of criteria and to determine the decision criteria and constraints that have an impact on deciding on the implementation of employee social sustainability policies in the organization. The interviews aid the study in validating 27 criteria that can be used as alternatives and identification of decision criteria. Moreover, the quantitative analysis (survey development) conducted by adopting SEM aids the development of DST by understanding and validating the relationship between social sustainability factors such as *Organizational Support, Work-Life Balance, Equity Factor, Work Control, Work Environment, Training, and Development, Contract Type*; and their significant impact on EMW and social sustainability. The description of these criteria is presented in Table 6.1.

Table 6-1 Underpinning Criteria Description

Underpinning Criteria/ Alternatives	Description
Organizational Support	The alternative and underpinning criteria define the organization's commitment and culture to provide social support to its employees in terms of management involvement, and association with supervisors to ensure the social sustainability of employees.
Work-Life Balance	The alternative and underpinning criteria present the organizational commitment to ensure time management in terms of allocating shifts and hiring staff. It describes how well the organization aids its employees to maintain work-life balance by ensuring sufficient staff, sufficient work timings, easy shifts system.

Equity Factor	The alternative and underpinning criteria describe the salary satisfaction and Pay equity of employees that ensure that employees are economically satisfied, and their needs are fulfilled that have a positive impact on their social sustainability and EMW.
Contract Type	The alternative defines the job safety and security of employees that allow them to be satisfied and sustainable
Training and Development	The alternative and underpinning criteria describe the organization's commitment to ensuring their employees are allowed to grow and develop in their careers.
Work Environment	It ensures the working environment of the employees in terms of their health and safety by ensuring suitable measures and practices are in place by the organization to ensure the working condition and health safety of employees.
Work Control	The alternative and criteria ensure that the employees in the organization are empowered, and they are given the option to choose their work role, teams, projects, and flexible work timings by organization taking measures the job are not physically and psychologically demanding.

The table presents the description of the alternatives (underpinning criteria) of employees' social sustainability adopted for the development of decision support tools.

**Development Phase** – the phase includes the adoption of a case study to develop and validate the decision criteria from the decision-makers in the organization. A single case study targeting the decision-makers of a private construction organization employing more than 400 employees aids the development of the DST by validating the decision criteria and classification of its objective function to be adopted for developing decision support tools. The decision-makers of the organization targeted include the financial, human resources, and line managers as shown in Table 6.2.

Table 6-2 Participant's Profile

Code	Role	Years of experience
P1	Supervisor (Line Manager)	23
P2	CFO - Financial	37
P3	Head of Human Resource	25

The study targeted 3 main decision-makers from the organization including the head of the financial department with 37 years of experience, and the head of human resources and line manager with 25 and 23 years of experience respectively.

Where the decision-makers were invited to discuss and validate the decision criteria identified from the literature and discussed in interviews as essential for the construction sector such as Cost of improvement /Budget, Risk, Compatibility with Organization, Return on Investment and Degree of Difficulty; and how they affect them

in their decision-making process. *All the participants accepted the criteria are significant for their organization in terms of decision making and aid the study to understand the classification of the criteria objective and its importance of it for the organization as presented in Table 6.3.*

Table 6-3 Decision Criteria

<b>Decision Criteria</b>	<b>Objective</b>	<b>Description</b>
Cost of Improvement	Minimize	It is an essential criterion of the organization to evaluate and calculate the cost it takes to improve or integrate the process. Here, the decision-maker perceives that the performance and influence of the alternative on social sustainability and EMW is a suitable alternative to invest in given the cost of improvement associated with it where the objective is to keep it to a minimum.
Risk Associated	Minimize	Risk management is an essential criterion for the organization to decide whether investing and including a criterion is significant. Thus, it allows the decision-makers to evaluate in terms of risk associated with integrating and investing the criteria in a dynamic environment, is it a reasonable decision based on its performance and influence on social sustainability, and whether EMW is a suitable choice given the risk associated with it, where the objective is to keep it to a minimum.
Compatibility with Organization	Maximize	For the organization to survive and gain a competitive advantage. The organization needs to incorporate periodic changes that must be compatible with the organization's culture. Thus, here the decision-makers perceive the inclusion of alternatives as a suitable option in terms of its influence on social sustainability and EMW has given its compatibility with the organization's culture, vision, and internal environment i.e., closed, or open channel environment.
Return on Investment	Maximize	For the project or process to be successful the organization must look into the gain and returns it gets after investing cost, time, and resources. Thus, this criterion allows the decision-maker to decide whether investing in the alternative is a reasonable decision given its significance of influence on social sustainability and EMW in terms of the return of investment the decision will bring.
Degree of Difficulty	Minimize	The decision-makers perceive is it a reasonable approach or decision to invest in the alternative given its significance of influence on social sustainability and EMW in terms of the degree of difficulty of adopting the alternative to the organization based on the culture, acceptance, and return of investment the decision will bring.

The table presents the objective and description of the decision criteria that allow the decision-makers to evaluate the performance or influence of the alternative on social sustainability such that in their perception and from their experience is investing in the alternative in terms of the decision criteria is a reasonable decision to ensure employees' social sustainability.

Thus, the decision criteria and alternatives identified from the predevelopment and development phases were integrated for the development of the DST by adopting the steps and calculation of the Hybrid AHP and Fuzzy MOORA approach presented in Chapter 3. The development of the DST comprises the following stages as shown in Figure 6.1 below.

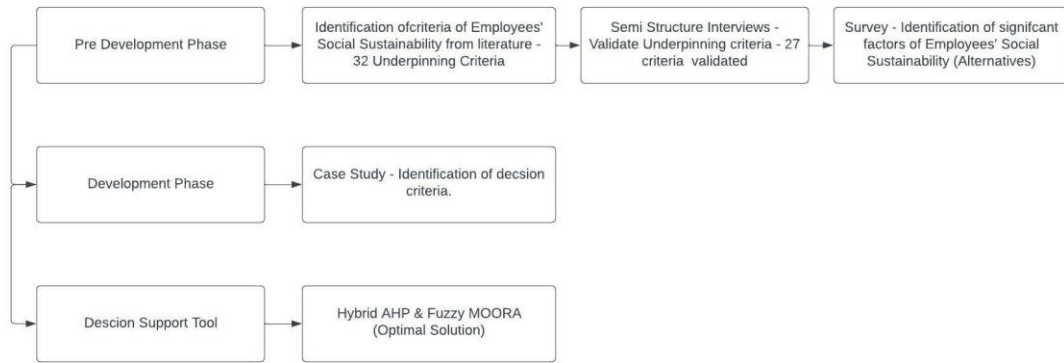


Figure 6-1 Development Process of Decision Support Tool

**Decision Support Tool** - The decision-makers were presented with the DST based on the Hybrid AHP and Fuzzy MOORA method to evaluate the performance and influence of alternatives on employees' social sustainability in terms of the decision criteria. The decision support tool presents an interface designed as shown in Figure 6.2.

Welcome

**Mental Health & Wellbeing Decision Support Tool**

Developed by : **Sara Saboor, G00080300**

Supervised By : **Dr. Vian Ahmed**

**Start**

Decision Criteria	Objective	Description
Cost of Improvement	Minimize	It is an essential criterion of the organization to evaluate and calculate the cost it takes to improve or integrate the process. Here, the decision maker perceives that the performance and influence of the alternative on social sustainability and EMW is a suitable alternative to invest given the cost of improvement associated with it where the objective is to keep it to minimum.
Risk Associated	Minimize	Risk management is an essential criterion for the organization to decide whether investing and including a criteria is significant. Thus, it allows the decision makers to evaluate in terms of risk associated with integrating and investing the criteria to dynamic environment, is it a reasonable decision based on its performance and influence on social sustainability and EMW is a suitable choice given the risk associated with it, where the objective is to keep it to minimum.
Compatibility with Organization	Maximize	For the organization to survive and gain competitive advantage. It is essential for the organization to incorporate periodic changes that must be compatible with the organization culture. Thus, here the decision makers perceive the inclusion of alternative is a suitable option in terms of its influence on social sustainability and EMW given its compatibility with the organizations culture, vision and internal environment i.e. closed or open channel environment.
Return on Investment	Maximize	For the project or process to be successful the organization must look into the gain and returns it gets after investing cost, time and resources. Thus, this criterion allows the decision maker to decide whether investing in the alternative is a reasonable decision given its significance of influence on social sustainability and EMW in terms of the return of investment the decision will bring.
Degree of Difficulty	Minimize	The decision makers perceive it is a reasonable approach or decision to invest in the alternative given its significance of influence on social sustainability and EMW in terms of the degree of difficulty of adopting the alternative to organization based on the culture, acceptance and return of investment the decision will bring.

Underpinning Criteria/ Alternatives	Description
Organizational Support	The alternative and underpinning criteria defines the organization's commitment and culture to provide social support to its employees in terms of management involvement, association with supervisor to ensure social sustainability of employees.
Work-Life Balance	The alternative and underpinning criteria presents the organizational commitment to ensure time management in terms of allocating shifts and hiring of staff. It describes how well the organization aids its employees to maintain work life balance by ensuring sufficient staff, sufficient work timings, easy shifts system.
Equity Factor	The alternative and underpinning criteria describes the salary satisfaction and Pay equity of employees that ensure that employees are economically satisfied, and their needs are fulfilled that have a positive impact on their social sustainability and EMW.
Contract Type	The alternative defines the job safety and security of employees that allow them to be satisfied and sustainable.
Training and Development	The alternative and underpinning criteria describes the organization's commitment to ensure their employees are given opportunity to grow and develop in their career.
Work Environment	It ensures the working environment of the employees in terms of their health and safety by ensuring suitable measures and practices are in place by organization to ensure working condition and health safety of employees.
Work Control	The alternative and criteria ensure that the employees in the organization are empowered, and they are given option to choose their work role, teams, projects and flexible work timings by organization taking measures the job is not physically and psychologically demanding.

Figure 6-2 EMW Decision Support Tool Interface

The interface allows the decision-makers to easily navigate through a different part of the decision tool by following the steps mentioned in the tool.

**Step 1** – It asks the decision-makers to enter the details of no. of the decision-makers taking part in the decision-making process. The tool allows a maximum of **10** experts to be included in the decision process. For this case study, the assumption of weightage of the decision-maker is considered similar due to the homogenous group.

Moreover, the step further asked decision-makers to mention *decision criteria/constraints* with the *classification of their objective function* to maximize or minimize the decision criteria based on the vision and situation of the organization, it also allows to include the *alternatives (factors of social sustainability)* for their organization with a maximum of 10 decision criteria.

For this study, **3 decision-makers**, **5 decision criteria** such as *Cost of improvement/Budget, Risk, Compatibility with Organization, Return on Investment, and Degree of Difficulty*, and **7 alternatives** such as *Organizational Support, Work-Life Balance, Equity Factor, Work Control, Work Environment, Training and Development, Contract Type* was adopted as shown in Figure 6.3.

