IMPACT OF COVID ON CONSTRUCTION INDUSTRY OF PAKISTAN

By

Rizwan Ahmad

(Registration No: 00000330303)

Department of Urban & Regional Planning

School of Civil and Environmental Engineering

National University of Sciences & Technology (NUST) Islamabad, Pakistan

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Rizwan Ahmad

(Registration No: 00000330303)

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(NUST) Islamabad, Pakistan

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HoD Urban & Regional Planning
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School of Civil & Environmental Engineering
National University of Sciences and Technology

Date: _____

Signature (Associate Dean, NICE) _____

Dr. S. Muhammad Jamil
Associate Dean
NICE, SCEE, NUST

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Principal & Dean
SCEE, NUST

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Examination Committee Members

1. Name: Dr Shahbaz Altaf - URP (NICE) Signature:

2. Name: Dr Khurram Iqbal - CEM (NICE) Signature:

Supervisor's name: Dr Abdul Waheed (HoD URP) Signature:

Date: 12/3/24

Head of Department

HoD Urban & Regional Planning
National University of Sciences and Technology

Date:

Associate Dean

Date:

Dr. S. Muhammad Jamil
Associate Dean
NICE, SCEE, NUST

COUNTERSIGNED

Date: 03 APR 2024

Principal & Dean

PROF DR MUHAMMAD IRFAN
Principal & Dean
SCEE, NUST

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Student Name: Rizwan Ahmad Signature:

Examination Committee:

a) External Examiner 1: Name Dr Shahbaz Altaf Signature:

b) External Examiner 2: Name Dr Khurram Iqbal Signature:

Supervisor Name: Dr Abdul Waheed Signature:

Name of HOD: Dr Abdul Waheed Signature:

Name of Associate Dean: Signature:

Name of Dean/Principal: Signature:

HoD Urban & Regional Planning

Dr. S. Muhammad Jamil
Associate Dean
NICE, SCEE, NUST

PROF DR MUHAMMAD IRFAN
Principal & Dean
SCEE, NUST

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DEDICATION

I dedicate this thesis to my family and teachers, whose unwavering support and encouragement have been the driving force behind my academic journey. Your belief in my abilities has been my constant inspiration. This work is a reflection of the lessons you have taught me and the strength you have instilled in me. And also for all the people who lost someone during Covid-19 pandemic.

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ABSTRACT

The COVID-19 pandemic is a highly consequential global health crisis of considerable magnitude in contemporary times. The worldwide ramifications of this phenomena have profoundly transformed work settings and the welfare of employees, resulting in an increased recognition of psychological and physical well-being. The COVID-19 epidemic has had a significant influence on the construction industry, necessitating efforts to improve the safety and well-being of its workforce. The research aims to enhance comprehension of factors and establish an initial assessment framework that can aid in the identification of issues and priority areas encountered within the Construction Industry during the COVID-19 pandemic. The objective of this study is to ascertain the health and safety hazards encountered by construction workers amidst the pandemic and propose appropriate management strategies to mitigate these risks. A thorough examination of current scholarly literature, industry insights, reports, and other pertinent sources was undertaken in order to collect and categorize the requisite data. Seventeen challenges associated with the COVID-19 pandemic were classified into four distinct categories. The results indicated that several factors, such as hazardous work conditions, overwhelming work demands, domestic situations, and concerns over employment stability, often contribute to the development of anxiety, despair, and perhaps suicidal tendencies. A total of eleven techniques were identified to effectively tackle these difficulties. The findings indicated that enhancing worksite safety by using strategies such as signage placement, keeping appropriate worker distances, supplying sanitizers and washing stations in the fields, and utilizing efficient technology might enhance project efficiency and guarantee worker well-being. The findings of this study will provide valuable insights for project managers and authorities within the construction industry, enabling them to better understand the challenges posed by the epidemic and effectively adopt strategies to improve the well-being and safety of their workforce. Furthermore, this paper presents an initial COVID evaluation framework that enables the construction industry, particularly contractors, consultants, and vendors, to gain a deeper understanding of and effectively handle the current situation. This framework aids in making informed decisions and strategies to mitigate the existing threats posed by the pandemic.

CHAPTER 1 - INTRODUCTION

COVID-19 is the short form Carona Virus Disease. SARS-CoV-2, short form of “Severe Acute Respiratory Syndrome Carona Virus 2, is the agent which causes this disease. It started in city of China which is known as Wuhan in December, 2019 which now considered as Global threat to Human beings. World Health Organization declared it a pandemic on 11 march, 2020 and uptill 28 June, 2020, this virus is known as COVID-19 which has caused approx. total 502,772 deaths (Piret and Boivin 2021).

The following disease can be transmitted in the form of infectious respiratory droplets when it comes direct in contact with Mouth, eyes, or nose through direct or indirect contact of the infected surfaces. For the following reason, strict lockdown was imposed by most of the governments around the globe. Its main purpose was to restrict the movement of people around and assembling so that they can reduce the transmission of virus. These lockdowns were lifted by the government with time as they try to control the transmission of such virus and meanwhile social distancing concept and strict SOPs is implemented. Such implementation on policies has disturbed the world economy severely. Each and every industry has been affected severely. As per the data, 5.9% in March and 40.1% during the lockdown in April, construction industry of UK was shrink down and mass downsizing was announced by the companies to cope with economic crisis with over 5000 jobs loss (Jawad, Maroof et al. 2021).

The pandemic had a significant impact on the construction industry. The architects and designers in Pakistan experienced significant repercussions, compelling them to vacate their workplaces and engage in remote work. Nevertheless, a substantial workforce was necessary to be present at the construction site during the implementation phase. The contractors' capacity was also impacted, resulting in the suspension of certain site operations and the infection of a significant portion of the labor force with Covid-19. The occurrence of material supply and payment delays can be attributed to insufficient resources, cash flows, and payment obligations. The interconnection of these components is evident. A series of delays, contractual payments, and decreased production have been caused by these causes. Contractors often encounter several primary obstacles, including the effective management of financial flows, the availability of trained workforce, and the timely completion of projects. The epidemic is causing significant disruptions to all three

sectors, resulting in contractors facing considerable pressure. The building industry holds significant importance in the economies and social welfare of the majority of countries. It accounts for 10% of employment and 8% of GDP in the UK. (Piret and Boivin 2021). This research aims to provide all existing information published on COVID-19 in several different formats during the last couple of years establishing the main challenges faced by the construction industry so that they can prepare to minimize the effect and to continue to be competitive. The findings of this research will be beneficial to various stakeholders of construction industry of Pakistan especially the service providers i.e contractors consultants, vendors, clients and policy makers. The conclusion of the study can also help the international scenario since COVID has affected globally in the similar way with slight local differences of local policies, norms and specific local characteristics.

Contractors require a starting reference point to navigate through crises and strategize for the future within a dynamic and ever-evolving context. This research is essential as it provides contractors with exact information regarding the new scenario brought about by the COVID-19 pandemic. Furthermore, this paper presents an initial COVID evaluation framework that enables the construction industry, particularly contractors, consultants, and vendors, to gain a deeper understanding of and effectively handle the current situation. This framework aids in making informed decisions and strategies to mitigate the existing threats posed by the pandemic.

1.1 Justification for the selection of the Topic

The research will be conducted to identify major problems that the construction industry is facing during the corona virus pandemic in Pakistan. The study will able to identify the following aspects effecting contractors during the coronavirus pandemic; on site health and safety regulations, the economic impact of the coronavirus pandemic, the possible legal implications on the contractor, the instabilities of supply chain and subcontractors, and the uncertainty caused by constant evolution of the coronavirus pandemic. It will cover financial, social and time overrun effects.

As the topic for this research is new and unfamiliar, there was not sufficient literature to support the impact of the pandemic from the perspective of the construction. Therefore, this research will prove to be beneficial to any research that may be conducted in the future. This research will try to take into account all the aspect that are affecting contractors in all the aspects and provides a detailed overview of the new consequences that arose due to the coronavirus pandemic. This study

will also provide a detailed framework for COVID assessment to mitigate these problems and to effectively plan and strategize for any future project that will be taken on by the contractor in construction industry of Pakistan.

The findings of this study will be beneficial for both contractors and any stakeholders in the construction industry, along with the sub-contractors suppliers and policy makers. The framework proposed will be beneficial for both local and foreign contractors respectively taking into account their respective local government policies regarding COVID pandemic.

1.2 Objectives

- Investigating the financial effects on construction projects due to COVID
- Investigating the Social impacts of COVID on workers, contractors and other stakeholders of the construction industry
- Studying the time over run changes observed in the construction practices since the COVID started.
- Suggesting strategies to mitigate the effects of the COVID on the construction industry.

1.3 Relevance to National Needs

Concluding thoughts:

- Contractors have a legal obligation to ensure the health and safety of all their staff.
- The spread of the coronavirus is to be controlled by practicing proper social distancing guidelines along with good hygiene practices such as frequent hand washing, using face masks and disinfecting any work surfaces. Formulation of a special task force dedicated to overview all these measures being conducted.
- The decreased onsite productivity may be increased by evolving with the changes and minimizing the distance of social distancing to at least 1 meter wherever the normal 2 meters is not possible.
- It is necessary to go with the study of impact of COVID on construction industry of Pakistan to analyze the financial, social, and time over run effect due to it

- The coronavirus pandemic has created many interruptions in onsite activity, lack of manpower and disruptions in supply chain. Insolvency has also played a vital role in shrinkage of the construction industry
- This research will determine that the degree of the effect of each variable on each contractor primarily relies on the size of the company, the rules and regulation imposed by local government, and the sector that the contractor works in. Small projects and SMEs may be more effected than larger organizations
- COVID-19 is constantly evolving and has created an uncertain conditions that have proved difficulties in a lot of inter connected factors which has made predicting the future more difficult for contractors and stakeholders.

1.3.1 **Advantages of Research**

This research work will not help for the case study area alone, but also it will result in helping the construction industry of Pakistan. Furthermore, the study will help us in investigating the financial effects on construction projects due to COVID, investigating the social impacts of COVID on workers, contractors and other stakeholders of the construction industry, it will also help in studying the time over run changes observed in the construction practices since the COVID started and suggesting strategies to mitigate the effects of the COVID on the construction industry.

1.4 Areas of Application

- Researchers: This research work will facilitate research endeavor among civil engineering students of Pakistan
- Stakeholders: The results of this study are anticipated to yield advantages for several stakeholders within the construction sector of Pakistan, with a particular focus on contractors. Additionally, suppliers, subcontractors, consultants, owners, and policymakers are all expected to benefit from these findings.
- General Public: This research will help the general public as due to time over run of project when it is affected by COVID, other than the stakeholders, public who is directly or indirectly linked with the project
- Other: Government authorities, health experts, policy makers

CHAPTER 2 - LITERATURE REVIEW

2.1 Construction Industry Pre COVID-19

Construction industry is considered as an important sector of the economy and have multiple forward and backward connection with other sectors. In Socio Economic development and employment, construction industry plays an important role. On certain common issues, there is a consensus that curse the construction industry in the developing countries(Rasheed, Rizwan et al. 2021).

The construction industry and its associated activities are significant contributors to economic growth, development, and overall economic activity. The construction and engineering services sectors are crucial for the economic advancement and growth of a corporation. It is regarded as a chance to create and establish a system for hiring a diverse workforce, including skilled, partially skilled, and unskilled workers. This phenomenon offers potential for income generation in both the formal and informal sectors. The inclusion of construction items and engineering procedures contributes to the generation of foreign exchange revenues within this industry.

The actions of construction industry are crucial to achieve the goals and objectives of the country's socioeconomic development as the progress is highly dependent on this sector, including the provision of employment, refuge, and infrastructure. It includes buildings such as schools, hospitals, offices, townships, homes, and other structures as well as urban infrastructure, utilities services such as sewerage and drainage, water supply. Similarly, highways, roads, ports, railways, airports, as well as agriculture systems, power systems and irrigation, telecommunications among other things. This industry encompasses all economic endeavours that are centered on the development, enhancement, repair, or expansion of fixed assets, including buildings and engineering-based land improvements. Additionally, this sector serves as a catalyst for the expansion of other businesses by facilitating both forward and backward connections, thereby generating substantial employment prospects. Hence, it is imperative to provide assistance to this industry in order to foster robust economic expansion.

Similarly, to the Nation's economy and society, Pakistan construction industry plays an important role. Contrarily, the sectors development has not kept pace with market demands despite Pakistan's potential market share in both the local and international economy. Thanks to the recent economic

growth in the form of CPEC, Pakistan today provides a raise in market for the construction industry. In order to take the benefits of this chance, Government of Pakistan has developed enormous expansions plans for the infrastructure works. When proper efforts are made to accomplish these goals, all these programmes have the ability to help the nation's local industry gaining respect and international status. The difficulties will be even great with the chance for advancement(Rasheed, Rizwan et al. 2021).

2.2 Success factors for construction industry

The construction industry is characterized by its dynamic nature. The definition of project performance in this area remains ambiguous. The perception of success in projects varies across different contexts and individuals. While several authors prioritize money, time, and quality as the main objectives, others contend that success is a more intricate matter. The construction business, like most other industries, is characterized by its dynamic nature. The increasing volatility of technology, financial resources, and development methodologies has resulted in a more dynamic environment. Over the course of a facility's lifespan, a project is successfully executed by a combination of premeditated and unanticipated occurrences and interactions, characterized by evolving models and processes within a dynamic environment. The construction industry is not only transient, fragmented, and short-term, but it also possesses similar attributes. The efficiency of project teams, particularly project managers, is significantly influenced by these traits. Project success refers to the process of improving the existing situation. However, the definition of this phrase has remained ambiguous according to experts in the construction business. Many project managers persist in employing an intuitive method to tackle this issue as they endeavour to effectively manage and distribute resources across various project domains (Jawad, Maroof et al. 2021).

Despite the fact that numerous researchers have investigated this subject, no consensus has been reached. Success in a project implies different things to different individuals. In addition to the success criteria of project continue to evolve as time passes. In order to build a framework for statistically and qualitatively quantifying construction success, it is necessary to conduct a comprehensive review of the available research. Each project team and each industry has its own concept regarding success. Pariff and Sanvido view success as an intangible perception feeling measuring criteria that varies management objectives varies between individuals and varies

between project phases. In truth, each of the project's owners, designers, consultants, contractors, and subcontractors have their own set of success criteria(Jawad, Maroof et al. 2021). For instance, architects could put utility or aesthetics above constructing costs. However, the client's viewpoint can be different. Additionally, a person's definition of success differs from project to project. Depending on the kind, size, complexity, experience of the participants and owners, and other factors, different projects may have different definitions of success.

A lot of researchers have shown a great deal of interest in this topic during the last ten years. Chan (1996; 1997) carried out a thorough analysis of project success measurement in the late 1980s and early 1990s. Nevertheless, following Chan's analysis, further research has been released. By providing a critical study of project performance over the last ten years, this report seeks to close the gap (Iqbal, Ahmad et al. 2021).

In the early 1990s, a project's success was inextricably linked to performance metrics, which in turn were connected to the project's goals. Time, money, and project performance all played a role in determining project success. The three main factors that determine whether a project is successful are time, cost, and quality. Nearly every article in the field, including Walker (1995; 1996), Belassi and Tukel (1996), and Hatush and Skidmore (1998), mentions these three factors and emphasises their importance from both the project's perspective and that of the participants (1997). The "Iron Triangle" is the name Atkinson (1999) gave to these three elements. The success criteria of money, time, and quality have persisted and are included in the real definition of project management, he adds, despite the fact that there have been several definitions of the term produced (Iqbal, Ahmad et al. 2021).

Pinto (1991) proposed that project psychosocial outcomes, or the satisfaction with interpersonal relationships with project team members, should also be included in measurements of project success in addition to these three essential requirements. "Soft" measures are subjective measurements, such as the degree of participant satisfaction. The addition of happiness as a success indicator was discussed in Wuellner's prior work as early as 1990. Additionally, Pocock et al. (1996) noted that this project success statistic bears "no legal claims." Another issue that the construction sector takes very seriously is safety. It is fair to suppose that both contractors and clients may be subject to legal claims, financial damage, and delays in contracts in the case of an accident. Kometa et al. (1995) used an extensive methodology to assess a project's performance.

These prerequisites include user adaptability, safety, economy (cost), operating/maintenance costs, and time. According to Songer and Molenaar (1997), a project is successful if it is finished on time, within budget, meets user expectations, adheres to specifications, is built using high-quality materials, and causes the least amount of construction bother. In their investigation on project appraisal, Kumaraswamy and Thorpe (1996) took a variety of variables into account. Budget, timetable, artisan quality, client and project management satisfaction, technology transfer, stewardship of the environment, and health and safety are a few of them(Iqbal, Ahmad et al. 2021).

According to Shenhar et al. (1997), project success should be broken down into four categories. These four time-dependent dimensions are shown in Figure 1. The length of time between the project's execution and conclusion makes up the first dimension. Soon after the client receives the project, the second dimension may be assessed. The third dimension can be assessed when a particular amount of sales have been made (one to two years). After the project is finished, it will take three to five years to analyse the fourth dimension.

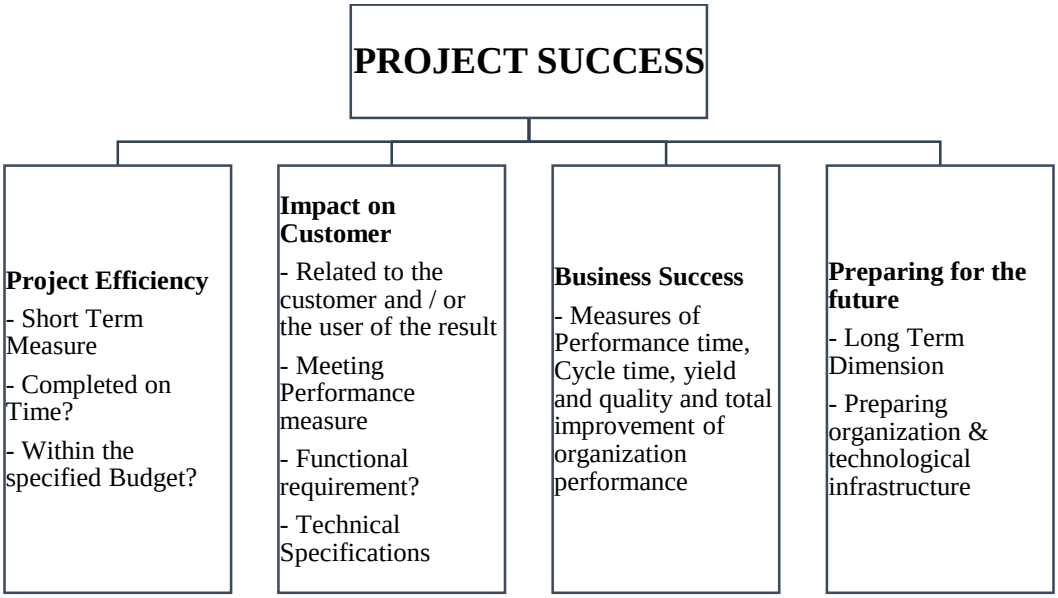

Figure 1: The Four Dimensions of project success

Atkinson (1999) defined the success of a project in a similar fashion by dividing it into three stages: the first stage is called "the delivery stage: the process: doing it correctly," the second stage is called "the post-delivery stage: the system: getting it right," and the third stage is called "the post delivery stage: the benefits: getting them right." Figure 2 illustrates the methodology that Atkinson recommends for determining whether or not a project was successful (Iqbal, Ahmad et al. 2021).

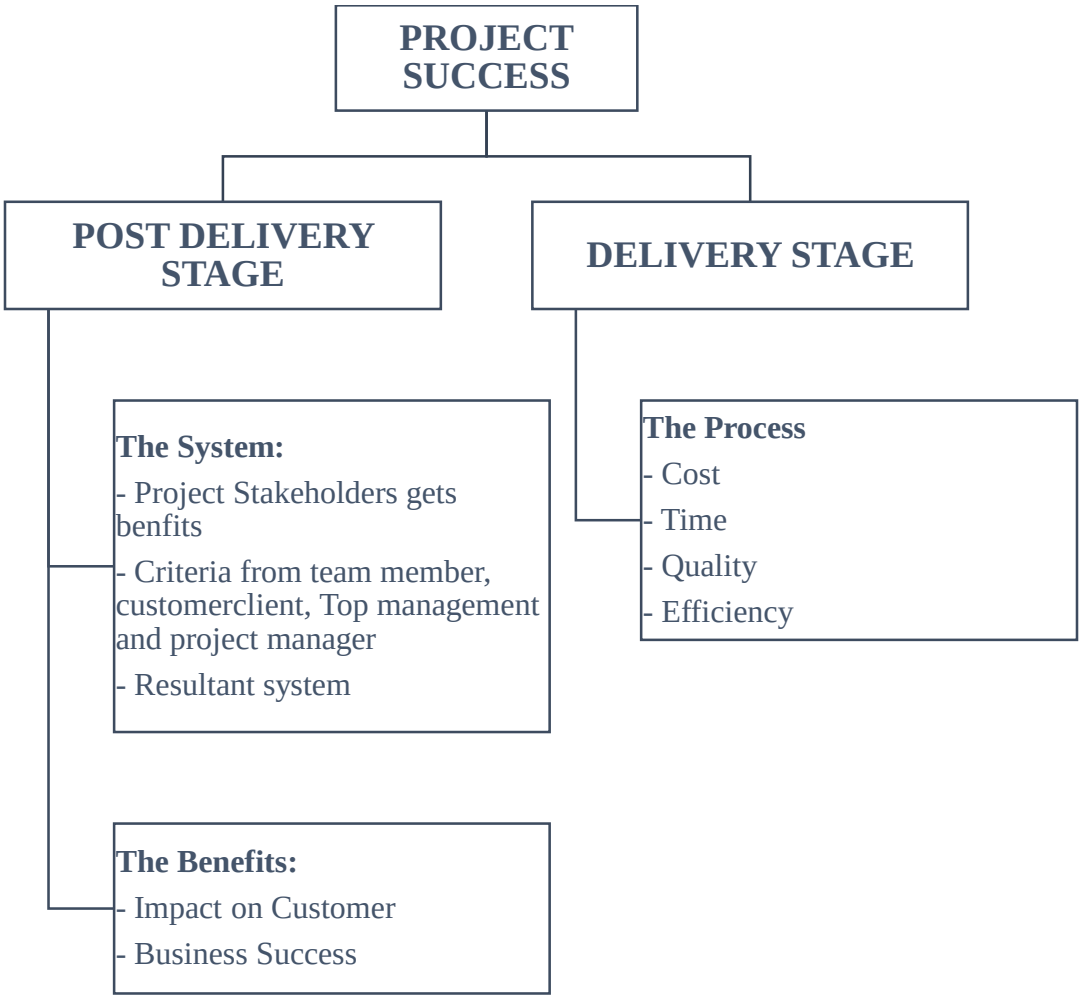

Figure 2: Atkinson Model of Measuring Project Success

According to Lim and Mohamed (1999), the success of a project should be evaluated from the perspectives of several stakeholders, including the individual owner, the developer, the contractor, the user, the general public, etc. The global and the micro viewpoints on the success of the project have each been presented as their own separate category. Figure 3 illustrates micro and macro viewpoints on the successful completion of a project (Jawad, Maroof et al. 2021).