Decision Criterion	Objective Function	Weights	+/-
Cost of Improvement	Min	21.6%	3.0%
Rate of Risk	Min	18.6%	2.1%
Compatibility with the Organization's Vision	Max	19.9%	1.0%
Return on Investment	Max	19.9%	1.0%
Degree of difficulty	Min	19.9%	1.0%
		.0%	.0%
		.0%	.0%
		.0%	.0%
		.0%	.0%
		.0%	.0%

Buttons: Edit, Save, Close, Decision Results, Press me to Reset all Previous Data to Zero

Figure 6-3 Interface Main Panel

Furthermore, after choosing the no. of decision-makers, no. of decision criteria along with their objective function and alternatives for the decision process. The interface allows the organization to navigate through the participant panel as Step 2.

**Step 2** – it allows the decision-makers to enter their perception in terms of pairwise importance of decision criteria and evaluate the performance and influence of the alternatives (underpinning criteria of social sustainability) on the social sustainability of employees in terms of the decision as shown in Figure 6.4.

Step 1 - Please compare the importance of the decision criteria in relation to the other criteria such that: For each pairwise comparison choose which is a more important decision criteria for your organization, is A or B, and how much more on a scale 1-9 as shown below it is important. Once all comparison done, proceed to Step 2.

Step 2 - The decision makers are therefore, asked to evaluate the performance or significance of influence of the alternative on social sustainability such that in their perception is investing in the alternative in terms of the decision criteria is a reasonable decision to ensure social sustainability. By way of example, is the decision maker perceive investing in organizational support a reasonable decision in terms of cost of improvement. The decision makers choose Very Poor if they perceive the influence of Organizational support on social sustainability and EMW is a Poor choice for investing in regard to its Cost of Improvement and choose Very Good if they perceive influence of Organizational support on social sustainability and EMW is a Good and reasonable approach in regard to its Cost of Improvement.

Comparison of Decision Criteria				Alternative Table										
Criteria More Important		Scale (1-9)		Decision Criteria										
A	B	A or B	Scale	Cost of Improvem	Rate of Risk	Compatibility with	Return on Investm	Degree of difficult	0	0	0	0	0	0
1	2	Cost of Improvem	Rate of Risk	20.0%	20.0%	20.0%	20.0%	20.0%	0%	0%	0%	0%	0%	0%
1	3	Rate of Risk	Compatibility with											
1	4	Compatibility with	Return on Investm											
1	5	Return on Investm	Degree of difficult											
1	6	Degree of difficult	0											
1	7	0	0											
1	8	0	0											
1	9	0	0											
2	3	Rate of Risk	Compatibility with											
2	4	Compatibility with	Return on Investm											
2	5	Return on Investm	Degree of difficult											
2	6	Degree of difficult	0											
2	7	0	0											
2	8	0	0											
3	4	Compatibility with	Return on Investm											
3	5	Return on Investm	Degree of difficult											
3	6	Degree of difficult	0											
3	7	0	0											
3	8	0	0											
4	5	Return on Investm	Degree of difficult											
4	6	Degree of difficult	0											
4	7	0	0											
4	8	0	0											
5	6	0	0											
5	7	0	0											
5	8	0	0											
6	7	0	0											
6	8	0	0											
7	8	0	0											

Objective: Org Support, Work Life Balance, Equity Factor, Contract Type, Training and Development, Work Environment, Work Control

Weights: 20.0%, 20.0%, 20.0%, 20.0%, 20.0%, 0%, 0%, 0%, 0%, 0%

Buttons: Edit, Save, Close

Figure 6-4 Decision Maker Panel

It can be seen from the interface above the decision-making process involve 2 steps that allow the decision-maker to.

Firstly, compare the decision criteria based on their importance to the decision-making process as shown in the Figure below by adopting Saaty’s scale provided in the interface and as presented in figure 6.5.

		Criteria		more important ?	Scale			
i	j	A	B	A or B	(1-9)			
1	2	Cost of Improvement	Risk	A	1			
1	3			Degree of Difficulty	A	1		
1	4				Compatibility with org	A	5	
1	5					ROI	A	1
1	6							
1	7							
1	8							
2	3						Risk	Degree of Difficulty
2	4	Compatibility with org	A					
2	5		ROI	B				
2	6							
2	7							
2	8							
3	4			Degree of Difficulty	Compatibility with org	A	7	
3	5	ROI				A	5	
3	6							
3	7							
3	8							
4	5		Compatibility with org	ROI	A	1		
4	6							
4	7							
4	8							
5	6							
5	7							
5	8							
6	7							
6	8							
7	8							

Figure 6-5 Decision Criteria Interface

Finally, it allows the decision-makers to evaluate the performance or influence of the alternative on social sustainability such that in their perception and from their experience is investing in the alternative in terms of the decision criteria is a reasonable decision to ensure social sustainability by adopting the linguistic scale as shown in Table 6.4 below.

Table 6-4 Linguistic Scale

VP	Very Poor	1,1,1	1
P	Poor	1,3,5	3
M	Moderate	3,5,7	5
G	Good	5,7,9	7
VG	Very Good	7,9,11	9

The decision-makers are, therefore, asked to evaluate the performance or significance of the influence of the alternative on social sustainability such that in their perception and from their experience investing in the alternative in terms of the decision criteria is a reasonable decision to ensure social sustainability. By way of example, is the decision-maker perceive investing in organizational support as a reasonable decision in terms of the cost of the improvement. The decision-makers choose **Very Poor** if they



alternatives to ensure and enhance employee’s social sustainability in the organization as shown in Figure 6.8.

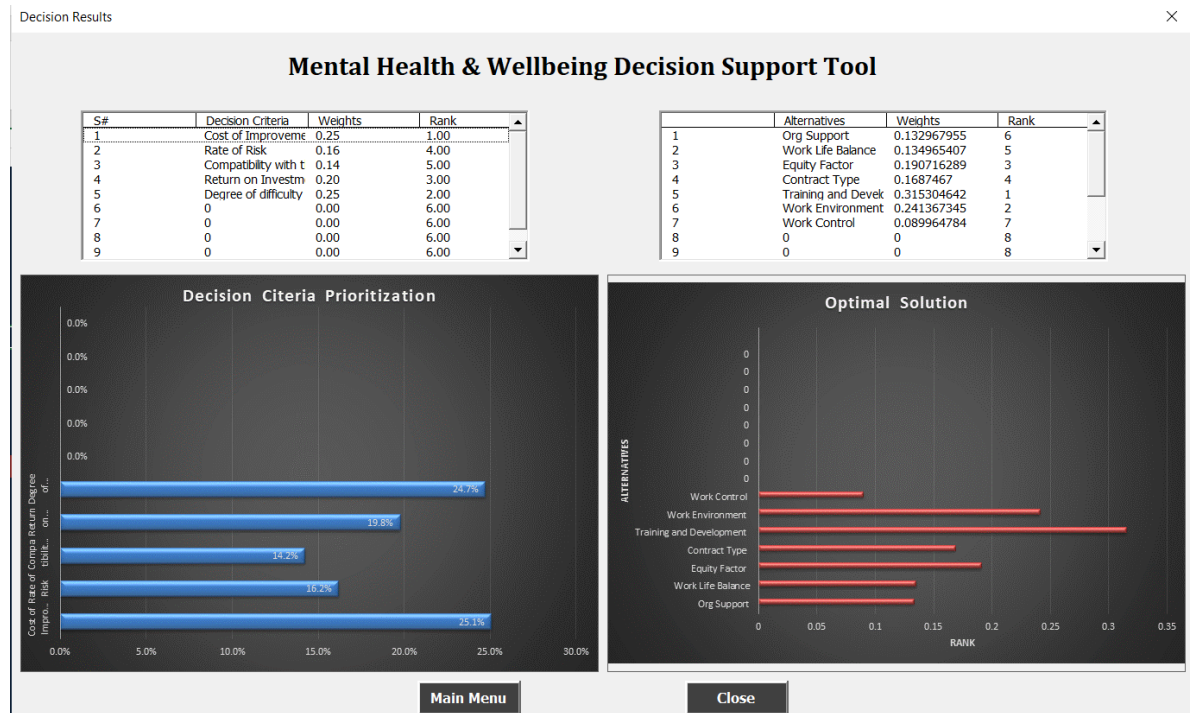


Figure 6-7 Decision Panel

Thus, from the Figure it can be concluded that for this case study (Organization), Cost of Improvement is the most important criterion for decision making and the optimal solution for investing is **A5 > A6 > A3 > A4 > A1 > A2 > A7** to ensure enhancing of the social sustainability of their employees. In addition, it should also be noted here that the optimal solution aligns with the perception of employees regarding the important criteria that impact their social sustainability in the organization. The decision support tool based on the Fuzzy-MOORA approach allows the decision-makers to determine the best and optimal alternative for the organization to invest in to enhance the social sustainability of its employee. Which identifies **Training and Development > Work Environment > Equity Factor > Contract type > organizational support > work-life balance > work control** as the optimal way of investing in terms of constraints and objectives of an organization to ensure the social sustainability of its employee.

Thus, from the findings, it can be concluded that the organization and decision-makers play an integral role in ensuring the social sustainability of the employees in the organization. Therefore, as pointed out by the interviewees there must be a system that

monitors the organization in achieving this goal. Thus, this study recommends the adoption of the conceptual framework of the BOTSSM framework as proposed in Chapter 3 to monitor and incentivize the organization that works towards ensuring the social sustainability of its employees. Therefore, it is important to validate the main contribution such as the decision support tool and conceptual framework through experts.

## 6.2. Expert Validation

This section helps in validating the solution suggested by the research with the experts in the field by conducting a *Focus Group* with experts in the construction sector for validating the DST and with WakeCap technologies as experts in IoT and Blockchain solutions.

### 6.2.1 Focus group

An online focus group was conducted by inviting the 3 experts from the interview process and 3 members of WakeCap Technologies to validate the proposed solution the decision Support tool and the conceptual framework BOTSSM. The experts were given the DST to evaluate the tool in terms of criteria found in the literature [173] such as *Effectiveness for decision making, User Friendly (Easily navigable, highly visible, and understandable guidelines) and Feasibility of adoption as part of the decision-making process (provided it did not interrupt their daily workflow patterns).*

**Construction Sector Experts** - For conducting a focus group to validate the decision support tool for functional testing, the experts from the interviews were again reached. Where 3 experts provided their consent to take part in an online Focus group as shown in Table 6.6 for validating the decision support tool.