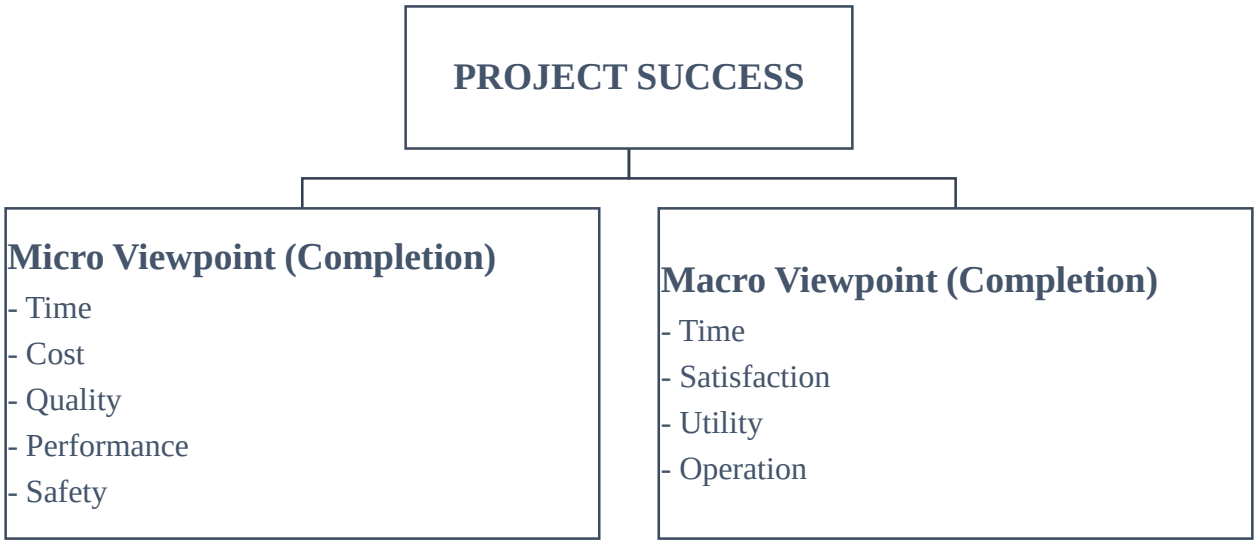

Figure 3: Micro and Macro Viewpoints of Project Success

According to an examination of the relevant literature, a number of different criteria were proposed by various academics. The several measurements developed by prior scholars are enumerated in table, which can be found below. A comprehensive framework for evaluating the success of building projects is depicted in Figure 4.

Figure 4: Consolidated Framework for measuring Project Success

2.3 History of Pandemic

Despite the lack of modern case definitions and medical language, authors have documented pandemics of their period during the previous two thousand years. This is despite the fact that it is difficult to differentiate between the illnesses and the agents that cause them due to the absence of contemporary case definitions. Some of these historic pandemics had a significant impact on the human civilizations that they occurred in. During the reign of Emperor Justinian (CE 541–542), a devastating outbreak of bubonic plague swept across Europe, Asia, and North Africa, killing millions of people. It is estimated that as much as 25 percent of the population has died in a number of different locations. The Byzantine Empire suffered losses as a result of the epidemic, losses from which it never completely recovered. The bubonic plague, sometimes known as the Black Death, swept through Europe between the years 1346 and 1353. It is possible that during these years, the plague claimed the lives of one-third or more of Europe's population, and it is estimated

that it took two centuries for the population to recover to the levels it had reached before the pandemic. As a direct consequence of this, well-established social, political, and religious institutions were severely shaken up. The quarantine on incoming ships in Italy was imposed for a period of forty days and was given the Italian word "quarantino." This was done in an effort to prevent the spread of disease. This is the place where the modern concept and phrase for quarantine first emerged. Instances of the bubonic plague continued to appear all over Europe for hundreds of years. John Graunt recorded the events of the plague year of 1665 in the mortality data that he compiled for London. He documented 9,967 births and 87,326 deaths, of which 68,595 were connected to the plague, resulting in a net population loss of 77,359 people. The plague was responsible for the majority of the deaths. In comparison, there were 8,097 reported deaths the year before, with only five of them being attributed to the epidemic. Since 1817, there have been seven pandemics of the disease cholera. During the cholera epidemic that occurred in London in the year 1854, John Snow pinpointed Broad Street as the epicentre of the disease and placed the blame on the neighborhood's public water pump. He famously removed the pump handle to prevent other incidents, but he also noted that the number of fatalities in the area had already dropped as a result of people fleeing a known focus point. This led him to conclude that removing the handle was not necessary (Piret and Boivin 2021).

The United States experienced the two cholera pandemics from 1829 to 1837, the third pandemic from 1846 to 1860, which spread along the routes to the California Gold Rush and the Oregon Trail, the fourth pandemic from 1863 to 1875, which was especially severe along the Mississippi River, including New Orleans, and the sixth pandemic from 1899 to 1923, which led to a small number of cases in New York City and the establishment of a quarantine facility there in 1910-1911. During the second pandemic, there were instances of uprisings in both the United States and Europe, targeting suspected source populations, government institutions, and quarantine measures. Within a span of less than a decade, a worldwide outbreak of influenza occurred, facilitated by the movement of both military personnel and civilians during World War I. Spain, being the sole western nation exempt from censorship and hence capable of reporting the epidemic, took the initiative to do so earliest, resulting in the erroneous classification of the pandemic as the Spanish Flu. The healthcare sector experienced a state of being inundated. The economic impact of the closing of bars, restaurants, libraries, and other communal spaces is detrimental to the local economy in several urban areas, such as Seattle. It was projected that influenza would result in the

mortality of around 2.5% of the worldwide population, with notable geographical disparities. The fatality rate in New York City experienced an upsurge during the influenza pandemic of 1918-1919. However, it is important to remember that this peak is significantly overshadowed by the cholera pandemic fatalities that occurred in the previous century. It is worth mentioning that the scale refers to deaths per thousand population (Piret and Boivin 2021).

There have been epidemics that have spread throughout a whole continent, but they are not pandemics. Ships in the 16th century brought a variety of infectious diseases that were common in Europe to the Americas, where the local population had no previous experience with them. It is possible that the Native American population was reduced due to the lack of herd immunity, which prevented repeated outbreaks of diseases like as measles, mumps, and smallpox. There have been epidemics that have spread throughout a whole continent, but they are not pandemics. By the year 1620, when the Mayflower arrived in the New World, the population of the Americas in the 16th century had dropped by 90 percent. The term "endemic" may be used to refer to major infectious causes of mortality that have happened more recently rather than "pandemic." Over the course of the past several years, the death toll caused by HIV/AIDS around the globe has decreased to a level below one million per year. In addition, each year, endemic worldwide diseases such as hepatitis C and malaria are responsible for the deaths of millions of people. Pneumonia and diarrheal diseases are two more major contributors to death rates all over the world (Piret and Boivin 2021).

On March 11, 2020, the World Health Organisation (WHO) announced that COVID-19 is now considered a pandemic. As of the middle of April, the total number of cases had topped two million, and more than 125,000 people had died as a result (Piret and Boivin 2021). One thing can be said for certain. There will always be a risk of epidemics and pandemics. Infectious diseases and the epidemics that they cause will have a significant impact on the people all over the world. The response that we have to future epidemics will be influenced by the lessons that we have learned from the bubonic plague, cholera, influenza, and COVID-19. In point of fact, the knowledge that we have right now might be able to assist us in the identification, treatment, and avoidance of epidemics such as tuberculosis and hepatitis C, as well as an age that has not yet been established for the future.

2.4 Effect of pandemic on construction Industry

The full name of the Carona Virus Disease is abbreviated as COVID-19. Syndrome of Acute Respiratory Deficiency (SARDS) SARS-CoV-2 is the abbreviated form of the coronavirus 2, which is the causative agent of this illness. It first appeared in December of 2019 in the city of Wuhan in China, and it is now considered a threat to humanity on a global scale. According to the World Health Organisation (WHO), as of June 28, 2020, the virus known as COVID-19 was responsible for a total of 502,772 fatalities worldwide. The pandemic was declared on March 11, 2020. The following disease is contagious and is transmitted by infectious respiratory droplets through contact with the eyes, nose, or mouth, as well as infected surfaces. Because of the following rationale, the majority of governments all over the world enacted rigorous lockdowns. The primary purpose of these lockdowns was to limit the mobility of people and the size of gatherings in order to impede the spread of the virus: Although some governments were eventually able to reduce these lockdowns in an effort to slow the spread of this illness, the notion of social separation is still strictly adhered to. The adoption of such policies has been extremely disruptive to the economy of the entire world. Every single industry was impacted by the issue. The numbers show that the construction industry in the UK decreased by 5.9% in March and by 40.1% during the shutdown in April. As a result of the economic crisis, firms have announced mass layoffs of over 5000 workers. The pandemic caused widespread disruption in the construction sector. Because of the disastrous impact the pandemic had on the United Kingdom, architects and designers were forced to work from home. Nevertheless, in order to meet the deadline, it was necessary to have a sizeable staff present on-site while the activity was being carried out. The capacities of the contractors were significantly reduced as a result of the outbreak. Because COVID-19 has infected a sizeable proportion of the staff, a number of facilities have been forced to temporarily halt their business operations. There have been holdups in both the supply of materials and the payment. Everything is a direct consequence of there being an inadequate amount of monetary flows, resources, and payments. Because of the interconnected nature of these problems, an ongoing cycle of delays, lower production, and missing payments has emerged as a direct consequence. During a pandemic, it is the responsibility of contractors to ensure the safety of the environment. Keeping a healthy cash flow, finishing projects on time, and finding skilled workers are often the three biggest challenges that contractors face. The epidemic has a negative impact on all three of them. Hence, contractors bear significant Pressure. The construction industry

makes a considerable contribution, both economically and socially, to the well-being of the majority of countries. It contributes 8% to the gross domestic product of the UK and 10% of the labour force. In order to produce the first scoping review in this field, the purpose of this study is to examine all of the existing information that has been published in a variety of formats over the past two years. This will allow the study to identify the most significant challenges that contractors face as a result of Covid so that they can prepare to mitigate those challenges and remain competitive. It is predicted that the findings will be beneficial for a wide variety of parties involved in the Pakistani construction industry. These participants include contractors, suppliers, subcontractors, consultants, owners, and policymakers. The findings of this study are applicable to situations that are analogous elsewhere in the world since, in today's globalised world, a portion of the pandemic's effects affect contractors in a manner that is equivalent to one another, despite the fact that there are certain regional variances as a result of local regulations and particular regional quirks. Contractors require a starting point in order to successfully handle the current crisis and plan for the future in a climate that is always altering. This research is vital because it equips contractors with precise information on the new circumstances brought about by COVID. In addition, the outcome of this paper is a preliminary COVID evaluation framework. This framework will enable contractors and the construction industry in general to better understand and evaluate the current situation and to make decisions that are more informed when planning strategies to minimise the risks that this pandemic entails (Adu-Gyamfi, Brenya et al. 2021).

The outbreak of the Corona virus (COVID-19) has caused widespread devastation in the globalised world we live in today. The COVID-19 pandemic has a detrimental effect on virtually all commercial, economic, and social pursuits. In a similar manner, the present economic slump is having an effect on the construction and engineering industries. Because the corona virus is an infectious disease, construction work has been temporarily paused in order to avoid the spread of the disease while also keeping the concerns of those who work in the construction industry in mind. As a result, the construction industry is suffering losses, which has implications for the economy of the entire world. Additionally, it has caused disruptions in the transportation system, which has an effect on the delivery of goods. As a consequence of the severe financial difficulties being experienced by a number of construction companies, a significant number of employees are being let off. The whole construction industry is currently experiencing a precarious downward spiral. This article investigates how Covid-19 has affected the building sector in eight different

countries: India, the United States of America, China, Italy, the United Kingdom, Australia, Russia, and the United Arab Emirates. The results of an analysis performed on the influence that COVID-19 had on the economies and construction sectors of a number of different countries are detailed in the table below. The consequences that COVID-19 will have on the building sector all over the world have been well researched, as evidenced by the material provided by each of these countries (Adu-Gyamfi, Brenya et al. 2021).

The impact of COVID-19 on the gross domestic product, employment rate, and building industry in the countries listed below:

Table 1: Impact of COVID-19 on Globally

Country	**Country's GDP shrink**	**Percentage of the total GDP came from construction**	**Construction company**	**Construction worker**	**Losses in construction**	**Country's overall unemployment**
INDIA	23.9% GDP of India Shrinks	Construction Sector – 8% of India GDP	There are 200 firms in the construction industry in India. In addition to these, there are 120000 class A contractors in government construction industries.	There are a total 5.1crore construction workers in the country	The impact of the Corona virus on India's construction industry is costing an estimated Rs 30,000 crore every day.	The number of unemployed in India has risen to 27.11% due to Corona virus(COVID-19) in the first week of may.
USA	Economy of U.S.A. diminished 4.8% in the 1st quarter of 2020 due to Corona Virus pandemic which has shut down the country.	In 2019, the value of the construction industry in the United States contributed 4.1% of GDP.	There are over 700000 construction company.	11.2 million people work in the construction sector.	45% of contractors are facing destruction related to the out breaks.	Corona virus outbreak raises unemployment by 14.7% in April 2020 and job losses reach 20.5 million.
CHINA	The Chinese economy shrank 6.8% in the first quarter of the year 2020.	the construction industry accounted for 6.8% of china's GDP. The industry was valued at 894 billion USD with five percent annual growth	There are about 32900 construction firms.	In 2018, the number of workers in China's construction industry was approximately 55.6 million.	As a result of this lockdown, all construction work has stopped and the amount of capital investment has decreased. China losses RMB 10 million from construction.	Unemployment rate in March 2020 was 5.9%.
ITALY	Italy's GDP fell by 4.7% in 1st quarter from the foregoing three months to March 2020.	From the 1st quarter of 2020 to 2nd quarter of 2020 GDP from construction in Italy shrunk from 15803.80 EUR million to 12168.40 EUR million.	Around 20,000 construction companies.	In 2016, there are 210781 employer in building construction industry.	The growth forecast for the Italian construction industry has been revised and the construction industry is expected to contract 0.7% in 2020, 1.5% growth is lower than previously forecast because of the effect	Italy's unemployment rate fell to 8.4% in March 2020.

					of the COVID-19 outbreak.	
UK	UK economy shrank by a record of 5.8% in March 2020.	Construction industry of UK contributes 6% of GDP.	There are 343,000 construction business in UK.	A total of 2.2 million people work directly or indirectly in the construction industry across the UK.	In this pandemic, the loss of U.K. construction industry is £301.5 million per day.	UK unemployment rate for three months to march 2020 was estimated at 3.9%.
AUSTRALIA	The Australian economy has shrunk by 10%.	The construction industry generates more than $360 billion and 9% of the country's total GDP comes from here.	There are more than 360000 building and construction	In 2019, more than 115 million people were employed in the construction industry which was 9% of all Australian jobs.	Australian construction losses about $5 billion due to COVID-19 pandemic.	The unemployment rate rose to 6.8% in August 2020.
RUSSIA	Russia GDP will shrink 5% in 2020.	From the 1st quarter of 2020 to 2nd quarter of 2020 GDP from construction in Russia increased from 708.60 RUB Billion to 1045.60 RUB Billion.	235000	In 2005, there are 10.9% employer works at construction	In this pandemic situation, Russia will face 10% of financial recession in construction sector.	Russia's unemployment rate jumps 30% in May 2020.
UAE	GDP shranks 1% in March 2020	The construction industry contributed approximately 6.4% to GDP in 2018.	In 2017, There was 11755 construction project in UAE.	10 million.	The construction industry is facing costly pressures and productivity has declined due to lack of labor.	Unemployment rate in UAE will reach 2.8% by the end of 2020.

The number of people who have fallen victim to COVID-19 keeps climbing, which has ramifications for the construction industry. The supply chain is being disrupted as a result of

government lockdowns, worker shortages are developing, businesses are experiencing economic difficulties, and they are having trouble retaining various contracts.

2.4.1 Supply chain Management

The global supply chain has encountered various obstacles across multiple regions worldwide. Due to the lockout, workers are prohibited from accessing the construction site externally to obtain the necessary building supplies for the project, resulting in a deceleration of development progress. The importation of different building goods is prohibited due to their origin from diverse manufacturers situated either domestically or internationally, and their transportation via separate carriers. Due to the inability of certain autos to comply with lockdown measures, the delivery of essential supplies has been impeded, hence rendering the completion of work unattainable. Not only has it caused the building industry to become non-functional, but it has also endangered the livelihoods of individuals whose occupations involve transporting these materials in their vehicles. Moreover, the enterprises engaged in the production of these commodities are experiencing substantial economic setbacks due to the lack of sales.

2.4.2 Transportation Problem

Because of the lockdown that has been implemented across the entire country, all forms of transportation have been impacted. As a result of this, the construction sector is not receiving any materials, and its workers are unable to perform any tasks remotely. Because of this, work has come to a halt.

2.4.3 Labour Shortage

As a result of the complete shutdown of the public transport system, workers are first unable to get to their places of employment. Second, because the illness is caused by a viral infection, employees who come into contact with one another have a greater chance of spreading the illness to one another. As a consequence of this, a lot of workers are reluctant to come into the office. Because of this, it is not possible to coerce people into labour when they are not protected.

2.4.4 Financial Problem

Due to the cessation of operations in the firms, there is a lack of profitability and, conversely, a surge in incurred losses. In addition to the company's financial losses, all suppliers providing

essential supplies to enterprises in the construction industry are also experiencing significant losses due to this situation. Due to the company's failure, the supply chain has been disrupted, leading to the cessation of activities in the factories responsible for producing the items. Consequently, significant losses have been incurred in terms of the manufactured products. Moreover, due to the lack of sales of factory-produced goods and the closure of the building industry, the government is incapable of collecting the requisite tax revenue from any of these areas. The aforementioned phenomenon exerts a direct influence on the gross domestic product (GDP) of a nation, and a decline in the GDP of a particular country engenders adverse repercussions on the global economy (Ali, Ahmed et al. 2021).

2.4.5 Contractual Implication Problems

It places a significant amount of emphasis on a phrase that is titled "Force majeure." The phrase "Large-Scale Pandemic" is one of the several limits that are specifically outlined in this paragraph. This category includes the COVID-19 pandemic that recently swept the globe. Because of this shutdown, all of these pieces of equipment have been left unused for a substantial portion of time. If the 'force majeure' clause is present in the contract, the government agency will not pay the contractor any compensation for any delays that occur as a result of the clause. When independent contractors stop working, it can cost a business a significant amount of money (Ali, Ahmed et al. 2021).

2.4.6 Unemployment

The shutdown has resulted in significant economic loss to the affected companies. Because of this, businesses are unable to provide their workers with proper compensation, and as a result, the company is laying off a significant number of employees. As a result of this, a number of positions have been terminated. Their families are also going through a number of challenges as a direct result of them losing their jobs. All things considered, a precarious situation has arisen.

2.5 Construction industry during COVID in Pakistan

Projects are unique and unique experiences that address unique problems with unique management challenges, which vary in both nature and origin. Two prevalent approaches employed by project managers to address emerging difficulties are the augmentation of established practices and the formulation of innovative methodologies. Scholars are emphasizing the utilization of a project-

specific framework as a viable alternative to the traditional approach of employing a universal strategy. It is crucial for the success of a project to ascertain the characteristics of the project and choose an appropriate project management approach. Numerous studies have indicated that the International Journal of Managing Projects in Business adopts a unique approach to project management, hence distinguishing its project endeavors from those of its counterparts. Sauer et al. argue that due to the unique nature of each project, it is not suitable to employ a uniform management approach. In conjunction with project-specific problems, external and unanticipated events like as armed conflicts and global health crises lead to an escalation in the level of risk connected with the endeavors. The present COVID-19 epidemic has brought an element of uncertainty and hindered the construction industry due to its abnormally high scale. Hence, it is crucial to comprehend the extent of the impact that COVID-19 exerts on the construction sector to effectively mitigate its consequences or adjust to the new norm (Iqbal, Ahmad et al. 2021).

In today's modern era, the COVID-19 outbreak has caused significant disruptions in the areas of healthcare, the economy, and society. It has messed with the normal functioning of many different kinds of businesses and organisation. Uncertainty has permeated every sector of the economy and every professional field, including project management in the construction sector. Since the end of World War II, COVID-19 has become the greatest public health, social, and economic disaster. The virus has a significant risk of spreading to others due to its rapid global spread, which has resulted in the deaths of hundreds of thousands of people (Jawad, Maroof et al. 2021). Up until November 14, 2020, the virus will have been responsible for approximately 1,290,653 deaths and will have infected approximately 52,487,476 people in 214 countries and territories (WHO, 2020a). During the first year of the pandemic, there was neither a cure nor a vaccination that could be used to protect people from becoming infected with this novel virus. As a result, the shutdown was a measure of last option that was put into place to stop the spread of a virus that could not be contained by using measures that are more traditionally used. As a result of lockdowns in a number of different locations of the world, the global supply chain was disrupted, and a great number of businesses were forced to shut down. This led to an increase in unemployment as well as delays in projects all across the world. The virus' most recent waves are currently making its way through a number of countries, including Italy, the United States, Spain, Russia, Pakistan, and others. This disease has also had a significant impact on Pakistan (Rasheed, Rizwan et al. 2021).

As of the 14th of November in 2020, the virus has infected around 349,992 people in Pakistan and was responsible for 7,055 deaths there (Ashfaq and Bashir 2021). Because of the sudden onset of the epidemic, every sector of the economy has been shaken up, but the building and construction sector has been particularly hard hit.

A number of construction projects have a poor reputation for their inability to deal with the unfavourable effects that are brought on by change. These projects have failed to meet their required completion times, costs, and levels of quality. According to research, the unprecedented lockdown and supply constraints that were implemented during the Covid-19 epidemic had a significant impact on the availability of building supplies (Ashfaq and Bashir 2021). The outbreak has caused a number of changes to be made to the projects, such as modifications to the schedules, finances, scope, and even project objectives. Individuals are now able to work from the comfort of their own homes while following to specific standards of confinement and physical separation in the event that they are obliged to be present at project locations. This was made possible as a result of the dramatic changes brought about by technological advancements in the modes of communication and working patterns. This creates a substantial barrier for businesses that are tasked with implementing initiatives in the midst of the widespread fear and uncertainty that is currently present in the markets. Organisations encounter various challenges when overseeing projects amidst a pandemic, encompassing the effective management of virtual teams, insufficient monitoring and reporting mechanisms, suboptimal data management practices, stakeholder relationship complexities, scarcity of necessary resources, financial constraints, limited public transportation options and travel restrictions, inadequate medical infrastructure, proliferation of misinformation and rumors pertaining to the pandemic, and persistent distress experienced by workers at project sites. Overseeing project delivery during a pandemic presents numerous obstacles, many of which are complex to tackle and overcome using a conventional project management approach. The construction industry, widely recognized as a vital sector and a fundamental pillar of the economy, experiences financial costs due to the need to tackle these difficulties (Ali, Ahmed et al. 2021). These costs can be attributed to the fact that the construction industry has to deal with these challenges. The construction industry contributes to fundamental development goals such as the generation of income and the creation of jobs. In Pakistan, the construction industry is responsible for supporting 42 auxiliary sectors in addition to employing approximately 7% of the country's labour force. According to the Pakistan economic survey 2019–

2020, throughout the past five fiscal years, the construction sector has contributed between 2.3% and 2.85% (approximately PKR 316 billion) to Pakistan's GDP (Gross Domestic Product) (Ashfaq and Bashir 2021). According to these research, the survival of the building sector is absolutely essential in order to forestall the projected financial troubles that would follow in the wake of the current epidemic. Because the industry will simultaneously contribute to reestablishing the equilibrium of society. As a result, it is of the utmost importance to search for innovative methods of managing construction projects during times of crisis and opportunities given by the current epidemic.

2.5.1 Financial Effects

One of the countries that has been hit the worst by the coronavirus outbreak is Pakistan. According to the Ministry of National Health Services Regulations and Coordination in 2020, the disease has killed approximately 2.1% of the more than 240,000 persons who have been affected by it. On March 24, 2020, the government of Pakistan implemented a comprehensive lockdown in an effort to stop the spread of the disease (Ashfaq and Bashir 2021). During this time, only essential businesses and industries were permitted to continue operating. On the other hand, a significant proportion of the population in Pakistan is impoverished and possesses either very little or almost no savings to cushion the blow of a slowdown in economic activity. Many of them participate on a daily basis in wagering activities that are associated with the underground economy; yet, the distancing measures and economic limits have left them without any sources of revenue. After seven weeks, the administration came to the realisation that strong limitations are not a viable long-term solution due to the significant economic constraints. As a result, the government began gradually lifting the lockdown. Even though the quarantine period in Pakistan has been much shorter than it has been in the vast majority of other countries, the outbreak is nevertheless wrecking havoc on the country's economy. The Pakistani government responded to the effects of the economic shock by enacting a number of policies that fall under the category of fiscal policy expansion. In order to jumpstart the lethargic economy and ensure the population's food security, the government has unveiled an economic assistance package with a total value of PKR 1.2 trillion (about USD 8 billion). It provided tax relief for the industries that were hit the hardest and lowered customs duties on a number of essential imports ("PM Imran launches financial stimulus plan," 2020). This was in stark contrast to the government's response to previous recent economic crises,

which highlighted budgetary consolidation and austerity measures. Those crises occurred in the preceding few years (Ali, Ahmed et al. 2021).

2.5.2 Social Effect

The fiscal response of the Pakistani government to the outbreak was impacted in part by the socioeconomic situation of the country's population. As a result of the epidemic, millions of people in Pakistan were unable to receive their salaries, despite the fact that around 24 percent of the country's population lives below the poverty line and a huge number of employees depend on daily earnings ("World Bank celebrates Pakistan's payment plan," 2020). The disruption of the agricultural value chain as a result of closed borders and increased security measures. This could lead to a decrease in the quantity of farm products and other items related to agriculture that are available to local customers. On the other hand, it may restrict people's access to food sources that are sufficient, diversified, and nutritious, in particular in places that are most severely impacted by the virus and/or that have an issue with food security that was already there. Groups with lower socioeconomic status are more susceptible. Particularly homes that are led by women and/or children (due to the fact that decreased household incomes and purchasing power will lead to decreased dietary diversity and increased rationing of food intake). Unfortunately, the data collected from the survey are insufficient to provide evidence that COVID-19 would have the adverse impacts that have been expected for it. Recently, regulatory authorities all over the world have come to the realisation that biological risks not only pose a threat to the health of the environment, but also pose a persistent and widespread threat to socioeconomic aspects. The repercussions of such epidemics on a number of state institutions, in particular (Rasheed, Rizwan et al. 2021).

2.5.3 Effects on Stakeholders

According to the accounts provided by respondents, COVID-19 has caused major disruptions to the production and manufacturing of goods and services across the globe. Following conversations with three different respondents, it became clear that the production process has become noticeably more challenging and complex as a direct effect of the pandemic epidemic. In addition, they highlighted that many corporations manufacture a single product by assembling subcomponents that are purchased from a number of different countries in order to meet the demand for that product in different areas of the world. These respondents also claimed that logistics is essential

to the success of import, production, and export, despite the fact that COVID-19 has significantly affected the manufacturing of commodities.

Following this, I had conversations with five of the responders, and all of them indicated that their country was the most prominent producer of drugs. In addition to this, they asserted that the COVID-19 had a detrimental effect on their industry, which led to the shutdown of a number of industrial locations. The respondents stressed the fact that the government has been forced to limit its imports as a result of the outbreak, and that the government is also having trouble keeping a healthy export volume. They claimed that they do not have the completed item in their possession. The fact that their country is one of the leading producers of medications means that there will be a serious lack of supply as a result of this. The procurement procedure has been significantly altered as a result of COVID-19, as shown through interviews with six different responders. The entire production process has reportedly been centralised in China and other low-cost economies such as Sri Lanka, Pakistan, India, and Bangladesh in a global economy, according to the responses of the survey participants. A follow-up contact with these responders revealed that the COVID-19 has put the continuity plans of the firm in jeopardy. As a result of the epidemic, buying managers now operate in a climate that is exceedingly unpredictable. They are unable to adjust their short-term sourcing option as a result of a major disruption among tier 1 suppliers. This is because supply network limits have prevented them from doing so. In addition, they claimed that, as a response to the upheavals in the procurement industry, businesses should change their focus to the long-term and possibly medium-term security of their supply chain foundation and just focus on tier-1 suppliers. This would be in addition to the fact that firms should only focus on tier-1 suppliers. Respondents also stressed the importance of businesses focusing on an unlocking strategy that would not only aid them in managing the immediate effects of COVID-19, but also assist them in establishing supply chains that are stronger and more robust so that they may thrive in this industry. This was a recurrent theme throughout the survey. A discussion with two other respondents revealed that they have had experiences that are comparable to yours. According to these responders, the process of procuring goods and services has been severely slowed down or even scrapped entirely in certain ongoing projects as a result of the epidemic. According to the respondents, the procurement teams are working diligently and bringing in international representatives to investigate the various potential options. However, the danger is getting closer, and there is a significant chance that contracts will be delayed or cancelled because businesses that

provide services and contractors will be unable to complete their contractual responsibilities because of temporary limits on border crossings. Additional information from three respondents suggests that there is a limited supply of goods and services on the market. In addition, there will be price inflation on the market as a result of the growing demand for goods and services that is exceeding the supply that is already available. In addition, they noted that the global market finds it extremely difficult to self-regulate during times of crisis, and that businesses are currently in a position where there is no definite solution for the markets. They added that this makes it extremely difficult for investors to make informed decisions. In addition, these respondents were of the opinion that there is no mechanism in place to correct the inefficiencies of the market. However, respondents also stated that they had created alternative sources of supply in order to handle any procurement difficulties that are anticipated to surface in the near future as a direct result of Covid-19. The sluggish progress of the building industry during the Covid-19 crisis attracts the attention of relevant parties (Rasheed, Rizwan et al. 2021). The damaging impacts of COVID-19, which slow down economic expansion, pose a threat to companies operating in the construction industry. As a direct result of the pandemic crisis, restrictions have been imposed on construction projects. These restrictions have resulted in a reduction in economic growth, an increase in unemployment, a disruption in the supply chain for construction supplies, and an acceleration of the drop in investment. It was projected that the growth rate of overseas building would drop from 3.1% to 0.5% this year. Regrettably, the crisis that the construction sector is experiencing in COVID-19 gives a once-in-a-generation opportunity to solve the most critical issues facing the industry. The issue known as COVID-19 was felt all around the world by many parties involved in the construction business. These parties include builders, contractors, and owners. As a result of the dilemma posed by this pandemic scenario, stakeholders have shifted their attention to both long-term and short-term projects that have the potential to assist in mitigating the global impact of the COVID-19 challenge. The COVID-19 problem has forced construction organisations to set long-term strategic goals for the building industry and implement optimal safety measures that might assist workers in pandemic conditions in continuing their job operations. These construction organisations have been prompted to do so as a direct result of the COVID-19 problem (Ali, Ahmed et al. 2021).

2.5.4 Changes in construction practices during COVID

The concept of working alternating days requires careful planning and organisation of regular working hours. The utilisation of time tracking and monitoring technologies during the process of setting up a home office is required in order to maximise the concept's potential utility. A number of the necessary equipment, such as mobile phones and computers, need to be made available to the workers who are affected by the access issues in order to eliminate any potential problems. Because the expenses of safety and sanitary precautions in the workplace are not too high, it is strongly suggested that all businesses pick and implement these measures in their respective workplaces. For the sake of labourers, it is recommended that the government either provide them with jobs paying lower wages or find a solution to this problem as soon as humanly possible. Techniques for optimising productivity need to be taken into consideration in order to strike a balance between the employees' financial difficulties, the delays in building, and any other issues that may arise. In light of the dreadful scenario painted by COVID-19, the most important question is whether or not the construction sector would move towards adopting a more conventional approach to the conduct of its business. This issue is going to be addressed by the implementation of three primary solutions.

Stage -1

In these age of pandemic diseases, construction companies absolutely have to protect their finances in order to keep their businesses afloat on the market and avoid becoming defaulters. Additionally, businesses have a responsibility to be ready for any prospective developments in the future. In the interest of preserving the viability of businesses, timely action may make it possible to avoid catastrophic losses in the construction industry. The prediction and identification of potential risks at the early phases of a project can help to reduce the likelihood of unfavourable results. However, because COVID-19 is an event that has never happened before, the government and other financial institutions are obligated to provide money and subsidies to the construction industry. Doing so will help reduce the risk of companies going bankrupt and will enhance business operations.

Stage-2

Because the construction industry is such a significant driver of economic expansion, it is imperative that it implement cutting-edge strategies and modernise its use of digital technology in order to enhance the effectiveness of its business operations. In addition, in order for businesses to

be able to combat the consequences of COVID-19 and make the most of the chances that it creates, they will need to devise major plans and recruit workforces that are adaptable. In order to grow the income of an organisation, the stakeholders in that organisation need to participate in merger and acquisition operations, which will increase the profits of the construction sector. In order to guarantee the continued prosperity of companies in the future, this mode of behaviour must have a purpose that is unmistakable and compelling.

Stage -3

Thirdly, to preserve the status quo, players in the industry, such as builders, contractors, and so on, need to turn their attention to the transition to a greener economy. It is important for companies to set sales targets and make use of all available marketing channels, including social media, print media, billboards, and electronic media. Key stakeholders in the construction industry are required to make investments in research and development activities in order to boost the profitability of construction businesses. The more traditional approaches of project management need to be phased out and replaced with building information modelling (BIM). There is a possibility that contemporary business models such as BIM will play a big part in the improvement of the projects' overall efficiency. The construction industry may be able to successfully meet its long-term goals if it maximises the efficiency of asset management and increases the variety of sources for its building materials.

2.6 Post Covid Developments in Construction Sector

Despite the widespread shutdown of businesses brought on by the spread of the coronavirus outbreak around the world, certain big building projects have continued to move on. Construction professionals are required to raise their safety standards in order to safeguard their employees and themselves from Covid-19. In order to support employees and their families in the most difficult aspects of this pandemic, responsible construction experts are keen to demonstrate that they can function correctly and prevent the spread of coronavirus. The Bureau of Labour Statistics estimates that there are around 7,505,000 people employed in the construction industry across the globe. In this day and age of COVID-19, construction practitioners should establish and implement site-specific health and safety plans for personnel in order to assure the highest quality of construction practises (Jawad, Maroof et al. 2021). The following preventative measures could be beneficial for workers in preventing COVID-19 and other disasters in the future:

a) Maintain Physical Distance

The coronavirus can spread more than 9 metres away from an infected person after they cough or sneeze. The droplets of Corona patients can also be spread through discussion. In the meantime, the virus can persist for many hours on surfaces such as equipment, worktops, and door knobs. It has also been found that a person who is infected with a virus but does not display any symptoms could be a carrier of the virus and cause infection in another person. The presence of these crucial facts demonstrates the relevance of maintaining a physical separation between personnel as a means of preventing the spread of the virus. On the job site, the construction industry professionals have the responsibility of ensuring that the physical distance policy is followed. The construction workers should ride to the job site on buses that are just halfway full so that they may maintain a safe social distance. A temperature reading of less than 37 degrees Celsius is required of every worker before they are allowed on the construction site (Adu-Gyamfi, Brenya et al. 2021).

b) One-Worker, One-task policy:

It is important to include in COVID-19 preventative measures while conducting evaluations of overall work and task hazards. It is the responsibility of each construction company to decide whether or not each task can be accomplished by a single employee, and if it cannot be, the company must adopt additional safety measures to ensure the wellbeing of all of its staff members. Because this preventative strategy might be effective for getting acquainted with the serious injury and fatality programme, it is recommended that smartphones be used to take pictures of hazard analyses and communicate them through SMS.

c) Monitoring with cutting edge technologies

Professionals with the appropriate level of training should oversee social distance. The construction site ought to be observed by closed-circuit television cameras as well as unmanned aerial vehicles. In light of the current COVID-19 pandemic, construction sites ought to implement safety software such as the Vinnie Al Interface, which assesses how well employees maintain the necessary distance between one another.

d) Scheduling

Work should be broken up into shifts so that both the amount of work and the number of people needed to complete it can be reduced. Altering the timetable of break time and allowing non-

essential employees to telecommute are two things that can be done to reduce the amount of worker contact.

e) Site Logistics and management

The capacity to impose limitations on entry is a fundamental element. In order to provide a sustainable environment for virus prevention, it is recommended that there be a restricted and limited number of visitors and personnel present on-site. This is crucial for preventing the spread of the infection. The control of the doors leading into the building and the parking spaces should be facilitated by the remotes and sensors. It is advisable to implement thermal imaging cameras, which have the capability to ascertain an individual's core temperature, in order to safeguard the overall welfare of all individuals. The implementation of a well-structured and efficient strategic policy is necessary for the efficient delivery of goods and miscellaneous items to workers. This policy should include the establishment of designated areas for parcel delivery to staff, the creation of lines to create designated spots for employees, the placement of barriers to isolate employees from delivery points, and the placement of trash boxes in specific locations to facilitate their transfer from the site. These measures aim to prevent social interaction in the current deteriorating situation. It is recommended that deliveries be conducted with drivers stationary in their vehicles and donning gloves during the process of delivering products to workers. It is imperative for the authorities to undertake an assessment of the construction site in order to ascertain the adequacy of physical segregation among the workers. Discipline should be applied to employees who demonstrate irresponsibility and contravene the safety protocols set forth by the firm. To ensure the maintenance of an optimal degree of social distancing, it will be necessary to implement the closure of public food markets. The removal of amenities such as coffee stations, water dispensers, and air conditioning in break spaces.Administrative measures and guidelines

Collaboration and inspiration are required at every tier of the construction sector in order to ensure compliance with safety protocols and forestall the spread of COVID-19 on construction sites. The issue of personnel surveillance on the work site is an extremely important one, and additional funds are required to acquire additional safety gadgets for the purpose of protecting the employees and their families. Building companies may receive assistance from the government and financial institutions in the form of zero-interest loans with extended periods of time to make payments. In order to successfully execute preventative safety measures, the leadership of construction projects

must embrace a zero-tolerance policy. Upper management should educate staff about the symptoms of COVID-19, which include coughing, sneezing, fever, and problems breathing. Sick personnel should be placed in self-isolation and self-quarantine for a period of two weeks.

A worker should be able to provide all of the relevant information regarding the symptoms of the virus on a form associated with COVID-19 that should be produced. The ability for workers to submit their daily health report through the use of an internet application ought to be made available. The following inquiries need to be added to the application for employment that prospective workers fill out.

- Do you have symptoms such as a dry cough, fever, or tiredness?
- In the past two weeks, have you been into close contact with people who have been diagnosed with coronavirus or who may have been infected?
- Have you ever travelled to a different country?
- In the event that there is an issue, are you capable of communicating with higher management?
- Is it typical for your body temperature to be?
- Are you able to provide an assurance that you will follow the guidelines set forth by the organisation?

To protect the safety of employees, be sure to designate a nurse on-site and execute 24-hour nurse triage screening for all employees. If it is not possible to hire a nurse on-site, a qualified employee should be appointed to monitor employee temperature and sickness. On-site installation of a sanitising gate at the entrance gate is required. In this difficult circumstance It is crucial to focus on the mental health of employees by inquiring about the preventative steps they and their families are doing. Establishing a strong safety culture to protect employees from COVID-19 will aid an organization's efforts to increase awareness and compliance.

f) On-Site Employee training and tutorials

Several businesses have operated under the assumption that their employees are aware of the realities regarding infectious viruses. Misinformation about COVID-19 being spread on social media poses the greatest challenge for both the government and health professionals. In addition, in order to ensure that workers and other construction practitioners adhere to the COVID-19 policies, the relevant authorities should have a discussion about standard operating procedures

(SOPs), such as how to manage social distancing among employees, how to report if an employee or colleague has COVID-19 symptoms, and when employees can return to work. This will ensure that the COVID-19 policies are effectively enforced. The upper management of the company should produce a video with a message about the prevention of COVID-19, post it to social media, and distribute it to all of the employees. At the entrance to the location, signs that read "stay home if you're sick" and "no mask, no admission" should be hung up. It is recommended that daily updates on COVID-19 patients be provided through the use of social media and staff chat groups. For the sake of the staff's convenience, on-site explanations and instructional materials should be made available in a variety of languages. The employees are required to abide by the laws of the government and the corporation whenever they engage in significant activities such as shopping, exercising, or any other significant activity.

g) Technical Controls

Depending on the characteristics of the work environment, a variety of engineering controls may be used to encourage the practise of social distancing and limit employee vulnerability. For instance, workers who perform their jobs in close quarters may benefit from the use of ventilation equipment. It will also assist to reduce the number of close encounters if there are additional stair towers and lifts installed. Plastic sheets could be used to separate people from dusty processes in the event that typical technical safeguards are unable to prevent the generation of dust. On the construction site, dust control may benefit from the deployment of a water cannon. Controlling Covid-19 is made easier by installing adhesive mats and shoe sanitation baths in areas designated for entering and exiting the building.

h) Sanitation and Cleanliness

When it comes to warding off COVID-19, proper hygiene and cleanliness are absolutely essential. When picking a project on the basis of its criteria for cleanliness and hygiene, give objects that may be touched, such as door handles, locks, and keys, higher priority than other factors. It is important that cleaning procedures include the routine cleaning of various items, such as keyboards, computers, doors, and pens, among other things. Sanitising the truck and thoroughly cleaning all of the contents inside it should come first before delivering any packages to the construction site. In addition, UV sterilisation and fog sterilisation are applied in the process of sanitising the products. It is the responsibility of the construction experts to ensure that there is

soap and hand sanitizer available for use on the job site. On a construction site, the restrooms ought to be cleaned on a regular basis, and disposable toilet paper ought to be utilised as seat coverings rather than coming into direct touch with the toilet itself. On construction sites, the use of disposable glasses and glasses that are brought from home is permitted.

Personal protective equipment (PPE) Every industry needs to implement the use of personal protective equipment (PPE) as a standard safety measure. Personal protection is absolutely necessary in the event that COVID-19 continues to worsen in order to prevent employees from catching the virus from their coworkers. Employees working on-site are required to always protect their hands and faces by wearing gloves, masks, gaiters, glasses, and face shields. All construction workers are required to follow the manufacturer's instructions for sanitation and disinfection prior to using any personal protective equipment (PPE) or clothing.

i) Tools and Equipments

Because the virus can remain infectious in droplets for a significant amount of time, it is imperative that any equipment that is utilised in the course of work and that is shared by workers be regularly discarded and cleaned. In order to prevent the spread of viruses, all pieces of apparatus must be sterilised and disinfected before they can be used, and the individuals who will operate the apparatus must first wash and then sanitise their hands. Before being made available to workers, previously used instruments are required to be put into storage for a period of three days after being cleaned with a bleach solution that has been diluted.