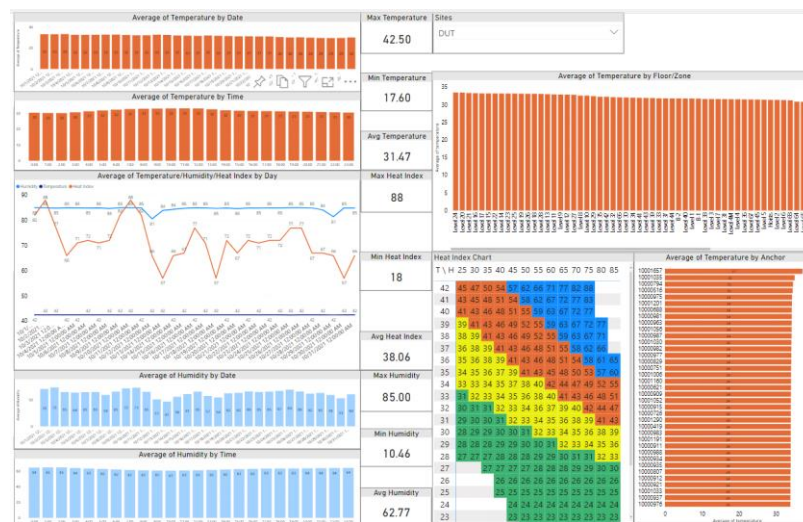
Table 6-5 Focus Group Construction Sector Experts

Code	Title	Years of Experience
P1	Chief Financial Officer (CFO)	24
P3	Head of HR Department	20
P6	Head of Quality & Materials Management	15

Moreover, to gain insight into IoT and Blockchain the experts in the field i.e., WakeCap Technologies were also invited.

**WakeCap Technologies** – The team CEO of WakeCap technologies and the technical team were invited to take part in an online focus group. The company specializes in providing IoT solutions to the Oil and Gas and construction sectors. It allows ensuring that factors such as Health and safety, work environment, work-life balance, and work control which define the social sustainability of employees are met and addressed by the organization as per the policies and legislation laid down by the government.

WakeCap technologies are designed to ensure the safety, efficiency, and productivity of employees on-site by offering solutions such as smart helmets, temperature and humidity sensors, smoke alerts, and fall detection. The network in place can capture the accurate geolocation of each wearable or fixed sensor in real-time as shown in Figure 6.9. The solution is integrated with a cloud-based server for security and integration with the system.



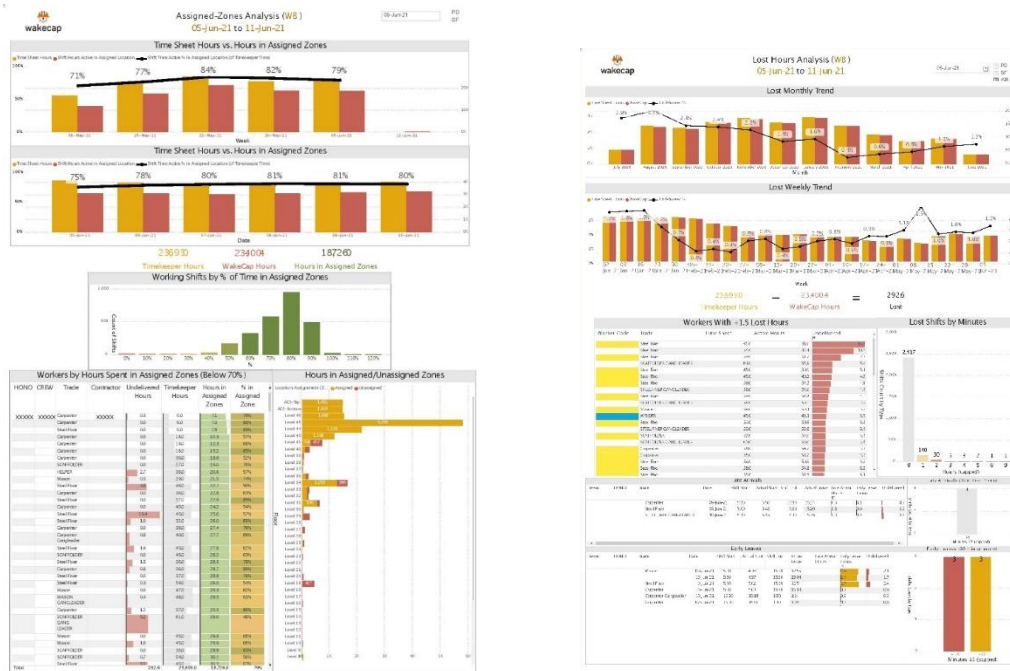


Figure 6-8 Existing System based on IoT. Source: WakeCap Technologies

Moreover, WakeCap technologies are an expert in offering smart safety, smart timekeeping, smart production, and smart asset tracking as shown in Figure 6.10.

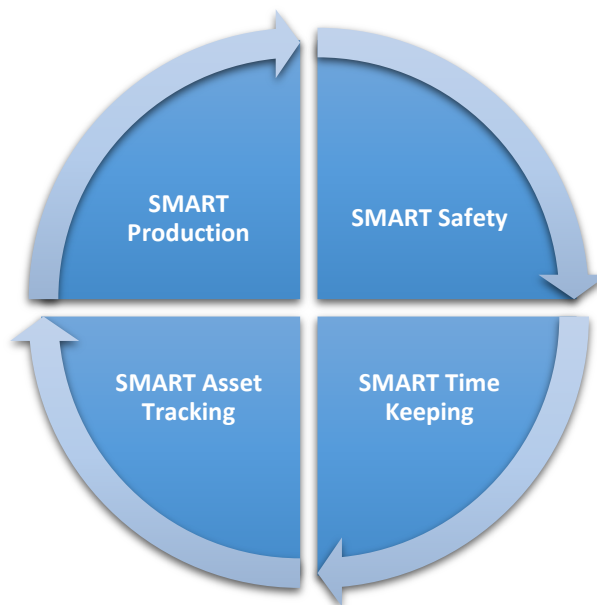


Figure 6-9 WakeCap technologies Solutions

The solutions provided by the company align with the aim of the study, therefore, making them an ideal organization to approach to validate the proposed framework.

The study adopts an unstructured interview strategy to understand the role of WakeCap as an expert and to validate the proposed solutions.

**Decision Support Tool** - The participants were informed regarding the purpose of the decision support tool and to test the functionality the participants were sent the decision support tool for hands-on experience along with a questionnaire using *Google Forms* to evaluate and validate the DST. The survey allows the research to determine the perception of experts on the performance and evaluation of the DST on the following criteria:

The experts were asked *if they perceive the guidelines provided with the DST are clear?* The participants were given a scale based on Vague, Appropriate, and Clear to rate the clarity of guidelines. Where all the participants show a positive response to the guidelines provided.

Moreover, the experts were asked *if it is easy to navigate through the tool with a scale ranging from Difficult, moderate to easy?* The participants were satisfied with the ease of navigation through the tool.

Furthermore, *to evaluate the relevance of the tool for decision making* the experts were given to rate on a scale of non-relevant, quite relevant, and relevant. Where four out of six experts said its relevant and two selected quite relevant.

In addition, the experts were asked *if they perceived the tool to be feasible to be adopted for decision making given that it does not affect the daily operation and workflow.*

All the experts perceived the tool to be feasible to be adopted as part of decision-making without any hindrance to their workflow.

Where to determine the functionality of the tool, the experts were asked *if the tool is user-friendly?* Five out of six experts highlighted the tool to be user-friendly, while one expert suggested that the tool can be developed as a part of an app or software with a better GUI.

Finally, to sum up, the evaluation the experts were asked *if they consider adopting the tool for the decision-making process.* All the participants showed a positive response where two mentioned they are most likely to adopt the tool and four said they will adopt the tool for decision making.

The findings of the evaluation are summarised in the table below.

Table 6-6 DST Expert Evaluation

Evaluation Criteria/Experts		E1	E2	E3	E4	E5	E6
Clarity of the guideline	Vague						
	Appropriate						
	Clear	*	*	*	*	*	*
Navigation through the tool	Difficult						
	Moderate						
	Easy	*	*	*	*	*	*
Relevance for decision making	Not relevant						
	Quite Relevant		*	*			
	Relevant	*			*	*	*
User Friendly	Not Friendly						
	Somewhat friendly						*
	Very Friendly	*	*	*	*	*	
Feasibility of the tool	Not feasible						
	Somewhat Feasible						
	Feasible	*	*	*	*	*	*
Adoption of tool	No						
	Likely	*				*	
	Yes		*	*	*		*

As can be seen from the table positive feedback was received from the experts in terms of the functionality of the decision support tool. Moreover, to validate the conceptual tool, discussion with the experts began.

**BOTSSM** - The focus group aids in understanding the vision and strength of the organization. The interviewees highlighted that the main aim behind the organization is to *‘Connect the workers in real-time at the construction site to allow the companies and decision-makers make a better decision based on the true picture of the project as 98% of construction projects are experiencing cost overruns or delays due to the lack of connectivity, slow information sharing and a lack of automation on site. Where the process of basic productivity analysis may take weeks. However, with the dynamic nature of construction sites, the site condition changes, thus making the improvement ideas already obsolete.’*

Moreover, the interviewee mentioned *‘Our strength lies in our technology itself. Digitalization has proven to increase productivity. Where the Construction sector has been lagging as reports have shown that the usage of technologies in the field continues to be the primary obstacle to getting the long-promised benefits of advanced systems..... Previous solutions tend to demand more time and attention whereas our solution is seamless, scalable, and easy to integrate..... with the adoption of IoT that plays a key role in the revolution of the construction industry.’* The solution thus proposed by the

organization is low costs and utilizes low-power sensors which provide the decision-makers with information in real-time that can be used to enhance development, improve safety, and social sustainability, reduce costs and increase profitability. Furthermore, on asking the interviewees about the cost and business model, they highlighted. *‘The products and services are provided on weekly, monthly, or annual subscription bases. With a one-time fee charged for the helmets and a subscription fee based on the number of workers, the construction site, and the desired features’...* Moreover, the interviewee mentioned that a case-by-case quote is provided to the companies with the associated ROI calculations to help them make their decision.

Finally, the proposed solution with a description was presented to the interviewees, the interviewees acknowledged the need for the solution by stating... *‘the proposed solution is a need of an hour as despite the compliance, regulation posed by the government... reports have shown issues linked to timesheets, number of employees allowed working at a specific location, working environment. Thus, the middleman i.e., the supervisor or the group leader must be removed from having the vetting power. As IoT and Blockchain can be utilized to monitor compliance and policies by removing manual checks. Where the organizations must understand that labour is the largest but the least understood cost. Thus, to run a more efficient and safer site, the adoption of the proposed solution is promising.’* Moreover, the interviewee mentioned.... *‘The proposed solution aligns with the aim of the reward system introduced by Taqdeer awards that aim to make UAE construction sector as the most labour friendly sector around the globe.’*

Furthermore, the interviewee stated that *‘there has been a gap that made the organization adopt technologies. Thus, having a proposed BOTSSM in place will result in making the construction companies join the network to get the benefits of the reward system.’*

In closing remarks, the interviewee stated... *‘the proposed solution will provide insight and transparency, that will allow to increase sustainability and allow the stakeholder the ability to achieve their agenda.’*

Thus, it can be concluded here that the proposed solution will allow ensuring the social sustainability of employees in the construction sector aligning with the aim of the study.