CHAPTER 3 - RESEARCH METHODOLOGY AND DATA COLLECTION

3.1 Introduction

An organized way to solve a problem is known as research methodology. It aims to appoint the right procedures to work out solutions or provide the research plan. It includes learning different techniques used during research, i.e., conducting surveys, interviews, tests, and critical studies. It includes the procedures of describing, explaining, and envisaging the research phenomenon and how the research process is to be carried out. In this section, the methodology to conduct research, indicators, types of data collection and techniques to analyse data for achieving the research objectives are briefly explained.

3.2 Research Design

This investigation makes use of a technique that is comprised of four significant elements, namely conception, data collecting, data analysis, and the formulation of solutions for environmentally responsible design and construction. During the phase of conceptualization, a study of the relevant literature was conducted with the purpose of selecting a topic, identifying a research gap, formulating a problem statement, determining research objectives, and formulating research questions. During this time, this review also assisted in the process of selecting dimensions and indicators. Additionally, a frequency analysis is carried out for the selection of dimensions and indicators, and the indicators whose frequency is found to be highest are chosen.

The case study area serves as the source of both primary and secondary data that is collected. Primary data was collected through the use of questionnaires distributed to construction companies with offices in Islamabad and Rawalpindi; structured interviews with architects, town planners, and engineers working for various construction companies; and focus group discussions with government officers, local contractors, and material suppliers. statistics from secondary sources, such as economic statistics, construction growth data, annual data from the construction industry, and best practises are examples of the types of information that are included in secondary data. After collecting all of the data, it is then subjected to additional analysis with SPSS and content analysis. In the end, we extracted the most important data, evaluated the results and debates, and established plans for the design and construction of sustainable housing.

For the purpose of this investigation, a hybrid research design was utilised, and both exploratory and descriptive research approaches were utilised for the purposes of data collection, analysis, and investigation. The descriptive research approach is one that makes an effort to provide explanations for queries concerning the when, how, where, and what of the investigation. In exploratory research, the method of gathering background information and developing questions to be addressed is known as "exploration."

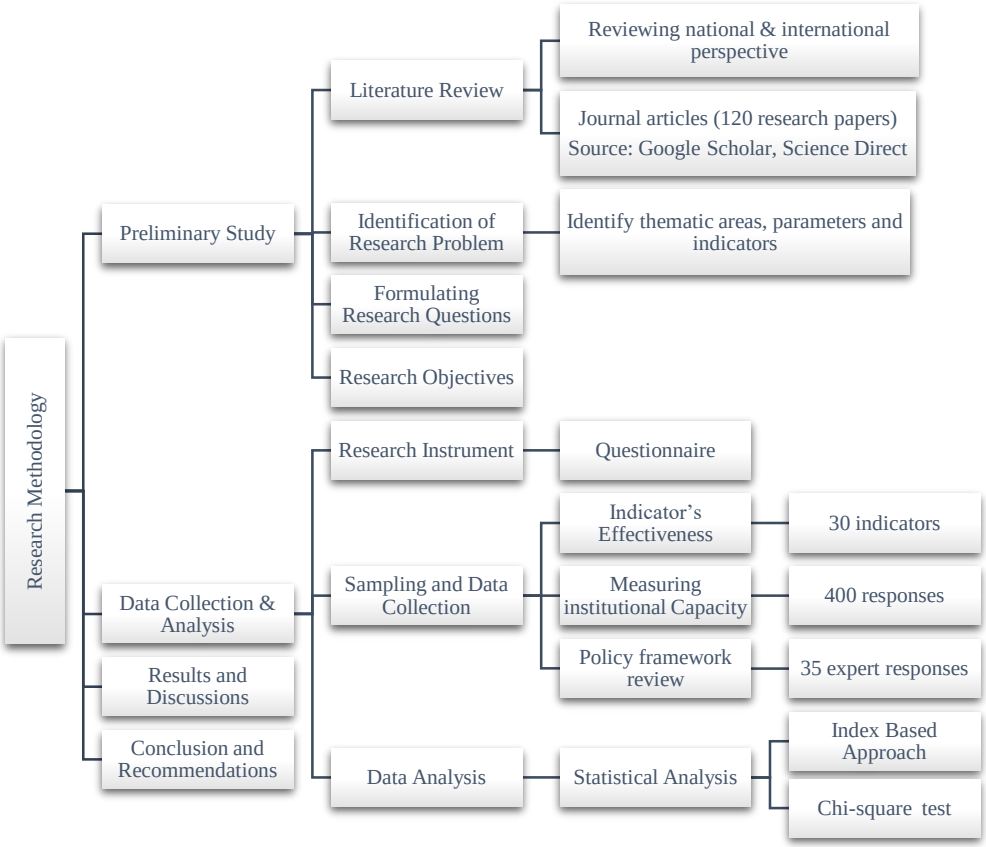

Figure 5: Research Methodology Diagram

3.3 Study Area

The research was conducted in two of the most important cities in Pakistan. One serves as the provincial capital of Pakistan, while the other serves as the country's federal capital. These two cities were chosen for the purpose of this research study because they are both heavily urbanised locations that are experiencing substantial population increase. Additionally, the headquarters of all of the largest construction corporations can be found in these two cities. As a result, it is

important to investigate the effects of COVID on the construction sector. These two cities were chosen for consideration. These are also important centres of culture in Pakistan.

The next few paragraphs will provide a synopsis of both of the chosen cities.

3.3.1 Islamabad

Islamabad is the only city in Pakistan that was planned, and planning began on it in 1960. It continued to develop throughout the years. The master plan for the city encompasses 906.50 kilometres squared; an additional 362.6 kilometres squared is referred to as the Specified Area, and it includes the Margalla Hills in the north and northeast. The neighbourhoods of the city are designated as Zone I, Zone II, Zone III, and Zone IV and Zone V respectively. Its population was 45,000 in the year 1960, but by the time of the 1998 census, it had climbed to 80,5235. Now, according to the results of the Pakistan Census from 2017, Islamabad has a population of 2,006,572 people.

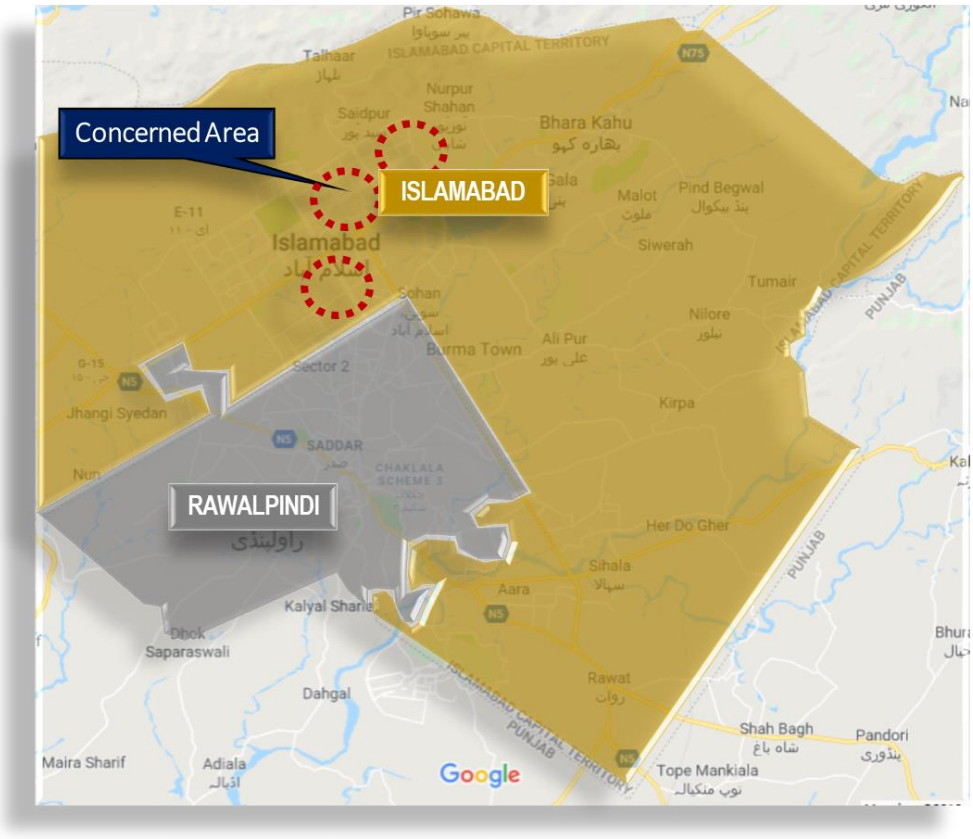

Figure 6: Map of Islamabad

3.3.2 Rawalpindi

Rawalpindi, situated in the Punjab province of Pakistan, serves as the administrative centre of Rawalpindi Division. Rawalpindi ranks as the fourth most populous city proper in Pakistan, trailing subsequently Karachi, Lahore, and Faisalabad. Rawalpindi, following Lahore and Faisalabad, is the third most populous metropolis in Punjab. Furthermore, the Islamabad-Rawalpindi metropolitan area, which encompasses the city, ranks as the fourth largest metropolitan area in Pakistan. Rawalpindi and Islamabad, the capital of Pakistan, are geographically adjacent and are commonly referred to as the "twin cities" due to their extensive social and economic interconnections.

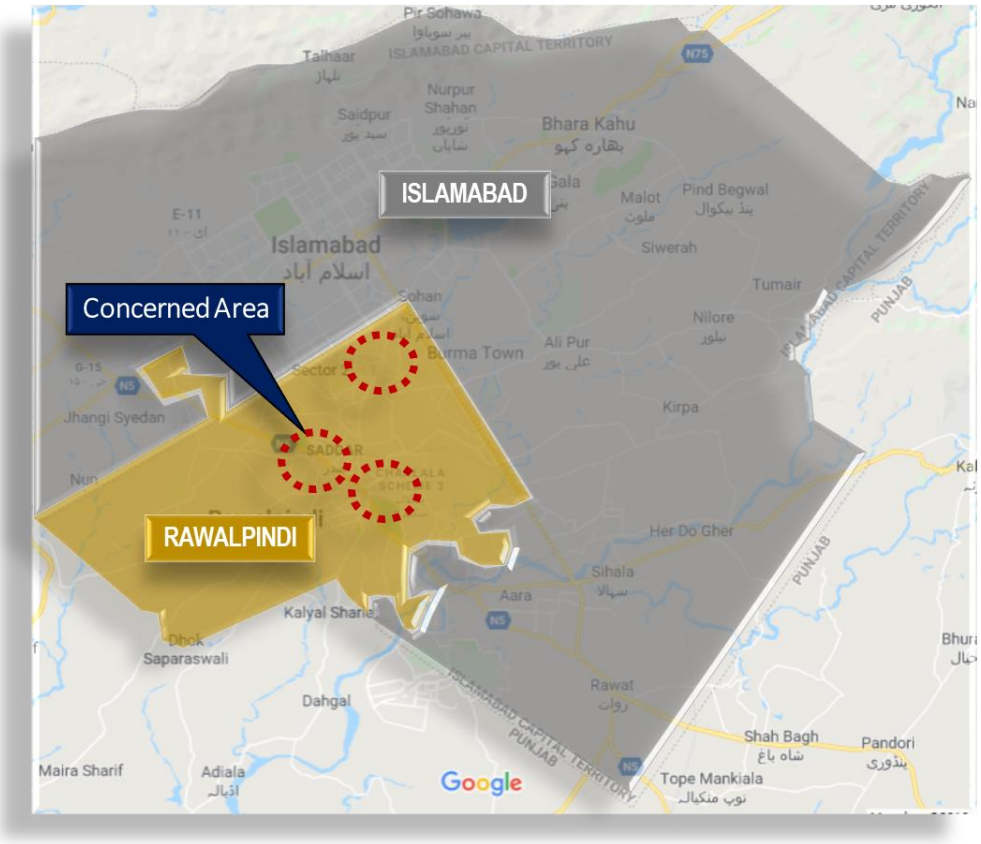

Figure 7: Map of Rawalpindi

3.4 Data collection

The primary focus of this research was on the acquisition of data. The primary purpose of our research was to quantify the efficacy of governance as well as to identify the obstacles that stand

in the way of measuring the effectiveness of governance. In order to accomplish this goal, primary and secondary data were required. As a result, both primary and secondary data were compiled and utilized in the study that was carried out. The data for the present study is collected using a survey technique. The questionnaire data has been compiled using Google forms, distributing printed documents to Contractors, Consultant and Client (All three stakeholders) of Rawalpindi and Islamabad. All the data has been gathered from the above mentioned cities from January, 2023 to April, 2023.

3.5 Secondary data

This research relied heavily on secondary sources of information. Online study using a variety of sources including published reports, research articles, policy papers, official reports, and publications led to the discovery of already existing impact of COVID measurement frameworks and associated indicators for quantifying the impact of COVID on the building industry of Pakistan. The information was retrieved from a variety of academic and government websites using an online search. It served as the foundation for our study. Previously existing literature on Impact of Covid on Construction Industry of Pakistan were identified from research papers, official reports, published reports and policy papers. Articles were downloaded from different scientific websites i.e Google Scholar, Science Direct and Web of Science published from 2019 to 2022, to collect the indicators to achieve the study's main objectives. Because quantifying the impact that Covid had had on the building sector in Pakistan was our primary objective, we compiled a list of indicators that were pertinent to the Impact that Covid had had.

3.6 Primary data

We collected primary data in order to measure the impact that Covid has had on the construction industry and to fill in some gaps in the secondary data. Three primary sources were utilized in the gathering of the primary data.

- Interviews with subject matter experts
- Primary research conducted in the field
- Focus group discussions

The questionnaire-based survey and the structured interviews with the industry experts were conducted in order to:

- Study the time over run changes that have been observed in the construction practices since the COVID began
- Suggest strategies to mitigate the effects of the COVID on the construction industry
- Investigate the financial effects that COVID has had on construction projects
- Study the social impacts that COVID has had on workers, contractors, and other stakeholders of the construction industry
- Investigate the financial effects that COVID has had on construction projects

Questionnaire surveys and in-depth interviews were carried out so that primary data could be collected. As a result, a comprehensive questionnaire was designed in order to collect information regarding the impact that Covid has had on the building industry in Pakistan. The questionnaire included both open-ended and close-ended statements, each of which was rated using a Likert Scale. The local construction companies of Pakistan, whose offices were located in Islamabad and Rawalpindi, were sent these questionnaires to fill out and return.

For in depth interviews of the experts from different contractors and consultant firms, Semi-structured interviewing techniques were employed for in-depth interviews. It offers trustworthy and comparable qualitative information. Additionally, it offers the chance to discover fresh perspectives on the subject at hand and allows the interviewees to express their opinions and thoughts in their own words. A set of planned questions for the interview were focused on the important actions that the institutions needed to perform in each of the four thematic areas of the disaster management cycle, namely Preparedness, Response, Recovery, and Mitigation. A few questions that were not pre-planned and came up on the spur of the moment were also asked while keeping in mind the conversation's natural flow.

The experts were given a checklist about the impact of Covid on the building industry in Pakistan, which was based on a Likert scale and allowed for correct ratings to be given according to the importance of the factors. In order to gain a deeper understanding of the effect that Covid has had on the construction sector in Pakistan, structured interviews were carried out with industry professionals who are considered to be experts in the field. Because of their extensive expertise and years of experience working in the construction business, these professionals have been chosen or taken into consideration for the position.

In conclusion, a group discussion was held in order to evaluate the influence that Covid has had on the construction business in Pakistan. A group discussion was held with ten engineers from Islamabad and Rawalpindi who work in various construction industries in Pakistan. The engineers were asked about the influence that Covid has had on the building business in Pakistan. The ratings that were supplied were then utilized in order to measure the influence that Covid has had on the building industry using the newly proposed methodology.

The questionnaire was distributed to different public and private stakeholders with all the possibility of equal participation from the two study areas. Some major contractors includes FWO, NLC, Kainatt Enterprises, HASAS Construction Private limited, Maqbool Associates etc,. Some major consultant includes Nespak, Osmani and Company (Pvt) Ltd, Zeeruk, EN EM Associates, Naqshnama etc.

3.7 Sample size for questionnaire survey

The minimum sample size was determined in two steps. In the first step, total number of employees was estimated from the data provided by HR department of different service providers (Contractors and Consultant) specifically from Islamabad and Rawalpindi. In second step, Solvin's formula was used to find the sample size.

Step 1:

The first step was estimating the total number of employees using information from the human resources departments of various service providers (Contractors and Consultants), particularly those in Islamabad and Rawalpindi. Some major contractors includes FWO, NLC, Kainatt Enterprises, HASAS Construction Private limited, Maqbool Associates etc. Some major consultant includes Nespak, Osmani and Company (Pvt) Ltd, EN EM Associates, Naqshnama etc. The total number of employees was 20,000. The sample size was calculated using Solvin's formula in the second stage.

Step 2:

To estimate sample size, Solvins formula was used as shown below

Sample size: $n = N/(1+Ne^2)$

Where N= Population, e margin of error

Using the confidence level 95%, e= 5%=0.05

Therefore,

$n= 20000/(1+20000(0.05)^2) = 392.15$

Therefore the sample size of 400 was chosen for questionnaire survey using Solvins formula from estimation based on the data provided from the human resources departments of various service providers (Contractors and Consultants), particularly those in Islamabad and Rawalpindi.

3.8 Questionnaire design

Questionnaire prepared for the study consist of major five areas i.e

3.8.1 Mobility and Accessibility

Mobility and accessibility in the construction industry have been significantly impacted by the COVID-19 pandemic. Construction is an essential industry, and the need for ongoing projects continued, but several challenges and changes emerged to ensure safety, compliance with regulations, and the well-being of workers and the public. Many construction professionals had to adapt to remote work for tasks such as project management, design, and planning. This required the use of digital tools and collaboration platforms to maintain communication and coordination among team members. To mitigate the spread of the virus, construction sites implemented strict health and safety protocols. This included social distancing measures, mandatory mask-wearing, regular testing, and temperature checks. These measures impacted the mobility and interaction of workers on construction sites. COVID-19 outbreaks on construction sites led to quarantines and reduced staffing levels. This reduced mobility as fewer workers were allowed on-site at any given time, potentially slowing down project progress. Mobility and accessibility for materials and equipment were also affected by supply chain disruptions. Lockdowns, factory closures, and transportation challenges led to delays in the delivery of construction materials and equipment, impacting project timelines. Some areas introduced remote inspection procedures to minimize physical contact. Inspectors could review progress and compliance through video calls and digital documentation, reducing the need for in-person site visits. The construction industry accelerated its adoption of digital technologies, such as Building Information Modeling (BIM), virtual reality, and augmented reality. These tools allowed for virtual inspections, remote collaboration, and improved project planning, reducing the need for physical presence on-site. Construction

companies implemented flexible work schedules to reduce congestion on job sites. This might involve staggered shifts or extended work hours to accommodate social distancing requirements. Some projects shifted toward modular and prefabricated construction techniques, which could be carried out in controlled environments off-site. This reduced the need for large on-site construction crews and enhanced safety. Training programs and safety protocols became essential for ensuring that construction workers were well-informed about COVID-19 risks and preventive measures. This was crucial for maintaining a safe and accessible work environment. Construction projects often interact with local communities. The pandemic required construction companies to engage with these communities to address concerns related to mobility, accessibility, noise, and safety, particularly during lockdowns and restrictions.

3.8.2 Coordination and interaction

Coordination and interaction in the construction industry underwent significant changes during the COVID-19 pandemic as safety measures and restrictions were put in place to protect workers and stakeholders. The construction industry adopted a range of digital tools and platforms for communication and collaboration. Video conferencing, project management software, and virtual design and construction tools became essential for remote teamwork and stakeholder engagement. In-person meetings and site visits were limited or replaced with virtual meetings. Project teams, clients, architects, engineers, and contractors met online to discuss project progress, issues, and decisions. This allowed for continued communication while minimizing physical contact. On construction sites, new communication protocols were established to maintain social distancing. Signs, floor markings, and designated areas for meetings and breaks helped ensure safe interactions. Contractors, developers, and project owners kept stakeholders informed through regular updates and transparent communication. Virtual tours and presentations were used to showcase project progress and plans to investors and community members. Daily safety briefings on COVID-19 protocols became a routine part of construction site operations. Workers were educated about the latest safety measures and guidelines. Effective communication with suppliers and vendors became crucial due to supply chain disruptions. Contractors had to adapt to delays and communicate revised timelines to keep projects on track. Construction contracts often needed revisions to account for COVID-19-related delays and disruptions. Clauses related to force majeure, project extensions, and additional costs were reviewed and adjusted as needed.

Construction companies had to manage their workforce differently, ensuring that workers could safely interact while on-site. Staggered shifts, reduced crew sizes, and remote work for administrative staff were common strategies. Regular health screenings, such as temperature checks and symptom assessments, were implemented for workers and visitors entering construction sites. Protocols for isolation and testing in case of potential exposure were also established. Construction sites limited access to essential personnel only, reducing the number of external visitors and stakeholders on-site. Virtual tours and remote inspections were encouraged to limit physical presence. Personal protective equipment (PPE) requirements were expanded to include face masks, face shields, and sometimes even full-body suits, depending on the nature of the work. Employers ensured that workers had access to proper PPE and training. Quality control and inspections evolved to include remote options where feasible. Inspectors used technology like drones and cameras to monitor progress and assess compliance with safety and quality standards. Construction companies developed and updated emergency response plans specific to COVID-19 outbreaks. These plans included procedures for isolating affected workers and conducting contact tracing.

The construction industry's ability to adapt to new communication and coordination methods was essential to keeping projects on track while prioritizing the health and safety of workers and stakeholders during the pandemic. Many of these changes, such as increased use of digital tools and remote collaboration, are likely to persist as the industry continues to evolve.

3.8.3 Financial Barriers

The COVID-19 pandemic has had a significant impact on the construction industry, including the introduction of various financial barriers. These barriers have affected different aspects of construction projects, from supply chain disruptions to labor shortages and increased costs. The pandemic disrupted global supply chains, leading to shortages and delays in the delivery of construction materials and equipment. This resulted in increased costs due to higher prices and the need for expedited shipping. Lockdowns, quarantine measures, and health concerns led to a shortage of skilled labor in the construction industry. This shortage of workers could result in project delays and increased labor costs. Due to lockdowns, social distancing measures, and other pandemic-related restrictions, many construction projects had to be delayed or put on hold. These delays can increase project costs due to extended timelines, higher overhead, and potential

penalties for missing deadlines. Construction companies had to implement new health and safety measures to protect workers from COVID-19. These measures included providing personal protective equipment (PPE), conducting regular testing, and implementing social distancing protocols. These added costs were not initially budgeted for in many projects. Some construction materials experienced price increases during the pandemic. Factors such as disruptions in the supply chain, increased demand for certain materials, and inflation contributed to rising material costs. The economic uncertainty caused by the pandemic made it more challenging for construction companies to secure financing for their projects. Lenders became more cautious, and interest rates may have fluctuated, affecting the overall cost of financing. Insurance costs for construction projects may have increased as insurers adjusted their policies to account for pandemic-related risks, including delays and shutdowns. Many construction professionals had to adapt to remote work, which required investments in technology and infrastructure. These costs were not initially planned for in many construction budgets. Compliance with changing health and safety regulations and pandemic-related guidelines required additional resources and costs for construction companies. Construction contracts often needed to be revised or renegotiated to account for pandemic-related delays and disruptions. Legal fees and dispute resolution costs could increase as a result.

To address these financial barriers, construction companies had to adapt to the changing circumstances, revise their project budgets, and implement new risk management strategies. The construction industry also learned valuable lessons about the importance of resilience and contingency planning to better cope with future unforeseen challenges.

3.8.4 Barriers to Physical & Mental Health

The COVID-19 pandemic has had significant impacts on physical and mental health across various industries, including the construction sector. Construction workers often work in close proximity to one another, increasing the risk of exposure to COVID-19. This risk can lead to illness, hospitalization, and even death, posing a significant physical health barrier. In the early stages of the pandemic, there was a shortage of PPE, which is essential for protecting workers from the virus. This scarcity created a barrier to maintaining physical health. Maintaining proper sanitation on construction sites can be challenging. Limited access to handwashing facilities and sanitizers can increase the risk of infection. Some construction workers may have limited access to healthcare

services, making it difficult to seek medical attention when needed. Construction sites can be hazardous, and the added stress and distractions related to the pandemic may have increased the risk of workplace injuries.

The pandemic led to social isolation, as many workers had to limit contact with family and friends. This isolation can contribute to feelings of loneliness and depression. Economic uncertainties caused by the pandemic, including layoffs and reduced work hours, can lead to financial stress, which can negatively impact mental health. Construction workers may have experienced heightened anxiety and stress due to the fear of contracting the virus while on the job. Frequent changes in work schedules, project delays, and uncertainties about the future of construction projects can contribute to feelings of uncertainty and anxiety. Access to mental health services may have been limited during the pandemic, making it difficult for construction workers to seek help when needed. The construction industry often demands long hours and physically demanding work. The added stress of the pandemic may have led to burnout among workers. Communication barriers, such as language differences and remote work arrangements, may have made it difficult for construction workers to express their mental health concerns and access support.

Addressing these barriers to physical and mental health during and after the pandemic requires a comprehensive approach that includes implementing safety measures, providing mental health resources, and promoting a supportive workplace culture. Employers, government agencies, and industry organizations should collaborate to create strategies that prioritize the well-being of construction workers in both the short and long term.

3.8.5 Barriers to Performance in construction Industry

The performance of the construction industry during the COVID-19 pandemic varied significantly depending on factors such as location, project type, and the specific measures taken by construction companies. In many regions, construction was classified as an essential industry, allowing certain projects to continue despite lockdowns and restrictions. Essential projects included those related to healthcare, infrastructure, and housing. Non-essential projects, such as commercial developments, were often delayed or cancelled. Construction projects, even essential ones, experienced delays and disruptions due to labor shortages, supply chain interruptions, and health and safety regulations. Social distancing measures often led to reduced on-site workforces and productivity. The pandemic caused cost increases in the construction industry. Supply chain

disruptions led to higher material costs, and health and safety measures increased project expenses. Contractors often had to absorb these additional costs or renegotiate contracts. Many construction companies adopted remote work and digital technologies to facilitate project management, communication, and collaboration. This shift toward technology adoption accelerated in response to the pandemic. Strict health and safety measures were implemented on construction sites to protect workers from COVID-19. These measures included mask mandates, social distancing requirements, enhanced sanitation practices, and health screenings. They added complexity and cost to construction operations. The pandemic led to labor shortages in some regions, as workers fell ill, were required to quarantine, or chose not to work due to safety concerns. Some construction companies addressed this by recruiting new workers or offering incentives to retain skilled labor. In some countries, governments provided financial support to the construction industry to mitigate the economic impact of the pandemic. This support often came in the form of grants, loans, or incentives to keep construction projects moving. To maintain regulatory oversight while minimizing physical contact, some jurisdictions implemented remote inspection and approval processes for construction projects. This helped to keep projects on track despite the pandemic. In some areas, there was an increased demand for residential construction during the pandemic, driven by factors such as low-interest rates and a desire for larger, more comfortable homes as people spent more time at home. This boom in residential construction offset some of the losses in commercial construction. The construction industry faced challenges related to the availability and delivery of materials. Shortages of lumber, steel, and other key construction materials impacted project timelines and budgets. Many construction companies adapted to the challenges of the pandemic by embracing innovative practices and technologies. This included off-site construction methods, modular construction, and the use of automation and robotics.

Overall, the construction industry's performance during COVID-19 was a mixed bag. While some segments of the industry faced significant challenges, others saw increased demand and opportunities for growth. Companies that were agile, adaptable, and invested in technology were better positioned to weather the disruptions caused by the pandemic. The long-term impact of COVID-19 on the construction industry continues to unfold as recovery efforts and adaptation strategies continue.

The questionnaire was finalized based on feedbacks received from pilot study.

3.9 Expert opinion questionnaire

To retrieve the expert opinion for identifying the Impacts of Covid on construction industry of Pakistan, 30 Questionnaires were disseminated among the experts from the public and private sector stakeholders, and 15 Questionnaires were received with response rate of 50%.

3.10 Data analysis method

Both qualitative and quantitative data were analysed as part of this study project. The Likert Scale was used to make judgements about the qualitative data. The Likert Scale is based on five-scale parameters, which are as follows: one represented very high means the condition is in its best possible state; two represented High means the good condition; three represented moderate means an average condition or that the respondent does not know the answer; four represented low means a poor condition; and five represented very low means the condition is in its worst possible state.

Table 2: Interpretation of Likert Scale

Value	**Response**	**Interpretation**
1	Very High	The condition is in its best possible state
2	High	Good condition
3	Moderate	An average condition or that the respondent does not know the answer
4	Low	A poor condition
5	Very Low	The condition is in its worst possible state

In addition, the descriptive data was gathered through the use of questionnaires with closed-ended questions. The statistical package SPSS and the spreadsheet programme Microsoft Excel were utilised in the analysis of the qualitative and quantitative data, respectively.

In order to determine the chi-square value (p-value), cross-tabulation, mean (X), standard deviation, and frequency distributions of the respondents, descriptive analysis was performed with SPSS.

For the purpose of graphical depiction of the data, Microsoft Excel was utilised. The SPSS programme was used to conduct a Factor Analysis (FA). The procedures for data analysis are broken down into sections below.

3.11 Chi-square test

The p-value has been applied as a method for determining the level of significance (where equals 0.05). If the p-value is lower than the critical value, then the respondents held a variety of perspectives regarding the issue. In the event that the p-value is lower than the critical value, the respondents did not share a consensus regarding the issue.

3.12 Cross tabulation

A cross tabulation is a method for doing a quantitative analysis of the correlation between the indicators being compared. The variables are grouped so that the correlation between the various variables, as well as the change in correlation from one grouping variable to another, may be determined.

3.13 Factor analysis

Using the information gathered from the expert survey regarding impediments, factor analysis was done. This analysis aims to enhance comprehension and interpretation of the barrier by utilizing factor analysis. Factor analysis facilitates the identification and categorization of a vast array of data variables into concise and significant factors, which in turn provide insights from a specific standpoint. The limited number of factors obtained from factor analysis provide an overview of all the variables contained within these factors. Within the SPSS software, the factor analysis utilized the Principal Components approach. This method was chosen because it is capable of identifying and calculating composite scores for the variables or factors being studied.

3.14 Index Based Approach

An index-based approach in SPSS (Statistical Package for the Social Sciences) research typically entails the development of composite variables or indices that symbolise the dimensions or underlying constructs of interest. This methodology is frequently employed in disciplines including economics, psychology, and sociology, where scholars frequently seek to quantify intricate notions that defy reduction to a solitary variable.

A synopsis of the general procedure for implementing an index-based approach in SPSS follows:

- Define your constructs: You must identify the underlying constructs or dimensions you wish to measure prior to developing indices. As an illustration, when examining the

socioeconomic standing of individuals, one might deem income, education, and occupation to be indicators of this particular construct.

- Determine variables: Select the variables from the given dataset that correspond to each of the identified constructs. Idealistically, these variables ought to be assessed using a comparable scale and possess a conceptual connection to the construct. Prior to integrating variables into an index, it is critical to evaluate the dependability of each individual variable as well as the intercorrelations between them. Factor analysis can be employed to evaluate the dimensionality of your variables, while Cronbach's alpha can be utilised to determine reliability. After selecting the variables and determining their dependability, the index can be computed using a variety of techniques. A prevalent methodology involves calculating a weighted average of the component variables' standardised scores, with the weights assigned to each variable signifying its comparative significance in representing the construct. Alternatively, factor ratings derived from factor analysis may be utilised.
- Validate the index: It is essential to validate the index after it has been created to ensure that it accurately represents the underlying construct. This may entail the analysis of correlations with other construct-theoretically related variables, the testing of hypotheses, or the comparison of groups that are known to differ with respect to the construct under consideration.
- Conduct data analysis: After obtaining the index, it can be utilised in statistical analyses in the same manner as any other variable. This may entail investigating potential correlations with additional variables, performing regression analyses, or hypothesis testing.

These procedures may be executed via the graphical user interface or the syntax in SPSS. The procedures to be followed are contingent upon the characteristics of the data and the statistical methods being employed. SPSS offers a variety of procedures and functions, including but not limited to those for factor analysis, data manipulation, and regression, that are applicable to the development and examination of composite indices.

3.15 COVID-19 (SOPS)

During the process of data collecting, the Standard Operating Procedures (SOPs) for Covid-19 were adhered to in a stringent manner as recommended by the National Command and Operation

Centre (NCOC), which is part of the Pakistani government. The following list provides an overview of the primary preventative measures implemented during the survey.

- I refrained from making direct physical contact with respondents while I was collecting data
- Guaranteed that the respondent and the surveyor were both outfitted with the mask
- Used hand sanitizer before presenting the questionnaire to the respondent and again after getting it from the respondent
- During both the survey of households and the survey of experts' opinions, a gap of six feet was kept between respondents
- Conduct a risk assessment to identify potential COVID-19 transmission points during the survey
- Develop a comprehensive plan that includes measures for social distancing, hygiene, and PPE use
- Require surveyors to wear appropriate PPE, such as masks or face shields, gloves, and possibly gowns if close contact is expected
- Ensure an adequate supply of PPE is available for all surveyors
- Implement measures to maintain a safe distance between surveyors and respondents (at least 6 feet or 2 meters)
- Limit the number of surveyors allowed in a confined space at any given time
- Adjust survey procedures to minimize close contact with respondents
- Provide hand sanitizing stations for surveyors to use before and after interactions with respondents
- Encourage frequent hand washing with soap and water for at least 20 seconds.
- Regularly disinfect survey materials and equipment, such as clipboards or tablets.
- Conduct daily health checks for surveyors, including temperature screenings and symptom assessments
- Instruct surveyors to stay home if they experience any symptoms of COVID-19 or if they have been in close contact with someone who tested positive
- Modify survey procedures to minimize the risk of COVID-19 transmission, such as conducting surveys outdoors or using remote survey methods where possible
- Implement strategies for virtual or phone surveys to reduce face-to-face interactions.

- Work closely with local communities to ensure understanding and compliance with preventative measures
- Provide education and resources on COVID-19 prevention to survey respondents and community members

CHAPTER 4 – RESULT & DISCUSSION

This chapter provides instances that illustrate data analysis as well as the findings that can be produced by using data analysis. SPSS and Microsoft Excel are both utilised as tools for the generation of descriptive statistics for qualitative and quantitative data, respectively. After then, the information is simplified and made more digestible by being displayed in the form of tables, pie charts, and graphs.

4.1 Outline of survey

A Questionnaire survey of 400 sample size was conducted from the stakeholders. Questionnaire prepared for the study consist of major five sections i.e

1) Mobility and Accessibility
2) Coordination and interaction
3) Financial Barriers
4) Barriers to Physical & Mental Health
5) Barriers to Performance in construction Industry

4.2 Socio profile of respondents

33 out of 400 respondents are less than 24 years and further classifying, 11 respondents are from contractors, 10 respondents from consultants and 12 respondents are from vendors. Major respondents 327 out of 400 are between age 24 – 41 years. 40 out of 400 were above 41 years. 299 out of 400 respondents are Male respondents and further classifying, 101 respondents are from contractors, 139 respondents from consultants and 59 respondents are from vendors. 101 out of 400 were females. 16 out of 400 respondents are higher secondary school qualified and further classifying, 187 out of 400 respondents are bachelors qualified, 184 out of 400 respondents are Masters qualified. 13 out of 400 respondents are PHD qualified. Major respondents for the questionnaire are bachelors and master's qualified. 193 out of 400 respondents are from company having employees between 1-100 and further classifying, 58 out of 400 respondents are from company having employees between 101-200, 20 out of 400 respondents are from company having employees between 201-300. 129 out of 400 respondents are from company having employees more than 300. Major respondents for the questionnaire are either from large group of company or from small.

Table 3: Socio Profile of Respondents

Description		Type of Company			Total	%
		Contractor	Consultant	Vendor		
Age of Respondent	Less then 24 Years	11	10	12	33	8.25
	24 - 41 Years	104	158	65	327	81.75
	Above 41 Years	11	22	7	40	10
Gender of Respondent	Male	101	139	59	299	74.75
	Female	25	51	25	101	25.25
Highest academic Level or degree achieved	Higher Secondary School	0	8	8	16	4
	Bachelors	70	89	28	187	46.75
	Masters	56	87	41	184	46
	PHD	0	6	7	13	3.25
Size of employees in the company?	1-100	73	96	24	193	48.25
	101-200	22	30	6	58	14.5
	201-300	0	16	4	20	5
	More then 300	31	48	50	129	32.25

4.3 Social Resilience

4.3.1 Impact of covid on work mobility

The covid 19 pandemic has brought unprecedented challenges to workplaces worldwide, forcing organizations to adapt quickly to new working conditions. This study examines the impact of the pandemic on work mobility and performance across different types of companies, including contractors, consultants and vendors. The data is based on responses from 400 participants and includes variables such as access to workplace, distance travelled, and mode of transport, mobility limitations, work arrangements, financial barriers and performance challenges faced by companies due to covid 19.

The data reveals that respondents from all types of companies faced varying levels of difficulty in accessing their respective workplaces during the pandemic. It is evident that most respondents reported moderate to high level of difficulty in accessing their sites and offices. This finding suggests that companies had to implement additional safety measures and restrictions to ensure a safe working environment during the pandemic. Moreover, the data also highlights that the distance travelled to reach the workplace had a significant impact on respondents across different types of companies. Notably, most respondents from all categories travelled shorter distances (0-10km) during the pandemic. This could be attributed to companies adopting remote work policies

or allowing employees to work from home if possible, reducing the need for daily commutes. The study also showed that the mode of transport used by employees during the pandemic was private. This trend can be contributed to health and safety concerns and a desire to avoid crowded public spaces during the pandemic. Results also demonstrated that most respondents across different types of companies experienced some level of mobility limitations during the pandemic. Companies likely had to adjust their operations and facilitate remote work arrangements to accommodate employees facing mobility challenges. In the end we also come to see that many companies faced mobility related financial barriers due to the pandemic. This finding suggests that companies had to invest in remote work infrastructure and other measures to overcome mobility issues.

Table 4: Impact of Covid on work mobility

		Type of Company			Total
		Contractor	Consultant	Vendor	
Were you able to access your site/office? S2Q1	Very high	4	32	26	62
	High	31	34	20	85
	Moderate	52	78	24	154
	Low	32	26	10	68
	Very low	7	20	4	31
How much distance you had to cover to reach your work? S2Q2	0-10 Km	44	78	20	142
	11-20 Km	31	39	42	112
	21-30 Km	15	42	8	65
	31-40 Km	23	16	14	53
	More then 41 Km	13	15	0	28
Mode of Transport S2Q3	Public Transport	29	18	10	57
	Private Transport	97	172	74	343
Was your mobility limited to office or site? S2Q5	Very high	7	27	0	34
	High	52	40	17	109
	Moderate	40	68	41	149
	Low	21	41	20	82
	Very low	6	14	6	26
Were you doing? S2Q7	Work from home	20	68	18	106
	Work from office	37	28	35	100
	Hybrid	69	94	31	194
Financial barrier faced by the company due to COVID i.e Mobility Issue S2Q32	Yes	30	57	38	125
	No	96	133	46	275
Performance barriers faced by the company due to	Yes	113	162	61	336
	No	13	28	23	64

COVID i.e Remote Work Challenges S2Q42					
Performance barriers faced by the company due to COVID i.e Limited Travelling S2Q39	Yes	108	158	70	336
	No	18	32	14	64

4.3.2 Impact on coordination and interactions

The global outbreak of the Covid-19 virus has presented workplaces with unparalleled difficulties, necessitating businesses to swiftly adjust to novel working circumstances. This study investigates the influence of the pandemic on coordination and interactions in various company categories, encompassing contractors, consultants, and vendors. The dataset comprises responses from 400 individuals and encompasses characteristics such as workplace accessibility, travel distance, transportation mode, mobility restrictions, work arrangements, financial obstacles, and performance difficulties encountered by firms because of the Covid-19 pandemic.

The data indicates that individuals from diverse company backgrounds encountered different degrees of challenges in gaining entry to their workplaces within the pandemic. The data clearly indicates that a significant number of participants expressed encountering moderate to high levels of difficulties when trying to coordinate and interact with their colleagues. This study implies that Safety protocols and restrictions implemented to safeguard stakeholders and employees during the COVID-19 pandemic substantially transformed coordination and interaction in the construction sector. The construction sector has embraced various digital tools and platforms to facilitate collaboration and communication.

For remote collaboration and stakeholder engagement, video conferencing, project management software, and virtual design and construction tools have become indispensable. Site visits and in-person meetings were reduced or substituted with virtual meetings. Architects, engineers, contractors, project teams, and clients convened virtually to deliberate on project advancements, challenges, and resolutions. This enabled sustained correspondence with reduced instances of physical interaction. In order to uphold social distancing measures, novel communication protocols were implemented on construction sites. To promote the safety of interactions, designated areas for meetings and breaks, floor markings, and signs were implemented. Stakeholders were duly

informed by contractors, developers, and project proprietors via consistent updates and open and honest communication. Investors and community members were provided with updates on the project through the utilization of virtual excursions and presentations (See Figure 8: Social Resilience).

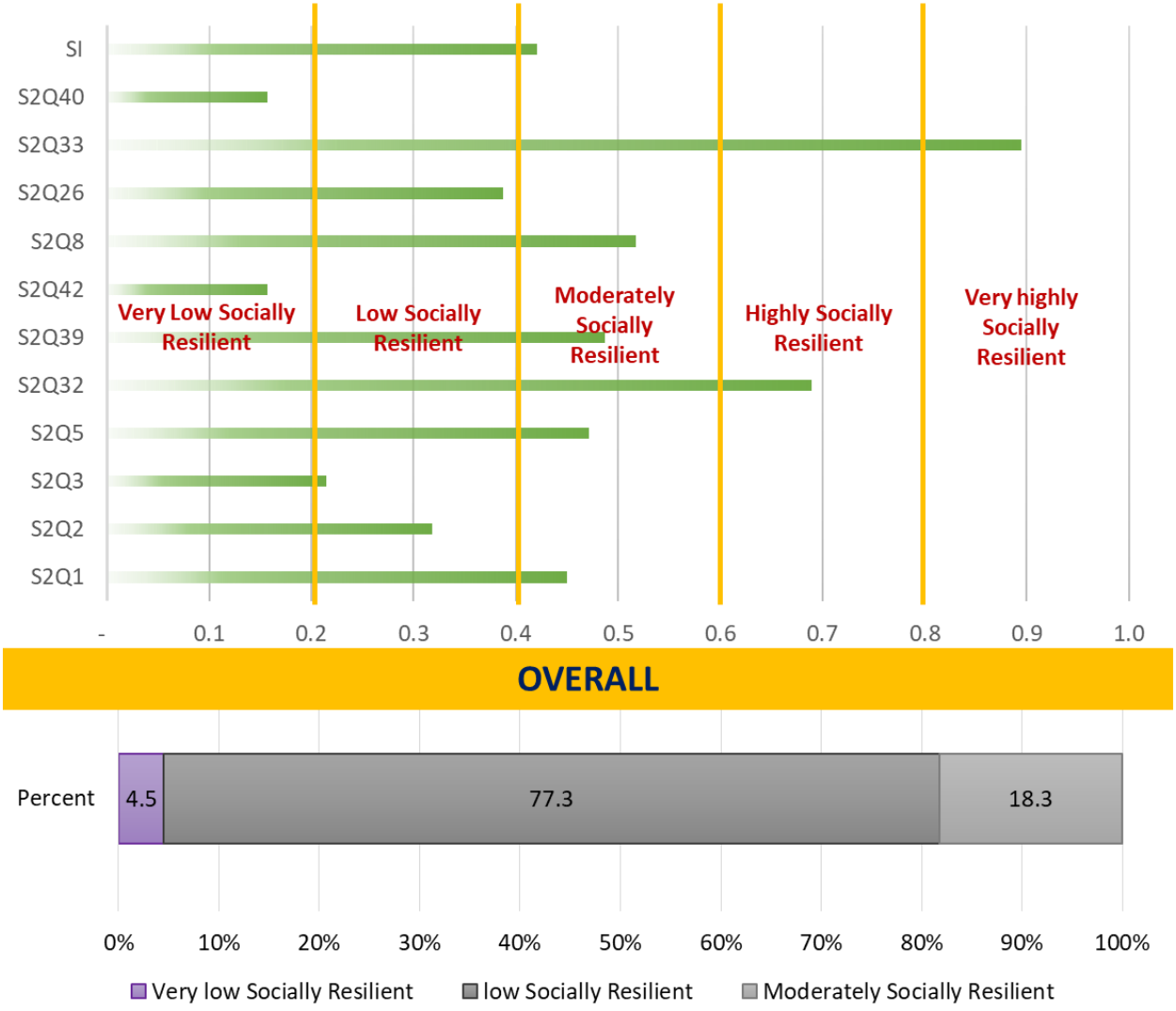

Figure 8: Socio Resilience

On construction sites, daily safety briefings regarding COVID-19 protocols were implemented as standard procedure. Employees were instructed on the most recent safety protocols and standards. The necessity for efficient communication with suppliers and vendors arose as a result of disruptions in the supply chain. In response to delays, contractors were required to modify their schedules and effectively communicate updated plans in order to maintain project progress.