### **6.3. Conclusion**

This chapter presents a decision support tool based on Hybrid AHP and Fuzzy-MOORA approach allows the decision-makers to determine the best and optimal alternative for the organization to ensure and enhance the social sustainability of its employee. Which identifies training and development, work environment, Equity Factor, Contract type, organizational support, work-life balance, and work control as the optimal way of investing to ensure the social sustainability of its employee.

Moreover, to complement the non-dynamic nature of the decision support tool the chapter proposes the adoption of BOTSSM as a conceptual framework to ensure and monitor social sustainability management to guarantee the organization achieves corporate social responsibility by achieving strong corporate governance, promotes business ethics, reduces onsite accidents, maintain environment according to the international standards and achieve sustainability by utilizing this technology, which includes functionalities such as smart contracts with the ministry of labour to incentivize the organization fulfilling their corporate social responsibility.

Furthermore, this chapter adopts a focus group as a way of expert validation to validate the functional operation of the decision support tool and conceptual framework by 6 experts from the construction sector and WakeCcap technologies. The findings of the focus group show a positive response of participants towards DST and conceptual framework.

## **Chapter 7. Discussion, Findings, Conclusion, and Recommendation**

This chapter intends to discuss and summarize the purpose and findings of this research. Followed by the limitations and recommendations for the successful implementation of proposed solutions.

### **7.1. Discussion**

The dissertation proposed and developed a decision support tool based on the Hybrid AHP and Fuzzy MOORA method, a form of multi-criteria decision-making method that addresses the research gap of no or little research conducted on tools or system/frameworks that can be adopted by an organization to take right and informed strategic decision to enhance employee's social sustainability.

First of all, the literature review was conducted to develop an understanding of the evolvement of mental health definitions from being defined as the *absence of the disease* to *the presence of well-being* to *social sustainability*. With the evolvement of its concepts, global initiatives, and measurement scales in parallel along with a focus on understanding EMW and social sustainability.

Moreover, the literature identifies a set of underpinning criteria that define employees' social sustainability. The literature identifies a set of 37 criteria of EMW that can be classified into four categories. The literature also looks into several MCDM techniques available in the literature and proposed adopting Hybrid AHP and F-MOORA as an efficient and robust tool that allows for simultaneously optimizing two or more conflicting alternatives in case of certain constraints such as maximizing profits and minimizing the cost or maximizing of the performance and minimizing of fuel consumption of a vehicle. At last, the literature looks upon the adoption of the latest technologies such as Blockchain and IoT and their benefits for monitoring social sustainability efforts conducted by the organization.

Secondly, the dissertation adopts semi-structured interviews and survey development to validate the findings of the literature and to determine the significant criteria that have a relationship and impact on EMW by adopting structural equation Modelling. The interviews also assist in understanding the current practices and challenges for the successful implementation of employees' social sustainability policies and practices in the organization. The decision criteria/ constraints were also identified through

interviews with the expert. Moreover, the quantitative analysis allows for a reduction in the dimension of criteria (alternatives) and identified 7 significant criteria that have an impact on EMW.

Thirdly, the alternatives identified from quantitative analysis and decision criteria identified from the qualitative analysis were integrated into the development of the decision support tool. To validate the DST, the dissertation adopts a private construction organization as a case study and targets 3 decision-makers. The decision support tool allows the decision-makers to take the right and informed decision based on the optimal option to invest by keeping in mind the decision criteria (objectives).

Finally, the dissertation proposed a conceptual framework for monitoring social sustainability efforts conducted by the organization by adopting the latest technological solutions such as BOTSSM.

## **7.2. Main Findings**

The dissertation yielded many interesting findings; however, the most important findings of the research can be summarised below:

- The history of the phenomena of mental health shows that the concept has been evolved over the last few decades from being defined as the absence of the disease to the presence of well-being to social sustainability
- Social sustainability is defined as “the process for creating sustainable places that promote wellbeing (Physical and Mental Health), by understanding the needs of people from the places they live and work. The criteria include human rights, fair labour practices, living conditions, health and safety, wellness, diversity, equity, work-life balance, empowerment, engagement, organization commitment, and more.
- A set of 37 the underpinning criteria of employee’s social sustainability and mental health and well-being were identified and classified into four categories as Organizational factors, Personal factors, social factors, and environmental factors.

- The SEM analysis identifies organizational support, work-life balance, equity factor, work control, work environment, training and development, and contract type) as significant criteria.
- The AHP analysis conducted by targeting the employees in the construction sector perceives work environment and training and development as the most important criteria that impact their social sustainability, mental health, and wellbeing. in addition, for the sub-criteria health and safety were perceived to be the most important.
- The Hybrid AHP and Fuzzy MOORA, an MCDM or MADM technique is identified as the efficient and robust method for simultaneously optimizing two or more conflicting alternatives in case of certain constraints such as maximizing profits and minimizing the cost of maximizing the performance and minimizing fuel consumption of a vehicle.
- The decision support tool aids the organization in identifying the optimal solution for the decision-makers to invest in by optimizing the decision criteria (multiple objectives) to ensure enhancing the social sustainability of their employees. the tool identifies training and development, work environment, equity factor, contract type, organizational support, work-life balance, and work control as the optimal way of investing to ensure the employees' social sustainability.
- The optimal solution aligns with the perception of employees regarding the important criteria that impact their social sustainability in the organization.
- The integration of Blockchain with IoT can improve the internet of things by providing a trustworthy sharing service that is both reliable and traceable.
- Sustainable development is associated with social sustainability and devoting attention to the social issues in the company is the foundation for achieving sustainability. Integration of IoT - Blockchain technology for the monitoring of social sustainability management ensures the organization achieves corporate social responsibility by achieving strong corporate governance, promoting business ethics, reducing onsite accidents, maintaining the environment

according to the international standards, and achieving sustainability by utilizing this technology.

### **7.3. Conclusion**

As identified from the literature there exist a research gap which reports that the existing studies tend to focus on a specific or narrow range of criteria which fails to explain the comprehensive nature of the concept. Finally, no, or little has been reported on adopting the set of criteria to develop a decision support tool that can assist the organizations to enhance the mental health of their employees.

This dissertation, therefore, addresses the gap by identifying the set of 37 underpinning criteria and proposing a DST based on the Hybrid AHP and Fuzzy MOORA method that allows the organizations or decision-makers to simultaneously optimize two or more conflicting alternatives in case of certain constraints. The dissertation adopts the case study to validate the DST and concluded that training and development, work environment, equity factor, contract type, organizational support, work-life balance, and work control as the optimal way of investing to ensure the social sustainability of its employee.

Moreover, to ensure the social sustainability management and monitoring, a conceptual framework based on adopting BOTSSM was proposed.

### **7.4. Limitations and Future Work**

The dissertation has several limitations which are as follows.

- The main limitation faced by the study was the access to data due to the Covid 19 pandemic which limits the researcher to accommodate the representation of workers at the construction site.
- The study assumes that the underpinning criteria identified have an impact on the employees' social sustainability without considering the demographics of employees. Therefore, the influence of these demographics may be adopted as future work to study its impact on the model fit.
- Due to the limitation of time, the study focuses on adopting the decision support tool based on only one approach. however, the scope of the study can be extended by comparing different methods of proposing a decision support tool.

- The conceptual framework only focused on human-related issues such as work environment and work-life balance to ensure the health and safety of the employees. Therefore, other issues such as economic, and environmental must be considered in future studies.
- The study successfully presented the framework with the integration of Blockchain and IoT to achieve instant traceability and monitoring of social sustainability. However, due to time constraints, the study does not develop smart contracts.
- Though the study presented expert validation of the framework, it lacks the empirical validation that can be achieved as a part of future studies.

### **7.5. Recommendation for future work**

The main recommendation for future work is to include three or more case studies from the different sector such as private, public, and semi to draw a comparison among them and their decision criteria that acts as constraints and objectives to be able to externally validate the decision support tool.

Moreover, Smart contracts and empirical analysis can be adopted in the future to provide more validation to the proposed BOTSSM solution.

Finally, the study can adopt ZOGP (Zero-One Goal Programming) model to be able to add insight into the priority weights of the employees regarding the importance of criteria to employees' social sustainability with respect to the decision criteria (objectives/constraints) of the organization.

## References

- [1] L. Wood, "Worldwide Construction Industry to 2030 - Featuring Grupo, Bouygues and Skanska Among Others," 2022.
- [2] J. M. Nwaogu, A. P. Chan, and M. O. Tetteh, "Staff resilience and coping behavior as protective factors for mental health among construction tradesmen," *Journal of Engineering, Design and Technology*, 2021.
- [3] A. Kumar and K. R. Nayar, "COVID 19 and its mental health consequences," *Journal of Mental Health*, pp. 1-2, 2020, doi: 10.1080/09638237.2020.1757052.
- [4] T. Colbourn *et al.*, "Modelling the health and economic impacts of different testing and tracing strategies for COVID-19 in the UK," *F1000Research*, vol. 9, p. 1454, 2020.
- [5] N. Dempsey, G. Bramley, S. Power, and C. Brown, "The social dimension of sustainable development: Defining urban social sustainability," *Sustainable development*, vol. 19, no. 5, pp. 289-300, 2011.
- [6] S. Vallance, H. C. Perkins, and J. E. Dixon, "What is social sustainability? A clarification of concepts," *Geoforum*, vol. 42, no. 3, pp. 342-348, 2011/06/01/2011, doi: <https://doi.org/10.1016/j.geoforum.2011.01.002>.
- [7] (2002). *Nations for Mental Health*. [Online] Available: [https://www.who.int/mental\\_health/media/en/400.pdf](https://www.who.int/mental_health/media/en/400.pdf)
- [8] J. Allen, R. Balfour, R. Bell, and M. Marmot, "Social determinants of mental health," *International Review of Psychiatry*, vol. 26, no. 4, pp. 392-407, 2014/08/01 2014, doi: 10.3109/09540261.2014.928270.
- [9] A. K. Power, "Transforming the Nation's Health: next steps in mental health promotion," (in eng), *American journal of public health*, vol. 100, no. 12, pp. 2343-2346, 2010, doi: 10.2105/AJPH.2010.192138.
- [10] *Mental health in the workplace*, 2020.
- [11] W. H. Organization, *World health statistics 2016: monitoring health for the SDGs sustainable development goals*. World Health Organization, 2016.
- [12] V. A. Lambert, C. E. Lambert, M. Petrini, X. M. Li, and Y. J. Zhang, "Workplace and personal factors associated with physical and mental health in hospital nurses in China," *Nursing & health sciences*, vol. 9, no. 2, pp. 120-126, 2007.
- [13] C. Spell and T. Arnold, "A MultiLevel Analysis of Organizational Justice Climate, Structure, and Employee Mental Health†," *Journal of Management - J MANAGE*, vol. 33, pp. 724-751, 10/01 2007, doi: 10.1177/0149206307305560.
- [14] G. Business, "42 percent UAE employees find workplace stressful report,"
- [15] (2020). *Mental Health in the United Arab Emirates–1992 - 2019*. [Online] Available: [https://www.mohap.gov.ae/Files/MOH\\_OpenData/1579/Mental%20health.pdf](https://www.mohap.gov.ae/Files/MOH_OpenData/1579/Mental%20health.pdf)
- [16] R. Warner and I. A. Moonesar Ph.D. R.D, "Diversity Management: The Case of the United Arab Emirates," vol. 21, 2019, pp. 41-63.
- [17] U. Parliament, "Construction Industry," ed, 2020.
- [18] D. Smith, V. Ahmed, and S. Saboor, "BREXIT: Assessing the Impact on the UK Construction Industry & Mitigating Identified Risks."

- [19] Y. Kotera, P. Green, and D. Sheffield, "Work-life balance of UK construction workers: relationship with mental health," *Construction Management and Economics*, vol. 38, no. 3, pp. 291-303, 2020/03/03 2020, doi: 10.1080/01446193.2019.1625417.
- [20] K. J. Sang, A. R. Dainty, and S. G. Ison, "The impact of the structure and culture of the construction industry on employee well-being: Directions for future research," in *20th Annual ARCOM Conference*, 2004, pp. 1-3.
- [21] T. Rajgopal, "Mental well-being at the workplace," *Indian journal of occupational and environmental medicine*, vol. 14, pp. 63-5, 09/01 2010, doi: 10.4103/0019-5278.75691.
- [22] J. Jignyasu Prafulla, P. Lavinsaa, W. Nabsiah Abdul, and S. Hemalatha, "Determinants of Work Stress for Construction Industry Employees in Malaysia," in *First ASEAN Business, Environment, and Technology Symposium (ABEATS 2019)*, 2020/05/18 2020: Atlantis Press, pp. 93-95, doi: <https://doi.org/10.2991/aebmr.k.200514.021>. [Online]. Available: <https://doi.org/10.2991/aebmr.k.200514.021>
- [23] M. A. Campbell and J. G. Gunning, "Strategies to improve mental health and well-being within the UK construction industry," *Proceedings of the Institution of Civil Engineers-Management, Procurement and Law*, vol. 173, no. 2, pp. 64-74, 2020.
- [24] G. A. Fordjour, A. P. C. Chan, and L. Tuffour-Kwarteng, "Exploring Construction Employees' Perspectives on the Potential Causes of Psychological Health Conditions in the Construction Industry: A Study in Ghana," *International Journal of Construction Education and Research*, pp. 1-21, 2020, doi: 10.1080/15578771.2020.1804491.
- [25] G. Ataa Fordjour, A. Chan, P. Amoah, and A. Fordjour, "Exploring the Effects of Occupational Psychological Disorders on Construction Employees and the Construction Industry," *Occupational Diseases and Environmental Medicine*, vol. 08, pp. 1-25, 01/01 2020, doi: 10.4236/odem.2020.81001.
- [26] B. News, "It's Past Time to Build Better Mental Health in the Construction Industry,"
- [27] G. Business, "What you should know about mental health and the UAE workforce,"
- [28] Z. Kronfol, M. Saleh, and M. Al-Ghafry, "Mental health issues among migrant workers in Gulf Cooperation Council countries: Literature review and case illustrations," *Asian Journal of Psychiatry*, vol. 10, pp. 109-113, 2014/08/01/2014, doi: <https://doi.org/10.1016/j.ajp.2014.03.003>.
- [29] F. Al-Maskari *et al.*, "Prevalence of depression and suicidal behaviors among male migrant workers in United Arab Emirates," *Journal of Immigrant and Minority Health*, vol. 13, no. 6, pp. 1027-1032, 2011.
- [30] A. Sajjad and W. Shahbaz, "Mindfulness and Social Sustainability: An Integrative Review," *Social Indicators Research*, vol. 150, no. 1, pp. 73-94, 2020/07/01 2020, doi: 10.1007/s11205-020-02297-9.
- [31] G. J. Westerhof and C. L. M. Keyes, "Mental Illness and Mental Health: The Two Continua Model Across the Lifespan," *Journal of Adult Development*, vol. 17, no. 2, pp. 110-119, 2010/06/01 2010, doi: 10.1007/s10804-009-9082-y.
- [32] C. Keyes, "Promoting and Protecting Mental Health as Flourishing: A Complementary Strategy for Improving National Mental Health," *The*

- American psychologist*, vol. 62, pp. 95-108, 02/01 2007, doi: 10.1037/0003-066X.62.2.95.
- [33] D. Borsboom, "A network theory of mental disorders," *World psychiatry*, vol. 16, no. 1, pp. 5-13, 2017.
- [34] M. Iasiello, J. Van Agteren, and E. Muir-Cochrane, "Evidence of the Complete State Model of Mental Health: Implications on public policy and practice," in *Third International Conference on Wellbeing and Public Policy*, 2018.
- [35] C. Keyes, "The Mental Health Continuum: From Languishing to Flourishing in Life," *Journal of health and social behavior*, vol. 43, pp. 207-22, 07/01 2002, doi: 10.2307/3090197.
- [36] K. M. Page and D. A. Vella-Brodrick, "The 'what', 'why' and 'how' of employee well-being: A new model," *Social indicators research*, vol. 90, no. 3, pp. 441-458, 2009.
- [37] C. D. Ryff, "Psychological well-being revisited: advances in the science and practice of eudaimonia," (in eng), *Psychotherapy and psychosomatics*, vol. 83, no. 1, pp. 10-28, 2014, doi: 10.1159/000353263.
- [38] W. A. Scott, "Research definitions of mental health and mental illness," *Psychological Bulletin*, vol. 55, no. 1, pp. 29-45, 1958, doi: 10.1037/h0042457.
- [39] M. Prince *et al.*, "No health without mental health," *The Lancet*, vol. 370, no. 9590, pp. 859-877, 2007/09/08/ 2007, doi: [https://doi.org/10.1016/S0140-6736\(07\)61238-0](https://doi.org/10.1016/S0140-6736(07)61238-0).
- [40] D. o. E. a. S. A. Disability, "Mental Health and Development,"
- [41] S. Developments, "THE GLOBAL GOALS," ed, 2020.
- [42] P. Y. Collins *et al.*, "Grand challenges in global mental health," *Nature*, vol. 475, no. 7354, pp. 27-30, 2011/07/01 2011, doi: 10.1038/475027a.
- [43] R. Jenkins, F. Baingana, R. Ahmad, D. McDaid, and R. Atun, "Health system challenges and solutions to improving mental health outcomes," *Mental health in family medicine*, vol. 8, pp. 119-27, 06/01 2011.
- [44] R. Jenkins, F. Baingana, R. Ahmad, D. McDaid, and R. Atun, "Mental health and the global agenda: core conceptual issues," (in eng), *Mental health in family medicine*, vol. 8, no. 2, pp. 69-82, 2011.
- [45] R. Jenkins, F. Baingana, R. Ahmad, D. McDaid, and R. Atun, "Social, economic, human rights and political challenges to global mental health," *Mental health in family medicine*, vol. 8, pp. 87-96, 06/01 2011.
- [46] N. Okkels, C. Kristiansen, P. Munk-Jørgensen, and N. Sartorius, "Urban mental health: Challenges and perspectives," *Current Opinion in Psychiatry*, vol. 31, p. 1, 03/01 2018, doi: 10.1097/YCO.0000000000000413.
- [47] R. Jenkins, F. Baingana, R. Ahmad, D. McDaid, and R. Atun, "International and national policy challenges in mental health," (in eng), *Mental health in family medicine*, vol. 8, no. 2, pp. 101-114, 2011.
- [48] S. Himmelfarb and S. A. Murrell, "Reliability and Validity of Five Mental Health Scales in Older Persons1," *Journal of Gerontology*, vol. 38, no. 3, pp. 333-339, 1983, doi: 10.1093/geronj/38.3.333.
- [49] VHR, "How Mental Health Impacts Employee Performance & Retention,"
- [50] (2018). *A GUIDE TO HAPPINESS & WELLBEING IN THE WORKPLACE*. [Online] Available: <https://www.hw.gov.au/en/download/a-guide-to-happiness-and-wellbeing-program-in-the-workplace-1>
- [51] R. Valaitis, D. Meagher-Stewart, R. Martin-Misener, S. Wong, M. MacDonald, and L. O'Mara, "Organizational factors influencing successful primary care and

- public health collaboration," *BMC Health Services Research*, vol. 18, 06/07 2018, doi: 10.1186/s12913-018-3194-7.
- [52] E. G. Lambert, N. L. Hogan, and R. I. Allen, "Correlates of correctional officer job stress: The impact of organizational structure," *American Journal of Criminal Justice*, vol. 30, no. 2, pp. 227-246, 2006/03/01 2006, doi: 10.1007/BF02885893.
- [53] K.-U. Rahman, W. Akhter, and S. U. Khan, "Factors affecting employee job satisfaction: A comparative study of conventional and Islamic insurance," *Cogent Business & Management*, vol. 4, no. 1, p. 1273082, 2017/01/01 2017, doi: 10.1080/23311975.2016.1273082.
- [54] N. Ailabouni, K. Gidado, and N. Painting, "Factors affecting employee productivity in the UAE construction industry," in *25th Annual ARCOM Conference, Nottingham, UK*, 2009, pp. 7-9.
- [55] L. Cheng, V. Hoe, A. Darus, and N. Bhoo-Pathy, "Association between night-shift work, sleep quality and health-related quality of life: a cross-sectional study among manufacturing workers in a middle- income setting," *BMJ Open*, vol. 10, p. 34455, 09/06 2020, doi: 10.1136/bmjopen-2019-034455.
- [56] V. K. Gudep, "An Empirical Study of the Relationships between the Flexible Work Systems (FWS), Organizational Commitment (OC), Work Life Balance (WLB) and Job Satisfaction (JS) for the Teaching Staff in the United Arab Emirates (UAE)," *International Journal of Management*, vol. 10, no. 5, 2019.
- [57] M. E. Ibrahim and A. Al Marri, "Role of gender and organizational support in work-family conflict for accountants in UAE," *International Journal of Commerce and Management*, 2015.
- [58] Z. Li, J. Dai, N. Wu, Y. Jia, J. Gao, and H. Fu, "Effect of long working hours on depression and mental well-being among employees in Shanghai: the role of having leisure hobbies," *International journal of environmental research and public health*, vol. 16, no. 24, p. 4980, 2019.
- [59] J. Cordery and S. Parker, "Work Design: Creating Jobs and Roles That Promote Individual Effectiveness," vol. 1, 2012, pp. 247-284.
- [60] V. Benuyenah and B. Pandya, "Measuring Employee Happiness in the UAE – Integrating Organisational Data into the National Statistics," *International Review of Management and Marketing*, vol. 10, pp. 83-92, 05/20 2020, doi: 10.32479/irmm.9698.
- [61] L. G. T. NGUYEN and H. T. PHAM, "Factors Affecting Employee Engagement at Not-For-Profit Organizations: A Case in Vietnam," *The Journal of Asian Finance, Economics and Business (JAFEB)*, vol. 7, no. 8, pp. 495-507, 2020.
- [62] A. Sageer, S. Rafat, and P. Agarwal, "Identification of variables affecting employee satisfaction and their impact on the organization," *IOSR Journal of business and management*, vol. 5, no. 1, pp. 32-39, 2012.
- [63] A. Al Nuaimi, "Low Employee Engagement in the UAE: Causes and Solutions to Overcome the Issue," in *Human Capital in the Middle East*: Springer, 2020, pp. 51-72.
- [64] B. Kashmoola, F. Ahmad, and Y. K. Kheng, "Job Satisfaction and Intention to Leave in SME Construction Companies of United Arab Emirates (UAE)," 2017.
- [65] C. Gagnon, E. John, and R. Theunissen, "Organizational health: A fast track to performance improvement," in "McKinsey Quarterly," 2017. [Online]. Available: <https://www.veruspartners.net/wp->