Contracts for construction frequently required modifications to accommodate disruptions and delays caused by COVID-19. The clauses pertaining to additional costs, force majeure, and project extensions were reviewed and modified as necessary. Construction firms were required to implement novel approaches to workforce management in order to guarantee the safety of workers during their interactions on-site. Strategies such as staggered schedules, reduced crew sizes, and remote work arrangements were frequently adopted by administrative staff. In addition, workers and visitors entering construction sites were subjected to routine health screenings, which included temperature checks and symptom assessments. Additionally, protocols were established for isolation and testing in the event of potential exposure. The restriction of access to construction sites to only critical personnel resulted in a decline in the presence of external visitors and stakeholders. The implementation of virtual visits and remote inspections was recommended in order to restrict physical presence (See Figure 9).

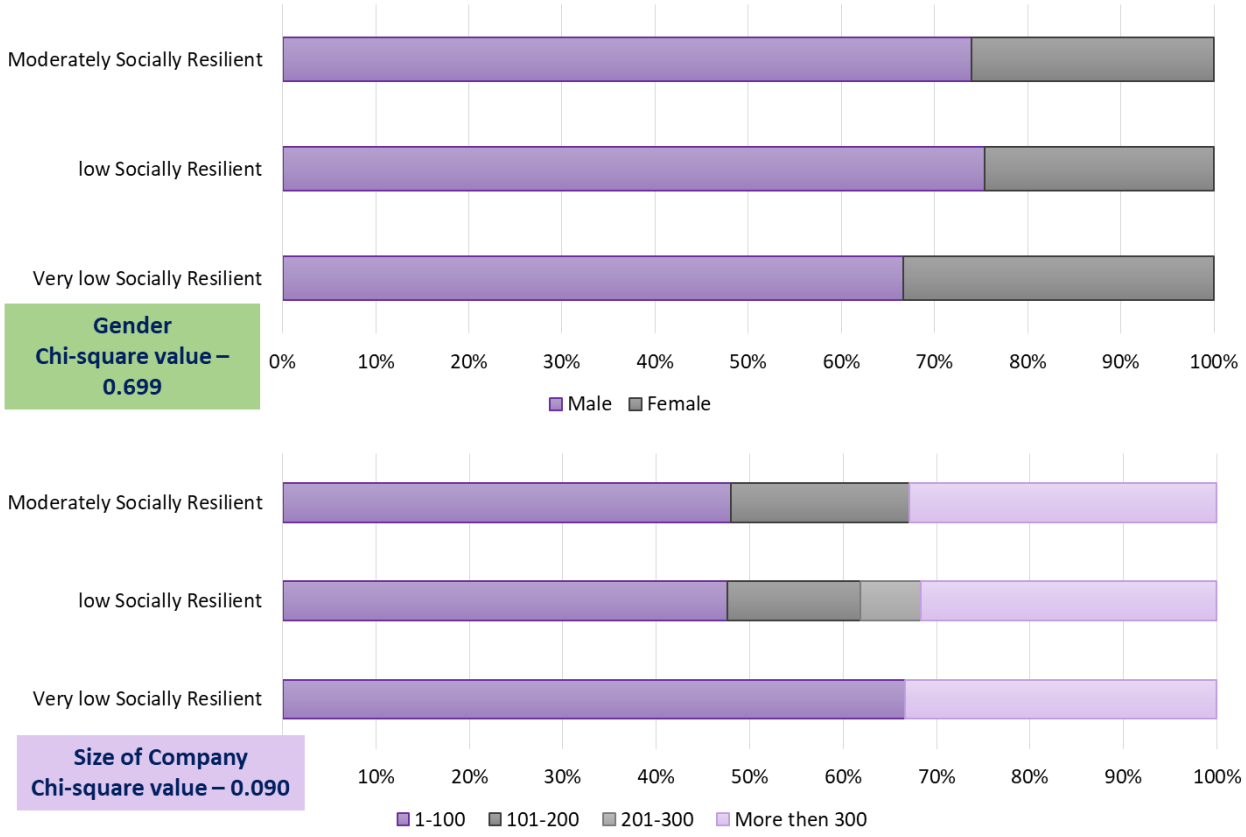

Figure 9: Social Impacts on respondent gender, size of company

Depending on the nature of the activity, personal protective equipment (PPE) regulations were expanded to include face masks, face shields, and occasionally full-body suits. Employers guaranteed that personnel were provided with appropriate PPE and training. The evolution of quality control and inspections has incorporated remote options whenever possible. Inspectors assessed adherence to safety and quality standards and monitored progress utilizing cameras and unmanned aerial vehicles (UAVs). Construction firms formulated and revised emergency response strategies in response to COVID-19 outbreaks. The strategies encompassed protocols for separating impacted personnel and undertaking contact tracing (See Figure 10).

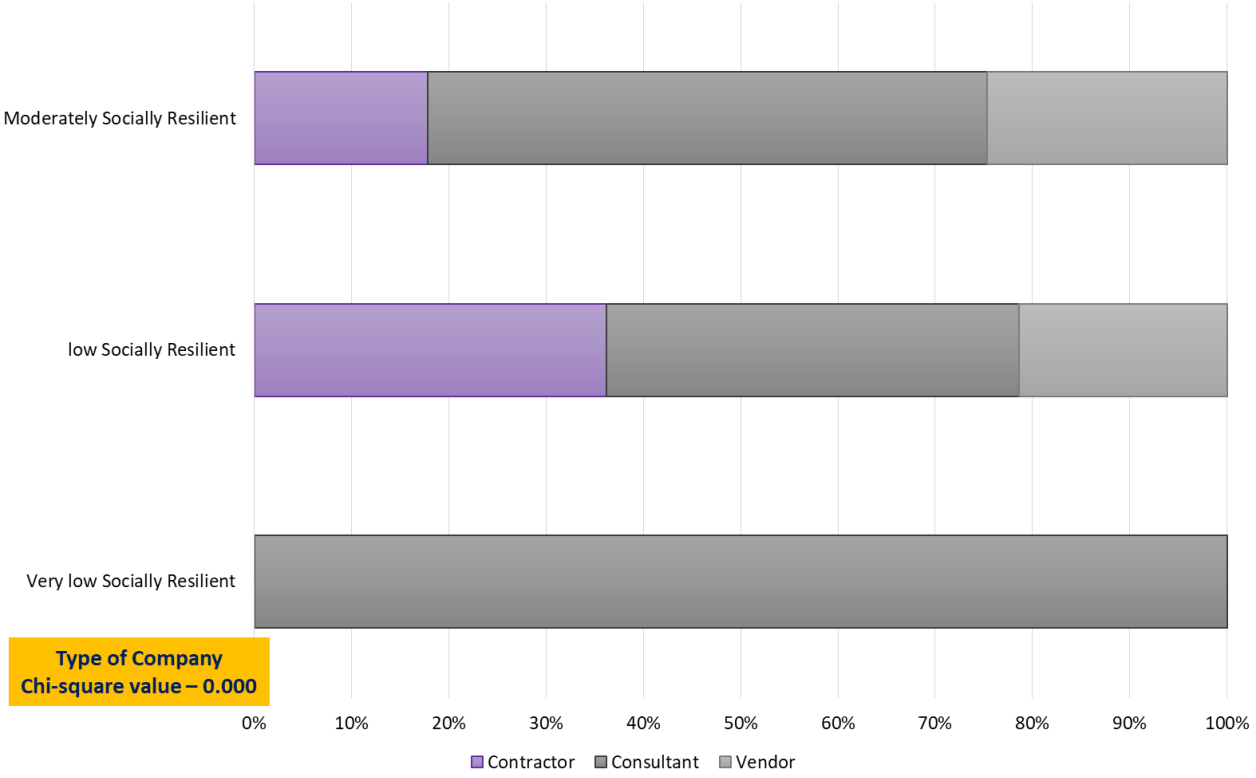

Figure 10: Social Impacts on type of company

Adaptability to new communication and coordination methods was crucial for the construction industry to maintain project time-lines while placing the health and safety of workers and stakeholders first during the pandemic. It is probable that a number of these developments, including the expanded utilization of digital tools and remote collaboration, will endure as the sector progresses (See Table 5).

Table 5: Impact of Covid-19 on coordination and interactions

		Type of Company			Total
		Contractor	Consultant	Vendor	
Were you able to purchase goods/Materials? S2Q8	Very high	4	16	8	28
	High	20	44	10	74
	Moderate	71	62	46	179
	Low	12	51	16	79
	Very low	19	17	4	40
Was your logistics affected? S2Q26	Very high	16	14	10	40
	High	39	93	42	174
	Moderate	65	50	20	135
	Low	6	23	0	29
	Very low	0	10	12	22
Financial barrier faced by the company due to COVID i.e Disruption in Supply chain S2Q33	Yes	16	20	6	42
	No	110	170	78	358
Performance barriers faced by the company due to COVID i.e Supply Chain Distruption S2Q40	Yes	113	162	61	336
	No	13	28	23	64

4.4 Financial Resilience

4.4.1 Impact of covid-19 on finance

Global workplaces have been confronted with unprecedented challenges as a result of the COVID-19 pandemic, which has compelled organizations to swiftly adjust to new working conditions. This research investigates the effects of the pandemic on work mobility and performance in various business sectors, encompassing contractors, consultants, and vendors. The dataset comprises information gathered from 400 respondents and encompasses a range of factors, including transportation mode, distance covered, workplace accessibility, financial constraints, work arrangements, and performance difficulties encountered by organizations as a result of the COVID-19 pandemic.

During the pandemic, respondents from a variety of business categories encountered varying degrees of difficulty gaining access to their respective workplaces, according to the data. The data clearly indicates that a significant proportion of the participants encountered moderate to high degrees of difficulty when attempting to access their respective sites and offices. The data reveals

that The COVID-19 pandemic has had a significant impact on the construction industry leading to disrupted global supply chains, leading to shortages and delays in the delivery of construction materials and equipment. This resulted in increased costs due to higher prices and the need for expedited shipping. The shortage of workers resulted in project delays and increased labor costs. Data also reveals that due to delay in project completion timelines resulted in increased project costs (See Figure 11).

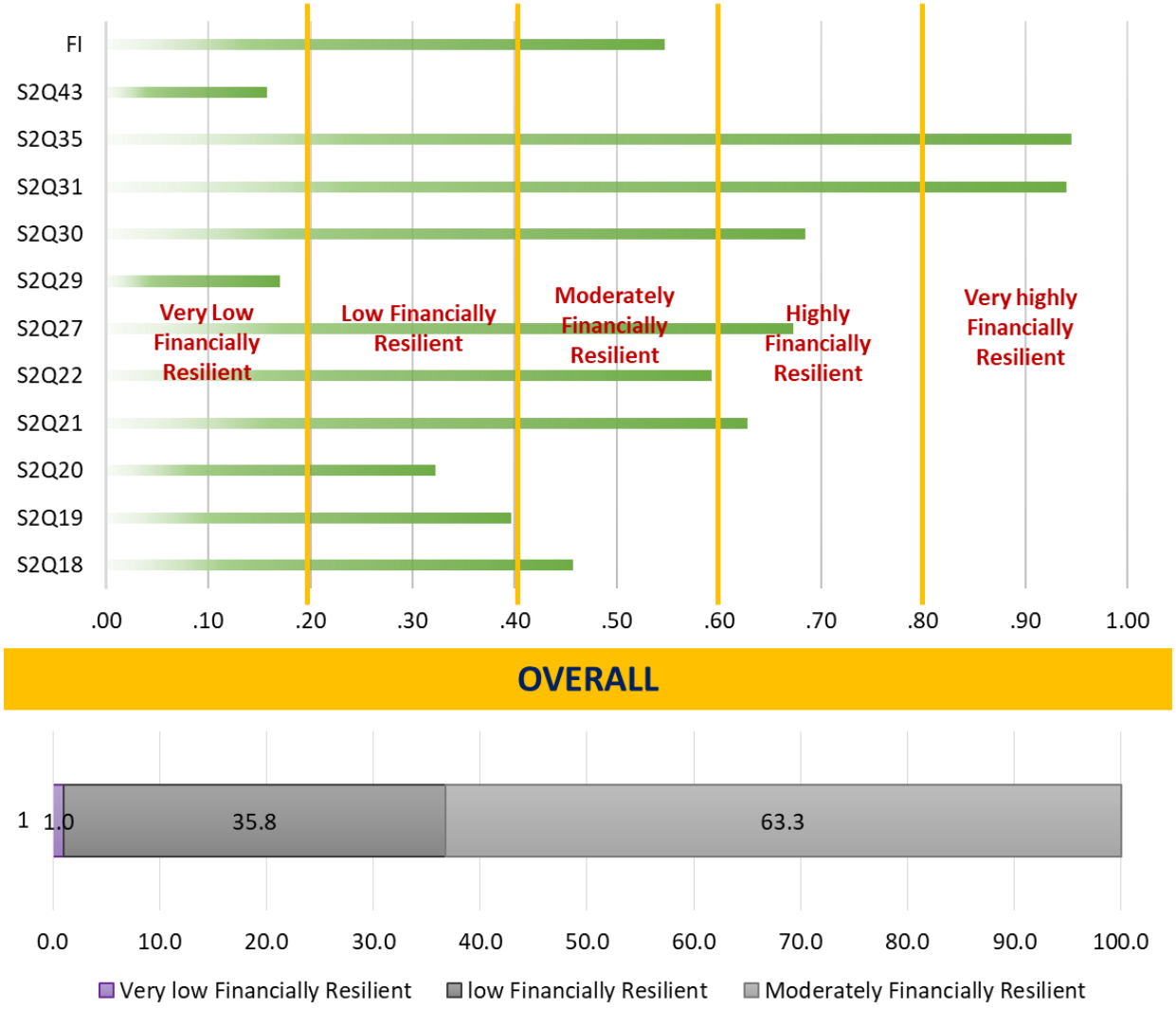

Figure 11: Financial Resilience

It was a challenge for the Construction companies that they had to implement new health and safety measures to protect workers from COVID-19 and these measures included providing

personal protective equipment (PPE), conducting regular testing, and implementing social distancing protocols. These added costs were not initially budgeted for in many projects.

Certain construction supplies encountered price surges amid the pandemic. Disruptions in the supply chain, heightened demand for specific resources, and inflation were all influential factors in the escalation of material costs. The pandemic-induced economic volatility exacerbated the difficulty for construction companies in obtaining financing for their projects. Lenders adopted a more prudent approach, and interest rates may have seen volatility, so impacting the overall expense of lending. Insurance premiums for building projects rose as insurers modified their policies to incorporate risks associated with the pandemic, such as project delays and closures. Several construction experts had to adjust to remote work, necessitating expenditures in technology and infrastructure. These expenses were not initially accounted for in numerous building estimates (See Table 6). Construction enterprises incurred more resources and expenses to adhere to evolving health and safety laws and pandemic-related rules. Construction contracts frequently required modification or renegotiation to accommodate delays and disruptions caused by the pandemic. There is a possibility that there could be an increase in legal expenses and expenditures associated with resolving disputes (See Figure 12).

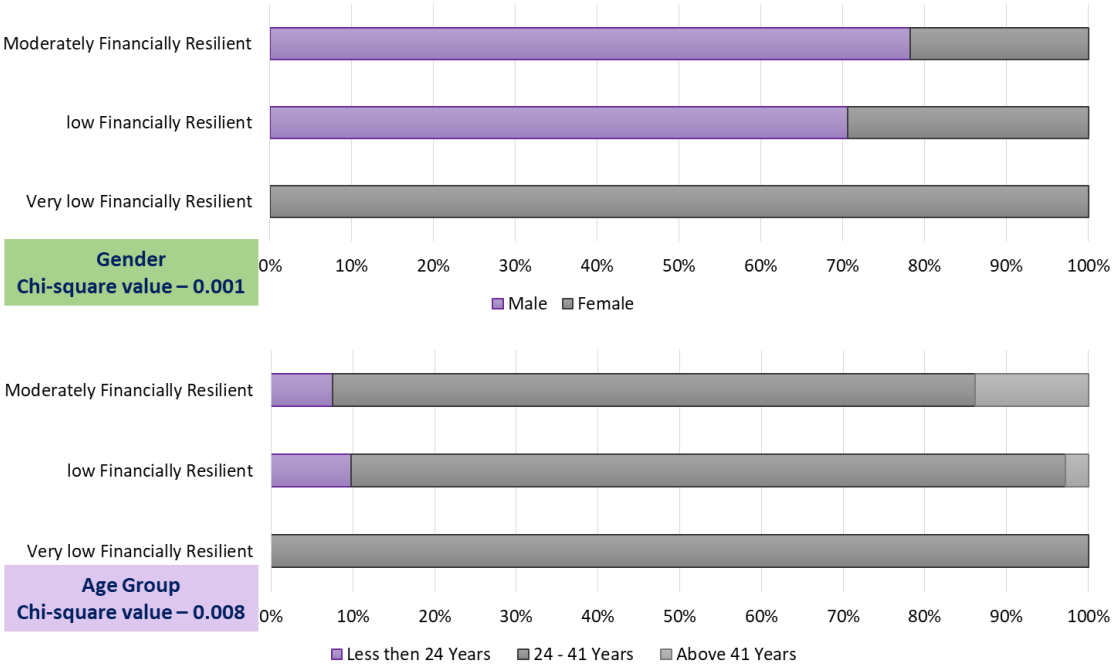

Figure 12: Financial Impacts on respondent gender & Age

To. overcome these financial obstacles, construction businesses had to adjust to the evolving circumstances, reassess their project budgets, and use novel risk management measures. The construction sector has also gained significant insights into the significance of resilience and contingency planning in order to effectively deal with future unforeseen crises (See Figure 13).