[content/uploads/2017/10/Organizational-health-A-fast-track-to-performance-improvement.pdf](https://content/uploads/2017/10/Organizational-health-A-fast-track-to-performance-improvement.pdf)

- [66] O. Learning. "Module 7: Consumer Behavior - Personal Factors." <https://courses.lumenlearning.com/suny-marketing-spring2016/chapter/reading-personal-factors/> (accessed).
- [67] B. R. Sharma and M. Mohapatra, "Personal & situational factors as predictors of managerial motivation," *Indian Journal of Industrial Relations*, pp. 426-440, 2009.
- [68] R. Seibt, S. Spitzer, D. Druschke, K. Scheuch, and A. Hinz, "Predictors of mental health in female teachers," *International Journal of Occupational Medicine and Environmental Health*, journal article vol. 26, no. 6, pp. 856-869, 2013, doi: 10.2478/s13382-013-0161-8.
- [69] M. B. D. Nielsen *et al.*, "Health, work, and personal-related predictors of time to return to work among employees with mental health problems," *Disability and Rehabilitation*, vol. 34, no. 15, pp. 1311-1316, 2012/07/01 2012, doi: 10.3109/09638288.2011.641664.
- [70] R. Considine *et al.*, "The Contribution of Individual, Social and Work Characteristics to Employee Mental Health in a Coal Mining Industry Population," *PLOS ONE*, vol. 12, no. 1, p. e0168445, 2017, doi: 10.1371/journal.pone.0168445.
- [71] L. Tisu, D. Lupşa, D. Vîrgă, and A. Rusu, "Personality characteristics, job performance and mental health: the mediating role of work engagement," *Personality and Individual Differences*, vol. 153, p. 109644, 2020/01/15/ 2020, doi: <https://doi.org/10.1016/j.paid.2019.109644>.
- [72] L. Luo, "Work motivation, job stress and employees' well-being," *Journal of applied management studies*, vol. 8, pp. 61-72, 1999.
- [73] M. Elovainio, M. Kivimäki, N. Steen, and T. Kalliomäki-Levanto, "Organizational and individual factors affecting mental health and job satisfaction: a multilevel analysis of job control and personality," *Journal of occupational health psychology*, vol. 5, no. 2, p. 269, 2000.
- [74] M. R. Islam, S. J. Miah, A. R. M. Kamal, and O. Burmeister, "A design construct of developing approaches to measure mental health conditions," *Australasian journal of information systems*, vol. 23, 2019.
- [75] O. M. Karatepe and L. Z. Tizabi, "Work-related depression in the hotel industry: a study in the United Arab Emirates," *International Journal of Contemporary Hospitality Management*, 2011.
- [76] Y. C. Lim, V. C. Hoe, A. Darus, and N. Bhoo-Pathy, "Association between night-shift work, sleep quality and health-related quality of life: a cross-sectional study among manufacturing workers in a middle-income setting," *BMJ open*, vol. 10, no. 9, p. e034455, 2020.
- [77] F. I. Saah and H. Amu, "Sleep quality and its predictors among waiters in upscale restaurants: A descriptive study in the Accra Metropolis," *PloS one*, vol. 15, no. 10, p. e0240599, 2020.
- [78] W. A. A. Khan, R. Conduit, G. A. Kennedy, and M. L. Jackson, "The relationship between shift-work, sleep, and mental health among paramedics in Australia," *Sleep Health*, vol. 6, no. 3, pp. 330-337, 2020/06/01/ 2020, doi: <https://doi.org/10.1016/j.sleh.2019.12.002>.

- [79] K. Piwowar-Sulej and D. Bąk-Grabowska, "Non-Permanent Employment and Employees' Health in the Context of Sustainable HRM with a Focus on Poland," *Social Sciences*, vol. 9, no. 7, p. 117, 2020.
- [80] A. O'Connor, T. Peckham, and N. Seixas, "Considering Work Arrangement as an "Exposure" in Occupational Health Research and Practice," *Frontiers in Public Health*, vol. 8, 08/04 2020, doi: 10.3389/fpubh.2020.00363.
- [81] M. Utzet, E. Valero, I. Mosquera, and U. Martin, "Employment precariousness and mental health, understanding a complex reality: a systematic review," *International Journal of Occupational Medicine and Environmental Health*, vol. 33, no. 5, pp. 569-598, 2020.
- [82] X. Sun, H. Xu, M. A. Köseoglu, and F. Okumus, "How do lifestyle hospitality and tourism entrepreneurs manage their work-life balance?," *International Journal of Hospitality Management*, vol. 85, p. 102359, 2020.
- [83] K. Lendák-Kabók, "Women's work-life balance strategies in academia," *Journal of Family Studies*, pp. 1-19, 2020.
- [84] K. Keyko, G. G. Cummings, O. Yonge, and C. A. Wong, "Work engagement in professional nursing practice: A systematic review," *International Journal of Nursing Studies*, vol. 61, pp. 142-164, 2016/09/01/ 2016, doi: <https://doi.org/10.1016/j.ijnurstu.2016.06.003>.
- [85] R. L. Repetti, "Social Factors in the Workplace and Mental Health," 1985.
- [86] J. W. Whiteoak and R. L. Manning, "Emotional intelligence and its implications on individual and group performance: a study investigating employee perceptions in the United Arab Emirates," *The International Journal of Human Resource Management*, vol. 23, no. 8, pp. 1660-1687, 2012.
- [87] B. Verkuil, S. Atasayi, and M. L. Molendijk, "Workplace bullying and mental health: a meta-analysis on cross-sectional and longitudinal data," *PloS one*, vol. 10, no. 8, p. e0135225, 2015.
- [88] I. Chatziioannidis, F. G. Bascialla, P. Chatziivalsama, F. Vouzas, and G. Mitsiakos, "Prevalence, causes and mental health impact of workplace bullying in the Neonatal Intensive Care Unit environment," *BMJ open*, vol. 8, no. 2, 2018.
- [89] S. Einarsen and M. B. Nielsen, "Workplace bullying as an antecedent of mental health problems: a five-year prospective and representative study," *International archives of occupational and environmental health*, vol. 88, no. 2, pp. 131-142, 2015.
- [90] L. Delagran, "How Does Your Personal Environment Impact Your Wellbeing?," ed. University of Minnesota.
- [91] A. P. Sarode and M. Shirsath, "The factors affecting employee work environment & it's relation with employee productivity," *international Journal of Science and Research*, vol. 3, no. 11, pp. 2735-2737, 2014.
- [92] H. Han and S. S. Hyun, "Green indoor and outdoor environment as nature-based solution and its role in increasing customer/employee mental health, well-being, and loyalty," *Business Strategy and the Environment*, vol. 28, no. 4, pp. 629-641, 2019.
- [93] M. Patterson, P. Warr, and M. West, "Organizational climate and company productivity: The role of employee affect and employee level," *Journal of occupational and organizational psychology*, vol. 77, no. 2, pp. 193-216, 2004.

- [94] J. Dextras-Gauthier, A. Marchand, and V. Haines III, "Organizational culture, work organization conditions, and mental health: A proposed integration," *International Journal of Stress Management*, vol. 19, no. 2, p. 81, 2012.
- [95] W. Loretto, S. Platt, and F. Popham, "Workplace change and employee mental health: Results from a longitudinal study," *British Journal of Management*, vol. 21, no. 2, pp. 526-540, 2010.
- [96] K. W. Kuhnert, R. R. Sims, and M. A. Lahey, "The relationship between job security and employee health," *Group & Organization Studies*, vol. 14, no. 4, pp. 399-410, 1989.
- [97] K. W. Kuhnert and D. R. Palmer, "Job security, health, and the intrinsic and extrinsic characteristics of work," *Group & Organization Studies*, vol. 16, no. 2, pp. 178-192, 1991.
- [98] P. Virtanen, J. Vahtera, M. Kivimäki, J. Pentti, and J. Ferrie, "Employment security and health," *Journal of Epidemiology & Community Health*, vol. 56, no. 8, pp. 569-574, 2002.
- [99] M. Majumder, "Multi criteria decision making," in *Impact of urbanization on water shortage in face of climatic aberrations*: Springer, 2015, pp. 35-47.
- [100] J. R. Eastman, *Multi-criteria and multi-objective decision making for land allocation using GIS*. The Clark Labs for Cartographic Technology and Geographic Analysis Clark University Worcester USA, 2020.
- [101] G.-H. Tzeng and J.-J. Huang, *Multiple attribute decision making: methods and applications*. CRC press, 2011.
- [102] M. Alvandi, S. Fazli, and M. Memarzade, "Novel MCDM method for supplier selection in E-SCM," *European Journal of Scientific Research*, vol. 67, pp. 16-44, 12/01 2011.
- [103] A. Rabbani, M. Zamani, A. Yazdani-Chamzini, and E. K. Zavadskas, "Proposing a new integrated model based on sustainability balanced scorecard (SBSC) and MCDM approaches by using linguistic variables for the performance evaluation of oil producing companies," *Expert Systems with Applications*, vol. 41, no. 16, pp. 7316-7327, 2014/11/15/ 2014, doi: <https://doi.org/10.1016/j.eswa.2014.05.023>.
- [104] J. J. Stanković, I. Marjanović, J. Papatthanasiou, and S. Drezgić, "Social, Economic and Environmental Sustainability of Port Regions: MCDM Approach in Composite Index Creation," *Journal of Marine Science and Engineering*, vol. 9, no. 1, 2021, doi: 10.3390/jmse9010074.
- [105] V. S. Narwane, V. S. Yadav, R. D. Raut, B. E. Narkhede, and B. B. Gardas, "Sustainable development challenges of the biofuel industry in India based on integrated MCDM approach," *Renewable Energy*, vol. 164, pp. 298-309, 2021/02/01/ 2021, doi: <https://doi.org/10.1016/j.renene.2020.09.077>.
- [106] L. Xie, J. He, P. Cheng, R. Xiao, and X. Zhou, "A multi-criteria 2-tuple linguistic group decision-making method based on TODIM for cholecystitis treatments selection," *IEEE Access*, vol. 7, pp. 127967-127986, 2019.
- [107] H. Zhao and S. Guo, "Selecting Green Supplier of Thermal Power Equipment by Using a Hybrid MCDM Method for Sustainability," *Sustainability*, vol. 6, no. 1, 2014, doi: 10.3390/su6010217.
- [108] M.-T. Lu, C.-C. Hsu, J. J. H. Liou, and H.-W. Lo, "A hybrid MCDM and sustainability-balanced scorecard model to establish sustainable performance evaluation for international airports," *Journal of Air Transport Management*,