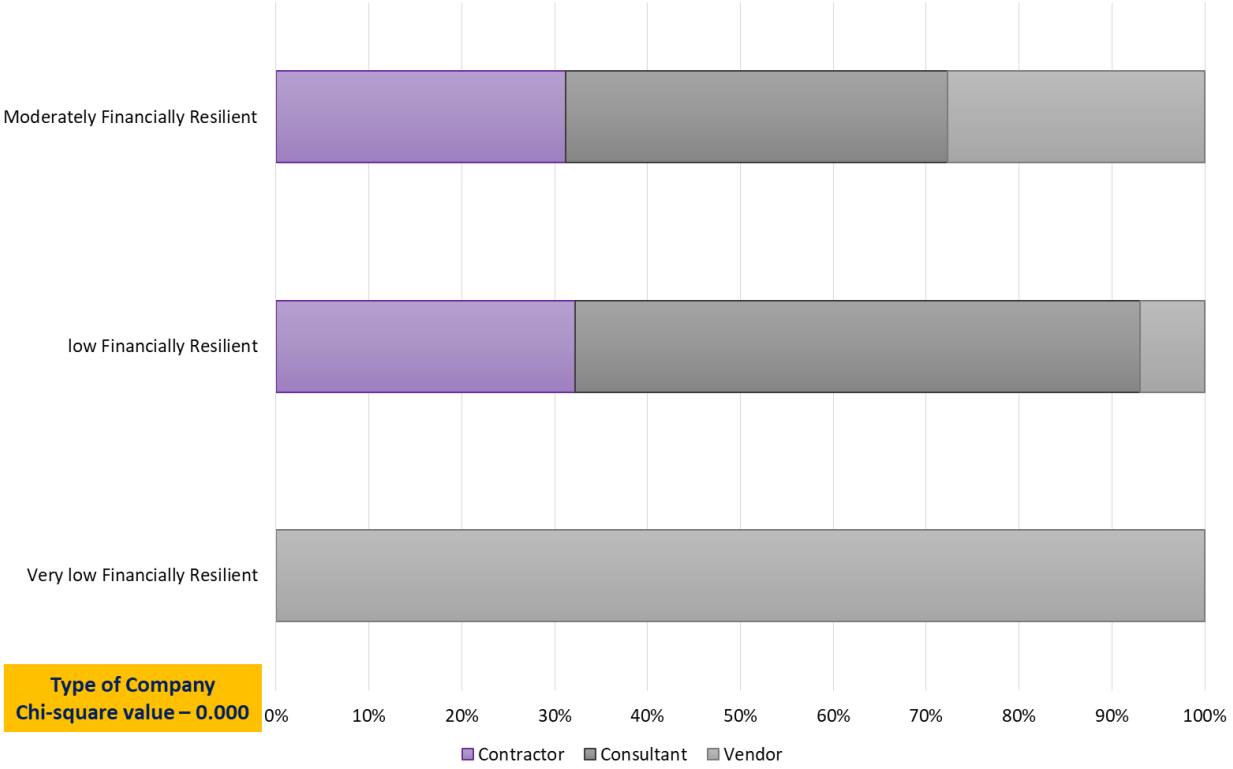

Figure 13: Financial Impacts on type of company

Table 6: Impact of Covid-19 on finance

		Type of Company			Total
		Contractor	Consultant	Vendor	
Were you able to get payments from client? S2Q18	Very high	0	24	10	34
	High	55	34	14	103
	Moderate	57	93	35	185
	Low	8	39	7	54
	Very low	6	0	18	24
Were you able to pay your employees? S2Q19	Very high	13	24	16	53
	High	56	46	16	118
	Moderate	44	108	39	191
	Low	6	12	0	18
	Very low	7	0	13	20

Was there any increase in project cost? S2Q20	Very high	36	34	33	103
	High	32	62	36	130
	Moderate	52	62	11	125
	Low	6	26	4	36
	Very low	0	6	0	6
Were you able to get financing from banks? S2Q21	Very high	0	0	4	4
	High	19	8	8	35
	Moderate	53	98	46	197
	Low	19	44	16	79
	Very low	35	40	10	85
Was there increase in profit? S2Q22	Very high	4	6	4	14
	High	14	16	4	34
	Moderate	67	97	29	193
	Low	27	45	35	107
	Very low	14	26	12	52
How much reduction in salaries of employees were made due to COVID? S2Q27	0-15 %	17	37	4	58
	16-30 %	16	30	4	50
	31-45 %	15	32	7	54
	46-60 %	12	8	12	32
	No reduction	66	83	57	206
How much loss company faced due to COVID? S2Q29	PKR 1 - 20 Mn	79	124	54	257
	PKR 21 - 40 Mn	27	34	14	75
	PKR 41 - 60 Mn	6	20	4	30
	PKR 61 - 80 Mn	7	4	0	11
	More the PKR 80 Mn	7	8	12	27
Financial barrier faced by the company due to COVID i.e Delay in Payments S2Q30	Yes	40	56	30	126
	No	86	134	54	274
Financial barrier faced by the company due to COVID i.e Closure of Banks S2Q31	Yes	8	16	0	24
	No	118	174	84	376
Financial barrier faced by the company due to COVID i.e Reduction in Salaries S2Q35	Yes	6	16	0	22
	No	120	174	84	378
Performance barriers faced by the company due to COVID i.e Financial Constraints S2Q43	Yes	108	158	70	336
	No	18	32	14	64

4.5 Health Resilience

4.5.1 Impact on physical & mental health

Workplaces worldwide have encountered unparalleled difficulties due to the COVID-19 pandemic, which has necessitated organizations to promptly adapt to novel operational circumstances. The present study examines the impact of the pandemic on Physical and Mental Health across a range of industry sectors, including that of vendors, contractors, and consultants. The dataset is comprised of data collected from 400 respondents and encompasses a variety of factors, including the mode of transportation utilized, the distance travelled, the accessibility of the workplace, financial limitations, work arrangements, and performance challenges faced by organizations due to the COVID-19 pandemic (See Figure 14).

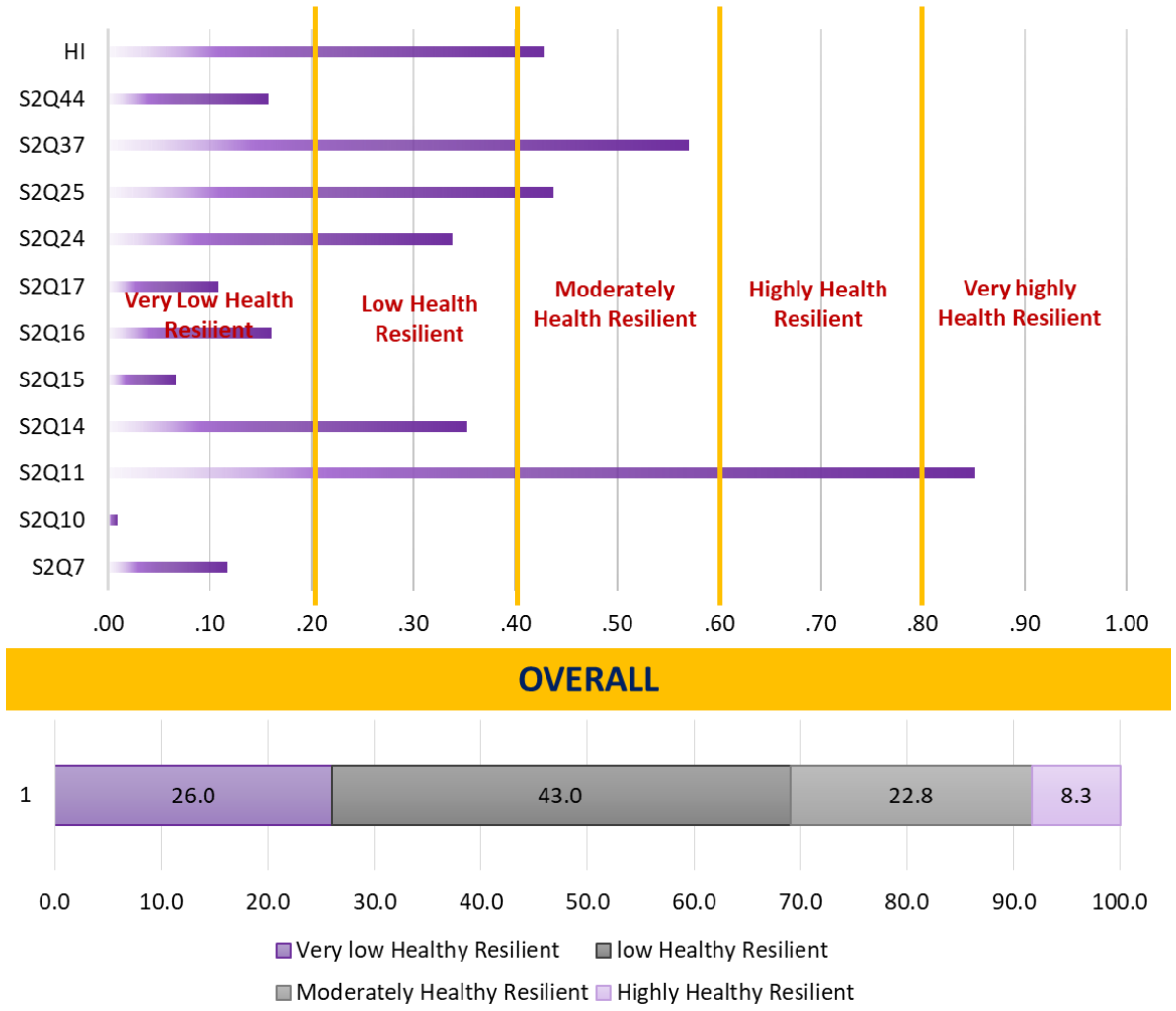

Figure 14: Health Resilience

According to the data, respondents representing diverse business categories experienced different levels of resistance when attempting to enter their workplaces amidst the pandemic. The data suggests that Constant close proximity among construction workers increases the likelihood of contracting COVID-19. Posing a substantial physical health barrier, this risk may result in morbidity, hospitalization, or mortality. During the early phases of the pandemic, PPE, which is critical for protecting employees from the virus, was in limited supply. This scarcity impeded the ability to preserve one's physical health. Ensuring adequate sanitation conditions on construction sites can present difficulties. A scarcity of hand washing stations and sanitizers may contribute to an elevated susceptibility to infection. Certain construction laborers might encounter challenges in accessing necessary medical attention due to restricted availability of healthcare services. The stress and distractions brought about by the pandemic may have exacerbated the dangers of construction sites and elevated the likelihood of workplace injuries (See Figure 15).

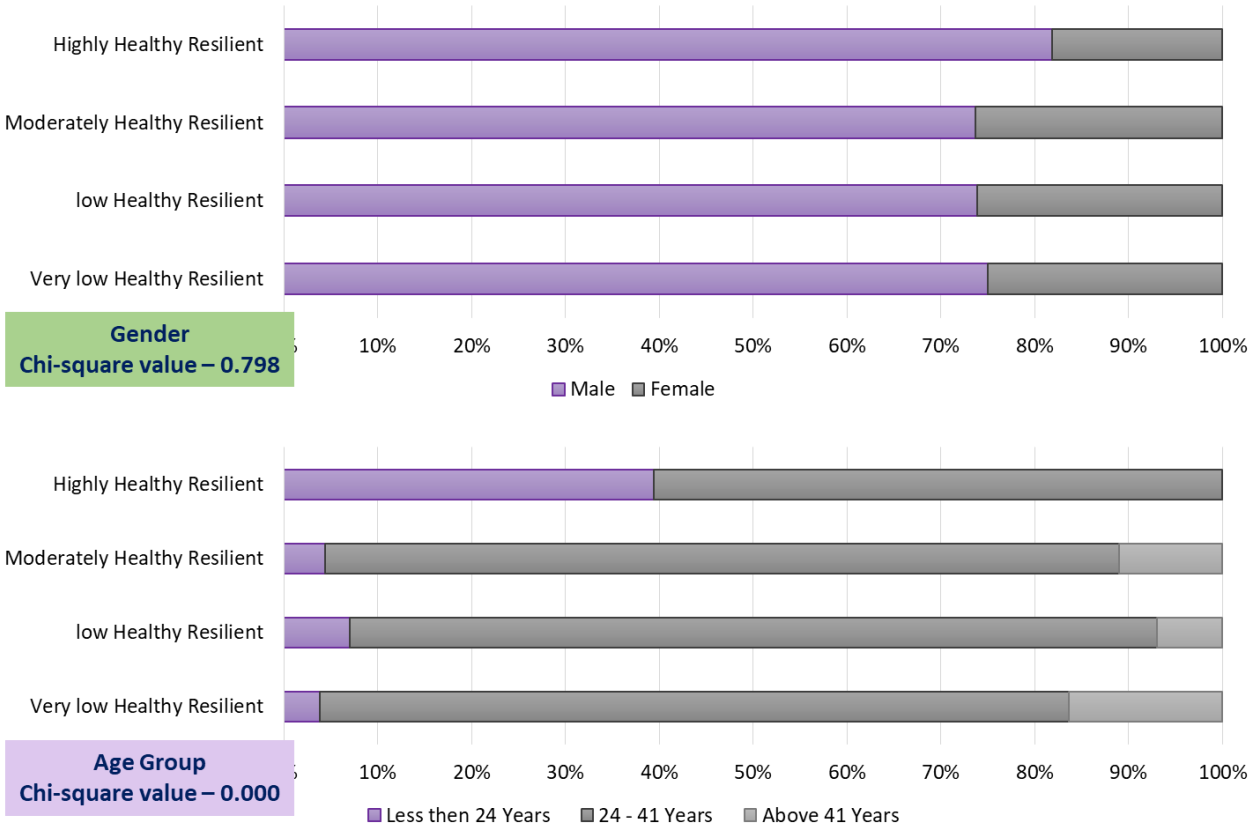

Figure 15: Health Impacts on respondent gender, Age Group

Many employees experienced social isolation as a result of the pandemic, which restricted their interactions with loved ones and acquaintances. Isolation has the potential to exacerbate emotions of loneliness and melancholy. Financial strain, precipitated by the pandemic-induced economic uncertainties such as workforce reductions and unemployment, may have adverse effects on mental health. Construction workers potentially encountered elevated levels of anxiety and stress as a result of the apprehension surrounding the possibility of acquiring the virus in the course of their professional duties. Construction projects that are subject to frequent alterations in work schedules, delays, and unpredictability regarding their future can all contribute to the development of anxiety and uncertainty (See Table 7). The ongoing pandemic may have imposed restrictions on the availability of mental health services, thereby impeding construction workers' ability to seek assistance when required. Frequently, the construction sector necessitates extended work hours and physically taxing tasks. The additional strain caused by the pandemic might have contributed to employee fatigue. Language barriers and remote work arrangements might have impeded the ability of construction workers to communicate their mental health concerns and obtain assistance.

A comprehensive strategy is required to overcome these obstacles to physical and mental health during and after the pandemic. This strategy should include promoting a supportive workplace culture, instituting safety measures, and providing mental health resources. It is imperative that employers, government agencies, and industry organizations work in concert to develop strategies that place immediate and long-term welfare of construction workers at the forefront (See Figure 16).

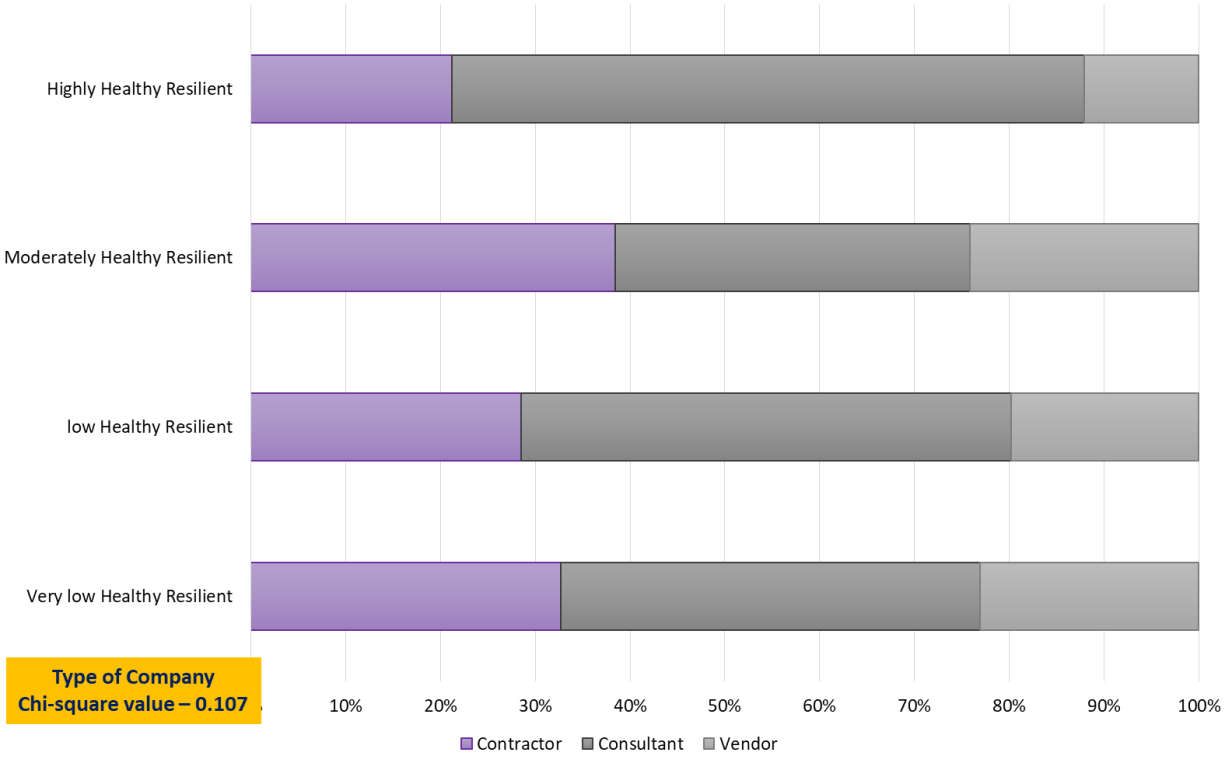

Figure 16: Health Impacts on type of company

Table 7: Impact of Covid-19 on health

		Type of Company			Total
		Contractor	Consultant	Vendor	
Work from home had a positive affect? S2Q7	Yes	52	121	39	212
	No	74	69	45	188
Was there any SOPs during COVID S2Q10	Yes	122	186	78	386
	No	4	4	6	14
Type of SOPs S2Q11	Wear a mask	8	25	10	43
	Use of Sanitizer	0	12	0	12
	Social Distancing	6	4	0	10
	Getting Tested for COVID-19 If Needed & COVID Vaccination	0	0	6	6
	All of the above	112	149	68	329
Was there any testing of employees during COVID? S2Q14	Very high	13	26	28	67
	High	61	92	27	180
	Moderate	36	50	12	98
	Low	6	18	4	28
	Very low	10	4	13	27

Was there any break/ holidays during COVID period? S2Q15	Yes	94	133	68	295
	No	32	57	16	105
Was there any quarantine facility provided to work force? S2Q16	Yes	47	84	14	145
	No	79	106	70	255
Were proper Site facilities available? i.e. lunch space, washing facility, accommodation, PPE etc. S2Q17	Yes	95	94	38	227
	No	31	96	46	173
Was your staff affected with Anxiety and depression? S2Q24	Very high	17	48	16	81
	High	48	65	36	149
	Moderate	31	65	22	118
	Low	30	12	10	52
Were you able to create a motivated environment? S2Q25	Very high	4	24	10	38
	High	55	44	10	109
	Moderate	60	79	43	182
	Low	7	39	11	57
	Very low	0	4	10	14
Performance barriers faced by the company due to COVID i.e Lack of Motivation due to Work from home S2Q37	Yes	83	130	58	271
	No	43	60	26	129
Performance barriers faced by the company due to COVID i.e Health and Safety Concerns S2Q44	Yes	113	162	61	336
	No	13	28	23	64

4.6 Performance Resilience

4.6.1 Impact of covid-19 on work performance and project terminations

The covid 19 pandemic disrupted businesses worldwide, leading to significant changes in work practices and project management. In this study we also investigate the impact of the pandemic on work performance and project termination across different types of companies. The analysis examines variables such as mode of meetings, job performance, project termination, financial barrier and performance challenges faced by companies due to covid-19. The data reveals interesting trends in the mode of meetings conducted during the pandemic. Virtual meetings, such as those conducted through platforms like zoom or Microsoft teams were the most popular choice. This finding suggests that companies embraced technology to maintain communication and collaboration while adhering to social distancing measures (See Figure 17).

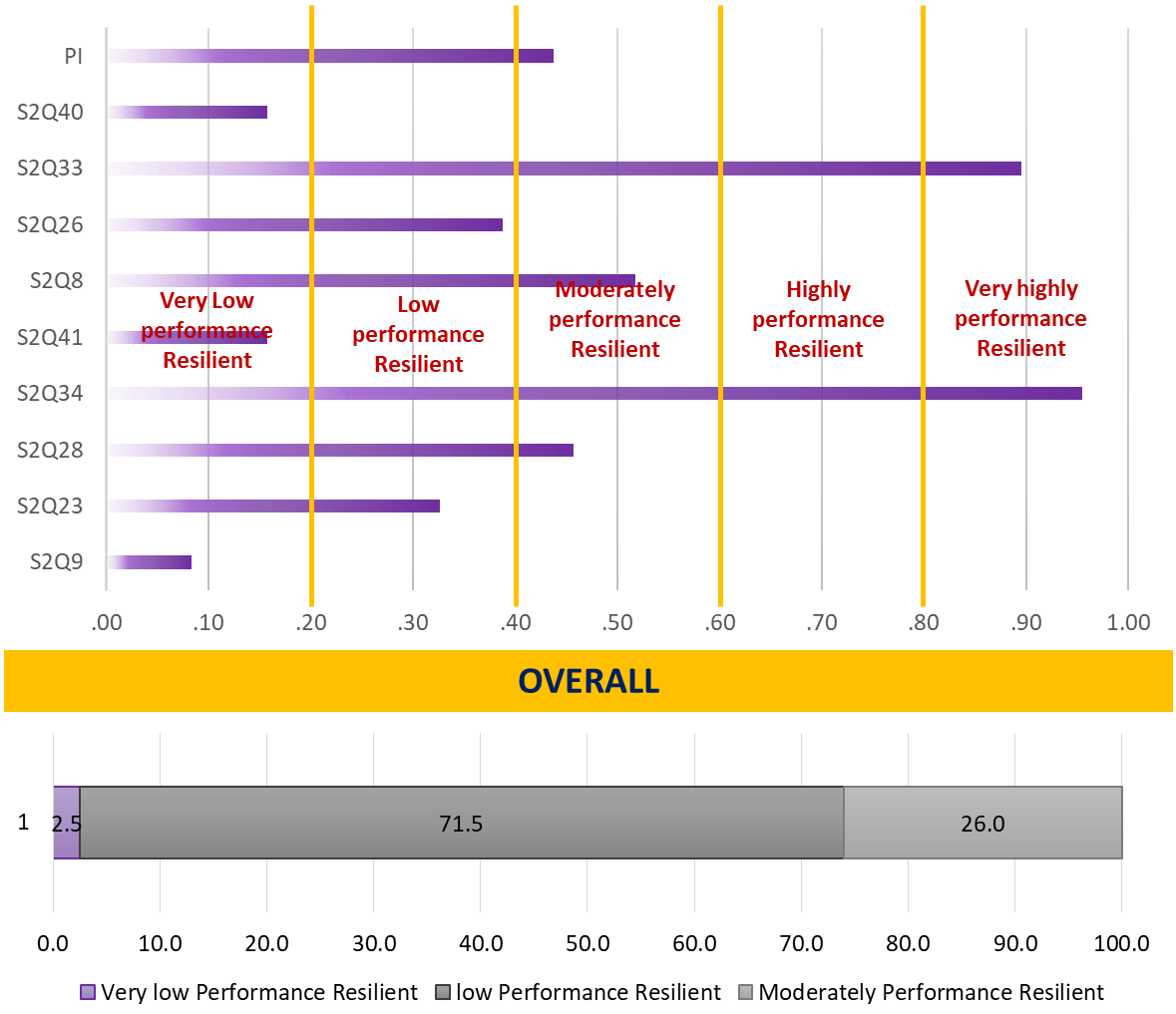

Figure 17: Performance Resilience

Face-to-face meetings were less common, likely due to health and safety concerns during the pandemic. The analysis also shows that a significant number of employees reported varying levels of impact on their job performance. Respondents across all types of companies reported experiencing different degrees of performance changes due to the pandemic (See Figure 18).