- vol. 71, pp. 9-19, 2018/08/01/ 2018, doi: <https://doi.org/10.1016/j.jairtraman.2018.05.008>.
- [109] A. Anand, D. D. Winfred Rufuss, V. Rajkumar, and L. Suganthi, "Evaluation of Sustainability Indicators in Smart Cities for India Using MCDM Approach," *Energy Procedia*, vol. 141, pp. 211-215, 2017/12/01/ 2017, doi: <https://doi.org/10.1016/j.egypro.2017.11.094>.
- [110] S. Nechi, B. Aouni, and Z. Mrabet, "Managing sustainable development through goal programming model and satisfaction functions," *Annals of operations research*, vol. 293, no. 2, pp. 747-766, 2020.
- [111] A. Arabsheybani, M. M. Paydar, and A. S. Safaei, "An integrated fuzzy MOORA method and FMEA technique for sustainable supplier selection considering quantity discounts and supplier's risk," *Journal of Cleaner Production*, vol. 190, pp. 577-591, 2018/07/20/ 2018, doi: <https://doi.org/10.1016/j.jclepro.2018.04.167>.
- [112] A. Sarkar, S. Panja, D. Das, and B. Sarkar, "Developing an efficient decision support system for non-traditional machine selection: an application of MOORA and MOOSRA," *Production & Manufacturing Research*, vol. 3, no. 1, pp. 324-342, 2015.
- [113] W. K. M. Brauers and E. K. Zavadskas, "Robustness of MULTIMOORA: a method for multi-objective optimization," *Informatica*, vol. 23, no. 1, pp. 1-25, 2012.
- [114] E. G. Genc and O. D. Basar, "Comparison of country ratings of credit rating agencies with moora method," *Business and Economics Research Journal*, vol. 10, no. 2, pp. 391-404, 2019.
- [115] A. Darko, A. P. C. Chan, E. E. Ameyaw, E. K. Owusu, E. Pärn, and D. J. Edwards, "Review of application of analytic hierarchy process (AHP) in construction," *International journal of construction management*, vol. 19, no. 5, pp. 436-452, 2019.
- [116] R. V. Vargas and P. IPMA-B, "Using the analytic hierarchy process (AHP) to select and prioritize projects in a portfolio," in *PMI global congress*, 2010, vol. 32, no. 3, pp. 1-22.
- [117] M. Waris *et al.*, "An application of analytic hierarchy process (AHP) for sustainable procurement of construction equipment: Multicriteria-based decision framework for Malaysia," *Mathematical Problems in Engineering*, vol. 2019, 2019.
- [118] W. K. M. Brauers, E. K. Zavadskas, F. Peldschus, and Z. Turskis, "Multi-objective decision-making for road design," *Transport*, vol. 23, no. 3, pp. 183-193, 2008.
- [119] D. RiosInsuaSimonFrench, *A framework for sensitivity analysis in discrete multi-objective decision-making*. School of Computer Studies, University of Leeds, Leeds LS2 9JT, UK, 2021.
- [120] N. P. Rudduck, *Multi-Objective Decision Making: A Critical Analysis of The Applicability Of Renewable Energy Technologies*. Paper presented at the SPE Asia Pacific Oil & Gas Conference and Exhibition, Adelaide, Australia, 2012.
- [121] P. Karande and S. Chakraborty, "Application of multi-objective optimization on the basis of ratio analysis (MOORA) method for materials selection," *Materials & Design*, vol. 37, pp. 317-324, 2012.

- [122] E. K. Zavadskas, *Project management by multimoora as an instrument for transition economies*. Vilnius Gediminas Technical University, Sauletekio al. 11, Vilnius, 10223, Lithuania, 2019.
- [123] A. Baležentis, T. Baležentis, and W. K. Brauers, "Personnel selection based on computing with words and fuzzy MULTIMOORA," *Expert Systems with applications*, vol. 39, no. 9, pp. 7961-7967, 2012.
- [124] M. Mesran, R. K. Hondro, M. Syahrizal, A. P. U. Siahaan, R. Rahim, and S. Suginam, "Student Admission Assessment using Multi-Objective Optimization on the Basis of Ratio Analysis (MOORA)," *Journal Online Jaringan COT POLIPD (JOJAPS)*, vol. 10, no. 7, 2017.
- [125] B. Dey, B. Bairagi, B. Sarkar, and S. Sanyal, "A MOORA based fuzzy multi-criteria decision making approach for supply chain strategy selection," *International Journal of Industrial Engineering Computations*, vol. 3, no. 4, pp. 649-662, 2012.
- [126] G. Campanella and R. A. Ribeiro, "A framework for dynamic multiple-criteria decision making," *Decision Support Systems*, vol. 52, no. 1, pp. 52-60, 2011.
- [127] Y. Liu, J. Li, and Y. Yang, "Strategic adjustment of land use policy under the economic transformation," *Land Use Policy*, vol. 74, pp. 5-14, 2018.
- [128] T. Hahn, F. Figge, J. Pinkse, and L. Preuss, "A paradox perspective on corporate sustainability: Descriptive, instrumental, and normative aspects," *Journal of Business Ethics*, vol. 148, no. 2, pp. 235-248, 2018.
- [129] M. Ying, H. Shan, and G. A. Tikuye, "How Do Stakeholder Pressures Affect Corporate Social Responsibility Adoption? Evidence from Chinese Manufacturing Enterprises in Ethiopia," *Sustainability*, vol. 14, no. 1, p. 443, 2021.
- [130] C. R. Carter and P. L. Easton, "Sustainable supply chain management: evolution and future directions," *International journal of physical distribution & logistics management*, 2011.
- [131] G. T. M. Hult, "Market-focused sustainability: market orientation plus!," vol. 39, ed: Springer, 2011, pp. 1-6.
- [132] M. M. Ajmal, M. Khan, M. Hussain, and P. Helo, "Conceptualizing and incorporating social sustainability in the business world," *International Journal of Sustainable Development & World Ecology*, vol. 25, no. 4, pp. 327-339, 2018.
- [133] B. C. Holtom, T. R. Mitchell, and T. W. Lee, "Increasing human and social capital by applying job embeddedness theory," *Organizational dynamics*, vol. 35, no. 4, pp. 316-331, 2006.
- [134] C. Darcy, J. Hill, T. McCabe, and P. McGovern, "A consideration of organisational sustainability in the SME context: A resource-based view and composite model," *European Journal of Training and Development*, 2014.
- [135] P. Paillé, N. Amara, and N. Halilem, "Greening the workplace through social sustainability among co-workers," *Journal of Business Research*, vol. 89, pp. 305-312, 2018.
- [136] V. Mani, C. J. C. Jabbour, and K. T. Mani, "Supply chain social sustainability in small and medium manufacturing enterprises and firms' performance: Empirical evidence from an emerging Asian economy," *International Journal of Production Economics*, vol. 227, p. 107656, 2020.

- [137] C. Gelhard and S. Von Delft, "The role of organizational capabilities in achieving superior sustainability performance," *Journal of business research*, vol. 69, no. 10, pp. 4632-4642, 2016.
- [138] S. S. Rai, S. Rai, and N. K. Singh, "Organizational resilience and social-economic sustainability: COVID-19 perspective," *Environment, Development and Sustainability*, vol. 23, no. 8, pp. 12006-12023, 2021.
- [139] E. Hofmann and M. Rüsçh, "Industry 4.0 and the current status as well as future prospects on logistics," *Computers in industry*, vol. 89, pp. 23-34, 2017.
- [140] V. Venkatesh, K. Kang, B. Wang, R. Y. Zhong, and A. Zhang, "System architecture for blockchain based transparency of supply chain social sustainability," *Robotics and Computer-Integrated Manufacturing*, vol. 63, p. 101896, 2020.
- [141] B. Esmailian, J. Sarkis, K. Lewis, and S. Behdad, "Blockchain for the future of sustainable supply chain management in Industry 4.0," *Resources, Conservation and Recycling*, vol. 163, p. 105064, 2020.
- [142] J. Leng *et al.*, "Blockchain-empowered sustainable manufacturing and product lifecycle management in industry 4.0: A survey," *Renewable and sustainable energy reviews*, vol. 132, p. 110112, 2020.
- [143] G. Aceto, V. Persico, and A. Pescapé, "A survey on information and communication technologies for industry 4.0: State-of-the-art, taxonomies, perspectives, and challenges," *IEEE Communications Surveys & Tutorials*, vol. 21, no. 4, pp. 3467-3501, 2019.
- [144] S. Agrawal and M. L. Das, "Internet of Things—A paradigm shift of future Internet applications," in *2011 Nirma University International Conference on Engineering*, 2011: IEEE, pp. 1-7.
- [145] J. Tan and S. G. Koo, "A survey of technologies in internet of things," in *2014 IEEE International Conference on Distributed Computing in Sensor Systems*, 2014: IEEE, pp. 269-274.
- [146] W. Zhou, Y. Jia, A. Peng, Y. Zhang, and P. Liu, "The effect of iot new features on security and privacy: New threats, existing solutions, and challenges yet to be solved," *IEEE Internet of things Journal*, vol. 6, no. 2, pp. 1606-1616, 2018.
- [147] J. H. Kim, B. W. Jo, J. H. Jo, and D. K. Kim, "Development of an IoT-Based Construction Worker Physiological Data Monitoring Platform at High Temperatures. LID - 10.3390/s20195682 [doi] LID - 5682," (in eng), no. 1424-8220 (Electronic).
- [148] P. Kuhar, K. Sharma, Y. Hooda, and N. K. Verma, "Internet of Things (IoT) based Smart Helmet for Construction," in *Journal of Physics: Conference Series*, 2021, vol. 1950, no. 1: IOP Publishing, p. 012075.
- [149] D. Calvetti, P. Mêda, M. Chichorro Gonçalves, and H. Sousa, "Worker 4.0: The future of sensed construction sites," *Buildings*, vol. 10, no. 10, p. 169, 2020.
- [150] L. Li, J. Yu, H. Cheng, and M. Peng, "A Smart Helmet-Based PLS-BPNN Error Compensation Model for Infrared Body Temperature Measurement of Construction Workers during COVID-19," *Mathematics*, vol. 9, no. 21, p. 2808, 2021.
- [151] J. Häikiö, J. Kallio, S.-M. Mäkelä, and J. Keränen, "IoT-based safety monitoring from the perspective of construction site workers," *International Journal of Occupational and Environmental Safety*, vol. 4, no. 1, pp. 1-14, 2020.
- [152] U. Bodkhe *et al.*, "Blockchain for industry 4.0: A comprehensive review," *IEEE Access*, vol. 8, pp. 79764-79800, 2020.