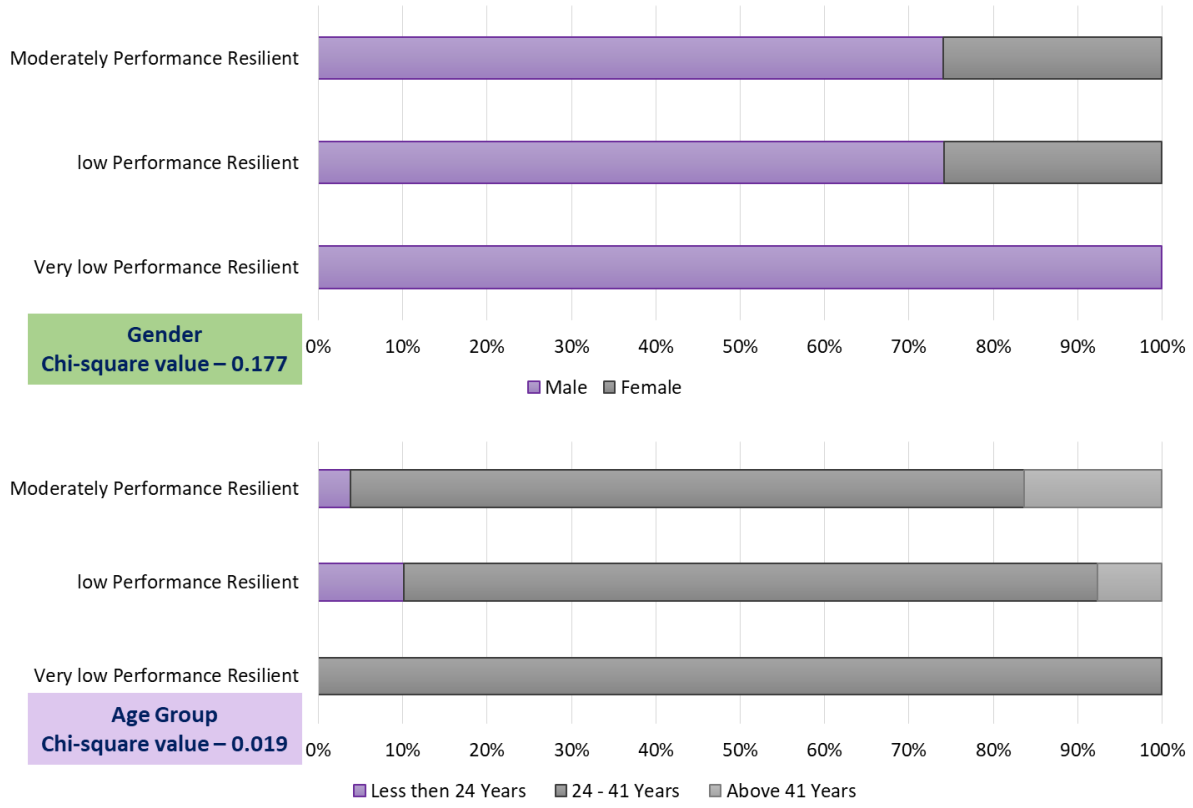

Figure 18: Performance Impacts on respondent gender, Age Group

Furthermore, a substantial number of respondents also reported that their companies did not terminate any projects. However, a notable number of companies did face hurdles in their project completion timeline. This finding reflects the economic challenges brought on by the pandemic, leading to changes in project priorities and resource allocations. The studies also examined challenges arising from reduced demands for products and services due to the pandemic. The data indicates that a significant number of companies across all types, faced reduced demand challenges (See Table 8). This finding highlights the widespread economic impact of the pandemic affecting industries irrespective of their type or nature of business (See Figure 19).

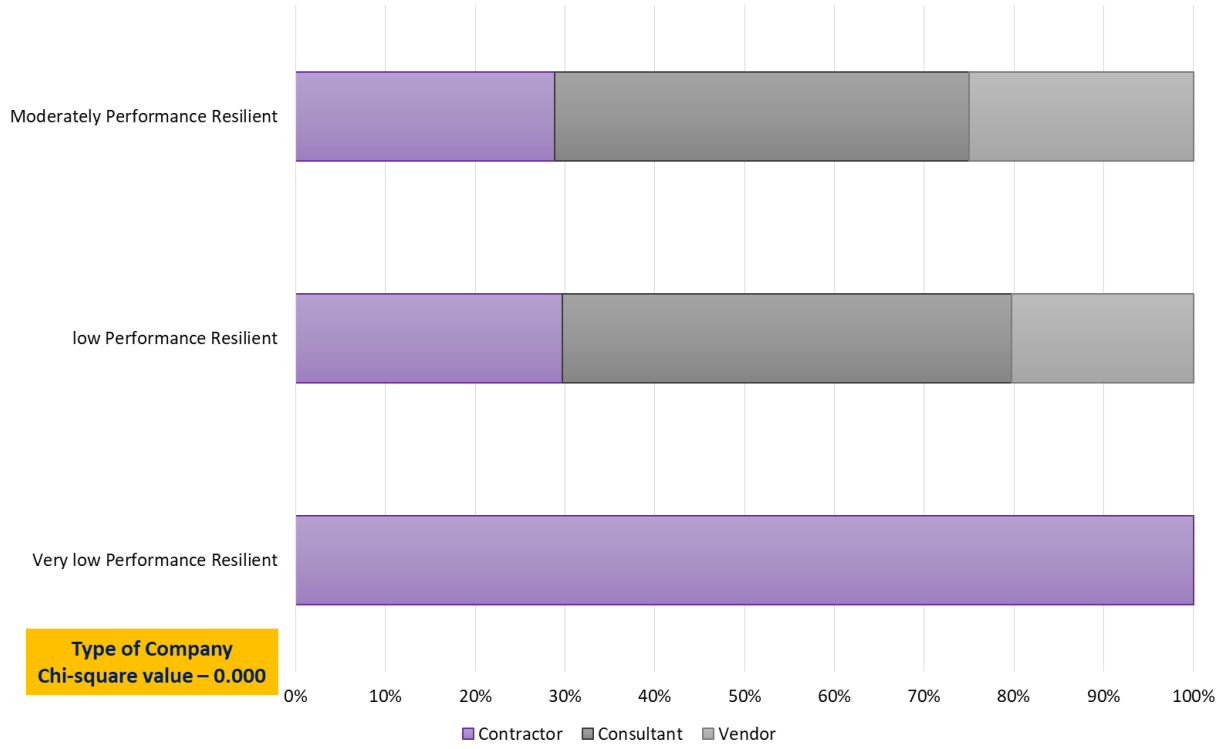

Figure 19: Performance Impacts on type of company

Table 8: Impact of Covid-19 on Performance

		Type of Company			Total
		Contractor	Consultant	Vendor	
Mode of meetings? S2Q9	Virtual Meeting (Zoom or Microsoft Teams etc)	71	152	43	266
	Face to Face meeting	55	38	41	134
Was the job performance of the employees affected due to COVID? S2Q23	Very high	32	36	12	80
	High	35	72	44	151
	Moderate	53	66	18	137
	Low	6	16	10	32
How many projects were terminated? S2Q28	No of Projects 1-3	24	59	21	104
	No of Projects 4-6	21	18	20	59
	No of Projects 7-9	14	18	0	32
	No project was terminated	67	95	43	205
Financial barrier faced by the company due to COVID i.e Termination of Projects	Yes	4	7	6	17

S2Q34	No	122	183	78	383
Performance barriers faced by the company due to COVID i.e Reduced Demand S2Q41	Yes	108	158	70	336
	No	18	32	14	64
Were you able to purchase goods/Materials? S2Q8	Very high	4	16	8	28
	High	20	44	10	74
	Moderate	71	62	46	179
	Low	12	51	16	79
	Very low	19	17	4	40
Was your logistics affected? S2Q26	Very high	16	14	10	40
	High	39	93	42	174
	Moderate	65	50	20	135
	Low	6	23	0	29
	Very low	0	10	12	22
Financial barrier faced by the company due to COVID i.e Disruption in Supply chain S2Q33	Yes	16	20	6	42
	No	110	170	78	358
Performance barriers faced by the company due to COVID i.e Supply Chain Distruption S2Q40	Yes	113	162	61	336
	No	13	28	23	64

4.7 Overall Resilience

The COVID-19 pandemic has significantly impacted the Construction Industry of Pakistan and worldwide, leading to job losses, financial stress, and revenue reduction. Despite the challenges, the stakeholders have shown resilience and adaptability by offering support to those affected by the pandemic. The pandemic has caused feelings of isolation and loneliness, particularly among older adults, leading to increased levels of anxiety, depression, and stress. The disruption of supply chain has resulted in project closures. The pandemic has placed a significant strain on healthcare systems, resulting in delays in routine medical procedures and treatments and negative health outcomes for some individuals (See Figure 20).

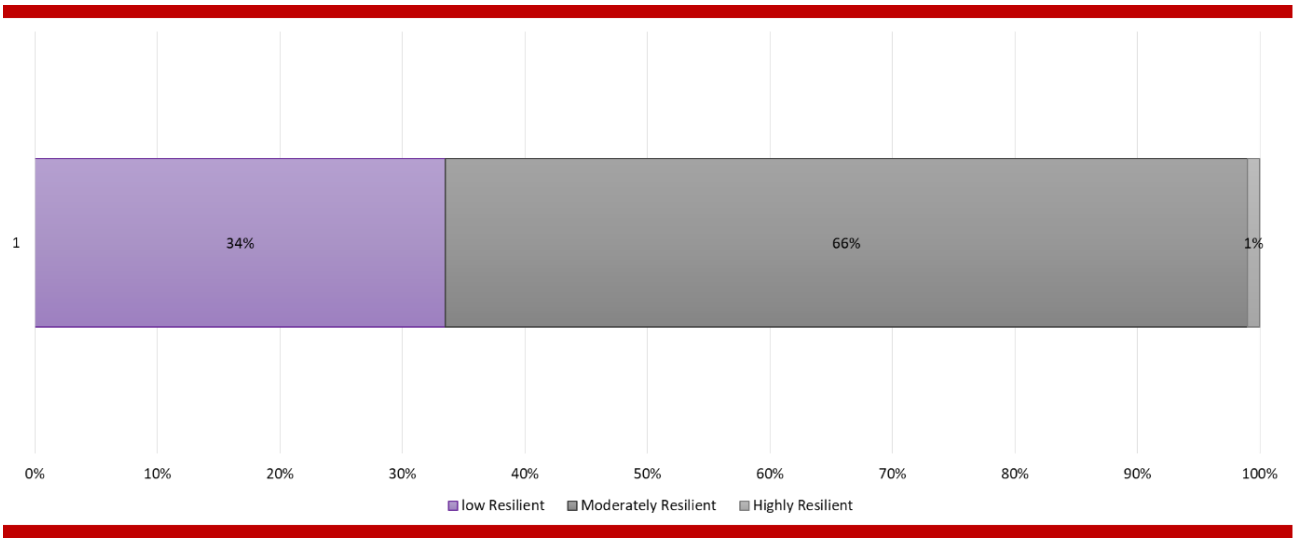

Figure 20: Overall Resilience

Many Construction Projects have been delayed or terminated, leading to job losses and decreased consumer spending, particularly in the retail and hospitality industries. The Construction industry has also been significantly impacted by decreased demand, closure of markets and shops, reduced income for labours, and difficulty accessing raw materials. Both the government and NGOs have played important roles in managing the pandemic and mitigating its impact on the local community. The Construction Industry is one of the most affected sectors in natural disasters and calamities, and the recent COVID-19 pandemic has had a severe impact on both the industry and Pakistan's economy. The pandemic provides an opportunity for the Construction industry to adopt sustainable practices, including promoting sustainable construction, diversifying products and markets, enhancing digital technology, strengthening partnerships, investing in technology & software's (See Figure 21).

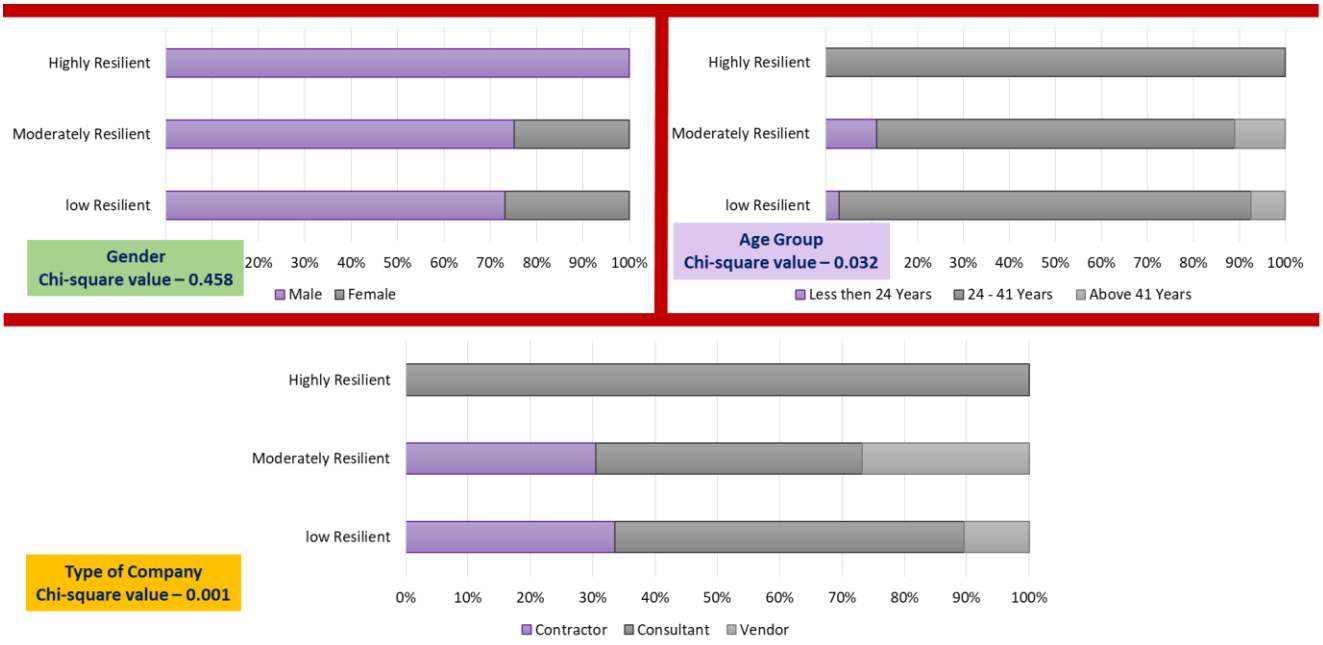

Figure 21: Overall resilience in context with gender, age group and type of company

4.8 Challenges and Strategies

The outcomes of the examination of the correlations between strategies and seventeen challenges are illustrated in Figure 22. The absence of a secure working environment and the prevalence of health and safety issues contribute to a demanding professional atmosphere for field workers. Consequently, the literature acknowledges that the obstacles associated with the organisational category are critical. Field workers are able to surmount the obstacles posed by a hazardous working environment by implementing strategies such as redefining job-site safety regulations, encouraging more remote work, extending project timelines, and instituting flexible work schedules, as illustrated in Figure 22. Additionally, as shown in Fig. 22, a sluggish revenue flow is a significant obstacle for both office and field employees, as it causes a dearth of personal protective equipment (PPE), material delivery delays, and decreased productivity. By conducting risk assessments and evaluations of contractors, as well as by documenting supply chains, cash flows can be efficiently managed and the continuity of a project ensured. Office personnel can surmount the obstacles of limited tool and equipment accessibility, stress, social isolation, and job security apprehensions through the implementation of improved technologies, identification of stress symptoms, and employer communication, respectively. Employers have the capacity to

assist older workers who are more susceptible to the pandemic by granting them remote work opportunities and providing them with technological tool training.

In summary, effective communication is the most crucial strategy for both office and field personnel. Employers and employees can mitigate the majority of the obstacles illustrated in Figure 22 by means of effective communication.

Employees ought to have the confidence to approach their employers with any safety-related issues that may arise on the job or any challenges they face when operating remotely. The novelty of this work stems from the identification of COVID-19 challenges encountered by office and field personnel, as well as the formulation of preventative or, at the very least, mitigating strategies for these challenges' unintended consequences. The potential obstacles and approaches examined in this study can function as principles for practitioners and policymakers to follow when formulating effective policies and/or undertaking suitable actions in comparable circumstances.

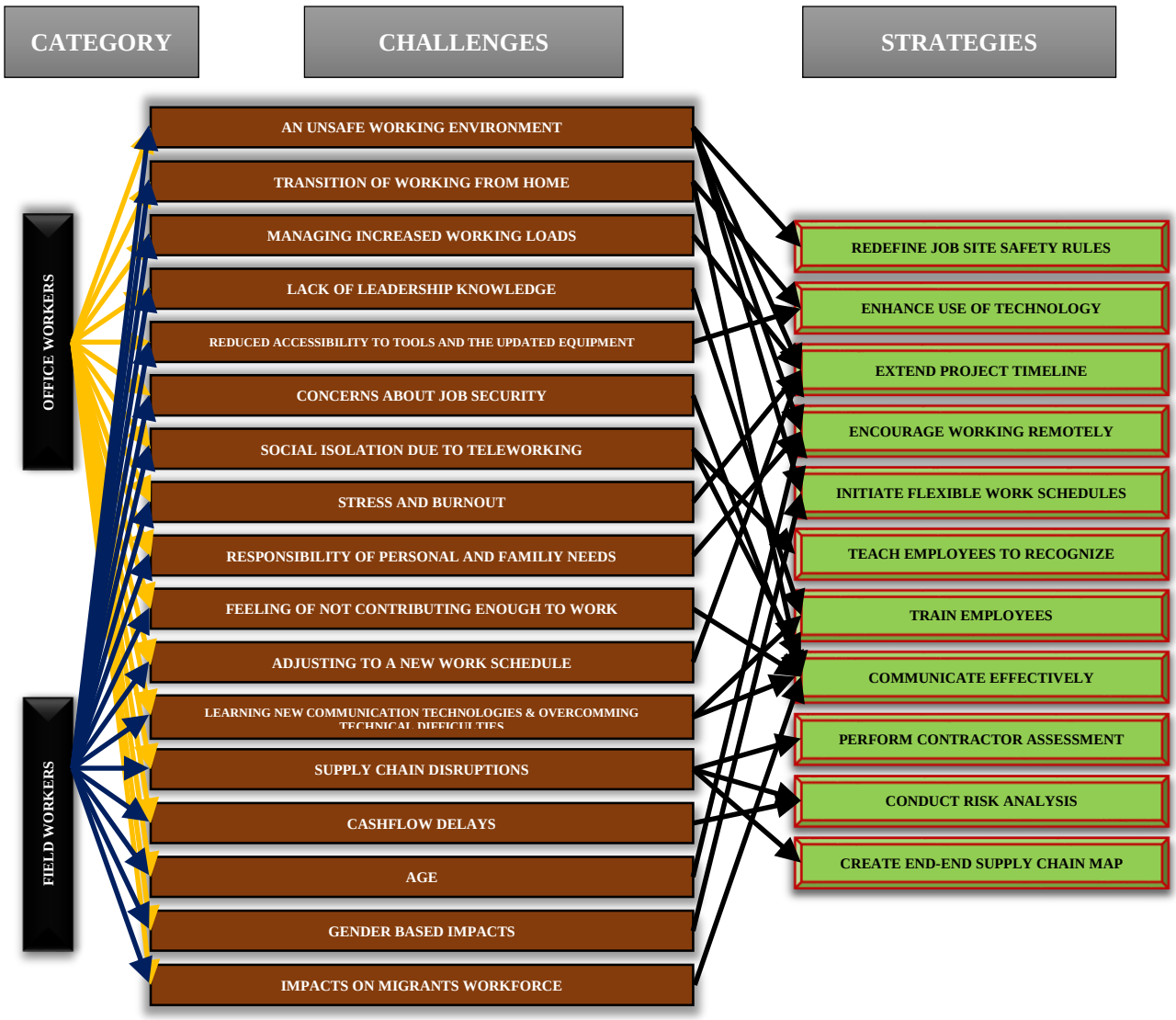

Figure 22: Strategies and challenges posed by COVID-19.

CHAPTER 5 - CONCLUSION AND RECOMMENDATIONS

The present research examines the effects of the COVID-19 pandemic on construction labour forces and suggests viable approaches to alleviate the difficulties that have arisen. The existing literature was utilised to identify different challenges, which were subsequently categorised into five distinct domains: Social, Financial, Health and Performance. Strategies that adequately tackle the challenges were identified and categorised into three primary classifications: safeguarding the personnel, protecting the performance of the project, and ensuring the continuity of the project. Age, personal and family obligations throughout the workday, hazardous working conditions, diminished accessibility to tools and equipment, and social isolation resulting from teleworking were the primary concerns in the organisational, economic, psychological, individual, and moderating domains, respectively. Workers are susceptible to contracting the virus when they are not provided with a secure working environment. Additionally, the absence of necessary tools and equipment hinders their ability to complete assigned tasks, while teleworking-related social isolation can contribute to mental health complications.

Eleven Strategies for mitigating these obstacles were identified. Implementing physical separation protocols among employees, regular temperature monitoring, and adaptable and dispersed work schedules can effectively mitigate worker exposure to the virus and enhance the overall working environment. Facilitating frequent interactions with remote workers and equipping them with necessary tools and technology promoters with virtual meetings are effective strategies for mitigating their anxiety and tension levels. In addition to the aforementioned measures, it was determined that mapping supply chains, undertaking risk assessments, and extending project deadlines were all effective in averting disruptions and ensuring project continuity. The outcomes of this research will significantly advantage project managers by enabling them to comprehend the COVID-19 obstacles faced by their personnel and prioritize their strategies in order to establish secure working environments that safeguard personnel and provide mental and physical support. Government entities may also find the results beneficial as they work to mitigate the negative consequences of the pandemic. In order to advance the field, this study suggests that future investigations involve surveying construction field and office workforces to evaluate the efficacy and implementation of each strategy in accordance with the identified factor.

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