- [153] A. Al Sadawi, B. Madani, S. Saboor, M. Ndiaye, and G. Abu-Lebdeh, "A comprehensive hierarchical blockchain system for carbon emission trading utilizing blockchain of things and smart contract," *Technological Forecasting and Social Change*, vol. 173, p. 121124, 2021.
- [154] M. Swan, *Blockchain : blueprint for a new economy*. [Sebastopol, Calif.]: O'Reilly (in English), 2015.
- [155] M. Iansiti and K. R. Lakhani, "The Truth about Blockchain," 2017.
- [156] M. Singh and S. Kim, "Blockchain technology for decentralized autonomous organizations," in *Advances in computers*, vol. 115: Elsevier, 2019, pp. 115-140.
- [157] F. Elghaish *et al.*, "Blockchain and the 'Internet of Things' for the construction industry: research trends and opportunities," *Automation in Construction*, vol. 132, p. 103942, 2021/12/01/ 2021, doi: <https://doi.org/10.1016/j.autcon.2021.103942>.
- [158] Ž. Turk and R. Klinc, "Potentials of Blockchain Technology for Construction Management," *Procedia Engineering*, vol. 196, pp. 638-645, 2017/01/01/ 2017, doi: <https://doi.org/10.1016/j.proeng.2017.08.052>.
- [159] J. Mason, "Intelligent contracts and the construction industry," *Journal of Legal Affairs and Dispute Resolution in Engineering and Construction*, vol. 9, no. 3, p. 04517012, 2017.
- [160] P. W. Jun WANG, Xiangyu WANG, Wenchi SHOU, "The outlook of blockchain technology for construction engineering management," *Front. Eng.*, vol. 4, no. 1, pp. 67-75, 2017-04-19 2017, doi: 10.15302/j-fem-2017006.
- [161] P. Singh, "Blockchain based Security Solutions with IoT Application in Construction Industry," *IOP Conference Series: Earth and Environmental Science*, vol. 614, no. 1, p. 012052, 2020/12/01 2020, doi: 10.1088/1755-1315/614/1/012052.
- [162] V. J. Morkunas, J. Paschen, and E. Boon, "How blockchain technologies impact your business model," *Business Horizons*, vol. 62, no. 3, pp. 295-306, 2019.
- [163] W. Goddard and S. Melville, *Research methodology: An introduction*. Juta and Company Ltd, 2004.
- [164] M. Saunders, P. Lewis, and A. Thornhill, "Research methods for business students," *Essex: Prentice Hall: Financial Times*, 2003.
- [165] V. Ahmed, A. Opoku, and Z. Aziz, *Research methodology in the built environment: a selection of case studies*. Routledge, 2016.
- [166] M. T. Easterby-Smith and R. Thorpe, "R. and Lowe, A.(2002)," *Management research: An introduction*, vol. 2, p. 342, 2002.
- [167] R. Fassinger and S. L. Morrow, "Toward best practices in quantitative, qualitative, and mixed-method research: A social justice perspective," *Journal for Social Action in Counseling & Psychology*, vol. 5, no. 2, pp. 69-83, 2013.
- [168] J. Gregar, "Research Design (Qualitative, Quantitative and Mixed Methods Approaches)," *Book published by SAGE Publications* 228, 1994.
- [169] Y. Mai, Z. Zhang, and Z. Wen, "Comparing Exploratory Structural Equation Modeling and Existing Approaches for Multiple Regression with Latent Variables," *Structural Equation Modeling: A Multidisciplinary Journal*, vol. 25, no. 5, pp. 737-749, 2018/09/03 2018, doi: 10.1080/10705511.2018.1444993.
- [170] D. Iskamto, P. Ghazali, A. Ghazali, A. Afthanorhan, and A. Bon, *Exploratory Factor Analysis (EFA) To Measure Entrepreneur Satisfaction*. 2020.

- [171] L. S. Lai and W. M. To, "Content analysis of social media: A grounded theory approach," *Journal of Electronic Commerce Research*, vol. 16, no. 2, p. 138, 2015.
- [172] H. F. Kaiser, "A revised measure of sampling adequacy for factor-analytic data matrices," *Educational and Psychological Measurement*, vol. 41, no. 2, pp. 379-381, 1981.
- [173] R. Anchala, E. Di Angelantonio, D. Prabhakaran, and O. H. Franco, "Development and validation of a clinical and computerised decision support system for management of hypertension (DSS-HTN) at a primary health care (PHC) setting," *PloS one*, vol. 8, no. 11, p. e79638, 2013.

# Appendix A

## **Social Sustainability Interview Questions**

### **Section I – Interviewee’s Profile**

1. Years of experience: \_\_\_\_\_
2. Years of experience working at a supervisory/HR Manager position: \_\_\_\_\_
3. Department: \_\_\_\_\_
4. Industry: \_\_\_\_\_
5. Designation/Position: \_\_\_\_\_
6. Number of years in the organization: \_\_\_\_\_

### **Section II – Organization’s Profile**

1. Size of organization
  - Small Organizations: Less than 10 employees
  - Small – Medium Organization: 10 - 50 employees
  - Medium Size Organization: Less than 100 employees
  - Medium – large size Organization: Between 100 -500 employees
  - Large organization: More than 500 employees
2. Organization Types
  - Multinational
  - Local/ Government Organization
  - Nongovernment Organization
  - International Organization
3. Does your organization have an Occupational Health/Organizational Health department?
  - Yes
  - No
4. Does your organization offer following services?
  - Wellness Programs (Social Support Services, Counselling Services)
  - Retirement plans.
  - Medical insurance.
  - Disability insurance.
  - Others: Please Specify (if any)

### **Section III – General Questions (Related to Supervisory/HR manager tasks)**

1. What is your role and responsibility in your current organization?

---

---

---

2. What has been the most difficult challenge you have faced in your entire experience as a Supervisor/HR manager?

---

---

---

3. In your experience, have you deal with the issues of employee mental health and wellbeing? If yes, then how?

---

---

---

**Section IV – Social Sustainability**

1. Have you come across the term 'Social Sustainability' in your years of experience?

Yes  No

2. Which of the following you think define social sustainability?

- Equality
- Diversity
- Quality of Life (Mental health and Wellbeing, Work-life balance)
- Democracy and Governance (To make sure budget and resources are adequate to sustain sustainability programs and the ability to measure it such as Wellness program, Training and development, Organization Culture, Safety and Security)
- Social Cohesion (sense of belonging, Social Support (peers, supervisors))

3. In your expertise, how you define 'Social Sustainability' and its practices?

---

---

---

4. What does 'Social Sustainability' mean to your organization. What are the current practices adopted by your organization for Social Sustainability?

---

---

---

5. In your opinion, what are the challenges and enablers of social sustainability in the industry.

Challenges: \_\_\_\_\_

---

---

Enablers: \_\_\_\_\_

---

---

6. What are the initiatives and policies (if any) by the government that commits your organization to social sustainability?

---

7. Does your organization consider 'Social Sustainability' factors in its five-year plan and budget planning? If yes, then, how?

---

---

---

**Section V – Social Sustainability Criteria**

Based on your experience, which of these criteria (found from the literature) you perceived to be relevant to the 'Social Sustainability' of the employees in the organization.

S#	Criteria	Relevant	Not Relevant	Comments
1	Personality Type (introvert, Extrovert)			
2	Marital Status (Married, Single, Divorced, Widowed)			
3	Family Type			
<b>Organizational Factor</b>				
4	Organization Structure			
5	Management involvement and awareness			
6	Flexible or Fixed work systems			
7	Work Design (Job control) - How much control they have over project, team, resources, and time selection			
8	Person - Job fit (the job meets the goals and skills set of the employee)			
9	Timely Payment of Salaries			
10	Role ambiguity/ Role clarity			
11	Role Conflict - Working different roles that requires different outcome			
12	Training and Development			
13	Salary Satisfaction			
<b>Personal Factors</b>				
14	Self-Efficacy - Self efficacy means a personal judgment of how well or poorly a person can cope with a given situation based on the skills			
15	Work motivation			
16	Burnout - How the job made them feel in the past few weeks			
17	Emotional Exhaustion			
18	Personal accomplishment/ Depersonalize			
19	Sleep Quality			
20	Contract Type			
21	Work-Life balance			
<b>Social Factors</b>				
22	Spousal support			
23	Job demand - Physical and psychological demand of the job			
24	Social support			
25	Association with supervision/ Employee perception of supervisor's/ Leadership Style/ Competencies of supervisors			
26	Self-Organizational Commitment			
<b>Environmental Factors</b>				
27	Organizational Culture			
28	Working environment and condition (Lighting, Noise, Colour, and Air Quality)			
29	Work stress/ Workload			
30	Job Security/Safety			
31	Pay Equity			
32	Gender Equality			

2. In your opinion, Kindly mention any criteria/factor that impact 'Social Sustainability' in the organization which is left out of the list.

---



---



---



---

**Thank you for your participation.**

## **Vita**

Sara Saboor was born in 1992, in Pakistan. She was educated from the Army Public School. She did her Bachelor's in Electrical Engineering with majors in Electronics, where she was awarded the highest academic award Quaid-e-Azam Gold medal for outstanding performance in bachelor's studies for a CGPA of 3.99. She received her master's degree in Electrical Engineering (Telecommunication) from National University of Sciences and Technology (NUST), one of the top universities in Pakistan.

Ms. Sara moved to UAE in 2015 and was given a chance to explore the field of Human resources as an HR personnel. Her studies and professional experience in the field have ignited an unending passion in her, due to which she applied for PhD in Engineering System Management in the American University of Sharjah. She also worked as Graduate Teaching and Research Assistant for four years at American University of Sharjah. She was awarded Outstanding CEN Graduate teaching assistant and university award of excellence in research.