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Factors Assessment for Labour Productivity in Sustainable Construction Projects in Pakistan

by

Munim Mujeeb Lashari

A thesis submitted in partial fulfillment for the
degree of Master of Science

in the

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Abstract

Labour productivity is a critical determinant of performance in the construction industry and is essential for the successful delivery of sustainable construction projects. In Pakistan, where construction activities remain highly labour-intensive, low labour productivity continues to contribute to cost overruns, schedule delays, and compromised quality. Despite the growing adoption of sustainable construction practices, limited quantitative research has examined labour productivity risks within sustainable project environments. This study aims to identify, assess, and prioritize labour productivity factors in sustainable construction projects in Pakistan and to propose mitigation guidelines. An extensive literature review initially identified a comprehensive list of productivity related factors, which were refined through expert validation using the Delphi technique. A structured questionnaire consisting of 32 productivity factors grouped into 6 major categories was developed and distributed to industry professionals, resulting in 91 valid responses. The reliability of the questionnaire was confirmed using Cronbach's alpha ($\alpha > 0.80$), and non-parametric statistical analysis was applied due to the non-normal distribution of the data. The Relative Importance Index (RII) method was employed to rank the identified factors, with RII values ranging from 0.59 to 0.95, indicating varying levels of influence on labour productivity. The results show that workforce-related factors dominate the overall rankings, with four of the top five factors belonging to this category and the highest RII value exceeding 0.94. Technical and design factors ranked second, followed by motivation and incentive factors, material, equipment and resource factors, management and supervision factors, while external and environmental factors ranked lowest, with the minimum RII value recorded at approximately 0.70. Key productivity drivers include role clarity, skilled labour availability, teamwork, clear design drawings, timely wage payments, and uninterrupted site operations, whereas punishment-based management practices and external disruptions were found to have comparatively limited influence on productivity improvement. Based on these prioritized findings, the study proposes targeted and actionable recommendations for contractors, project managers, and academic institutions aimed at systematically enhancing labour productivity and

supporting the effective implementation of sustainable construction practices in Pakistan.

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Abbreviations

AHP	Analytical Hierarchy Process
AI	Artificial Intelligence
BIM	Building Information Modeling
ER	Extended Reality
GDP	Gross Domestic Product
KPIs	Key Performance Indicators
LCA	Life Cycle Assessment
PSSC	Phosphogypsum-based Supersulfated Cement
RII	Relative Importance Index
SDGs	Sustainable Development Goals

Chapter 1

Introduction

1.1 Background

Construction has remained a fundamental driver of human progress since the earliest civilizations, providing the built environment necessary for societal development [1]. Over time, it has evolved with advancements in engineering, materials, and technical innovation, supporting the creation and maintenance of essential infrastructure such as buildings, transportation systems, and public service facilities. The construction sector has therefore transformed into a multidisciplinary field focused on producing structures that are not only functional and durable but also safe and efficient for modern life [2].

Recognizing its essential role in shaping communities, the importance of construction continues to expand as nations rely on infrastructure development to boost economic stability, improve living standards, and strengthen public welfare [3]. Well-executed construction projects ensure access to fundamental services, facilitate trade and mobility, and promote national competitiveness [4].

The industry has also increasingly aligned with environmental responsibilities, showing that construction is deeply tied to both economic growth and sustainable development [5]. Consequently, the sector operates as a backbone of national progress.

In this context, the construction industry's contribution extends far beyond physical structures, as it influences multiple economic sectors, supports industrial expansion, and generates large-scale employment for workers across various skill levels [6]. Each successfully delivered project contributes to the development of national infrastructure systems and enhances their capacity to withstand emerging pressures such as rapid urban growth and climate variability. These multifaceted contributions highlight the construction industry as a critical agent of social and economic transformation [7, 8].

Given contemporary sustainability challenges, the global construction industry has adopted new practices that balance resource efficiency, environmental protection, and social well-being [6]. Sustainable construction emphasizes minimizing waste, conserving natural resources, and enhancing the life cycle performance of structures through modern technologies and renewable solutions [4]. As a result, sustainability has shifted from being an innovative trend to a global necessity.

However, sustainability goals in construction can only be achieved through robust project delivery, which requires managing risks associated with cost, time, safety, quality, and environmental conditions [9]. Risk assessment and mitigation have therefore become essential components of construction management, enabling project teams to anticipate challenges and implement preventive measures that support reliability and success [10]. Effective risk management avoids performance setbacks and ensures more resilient construction outcomes.

Among all project resources, labour forms the most dynamic and influential component that directly shapes productivity levels and project performance [11]. Skilled, motivated, and properly managed workers transform plans into tangible construction output. Their performance determines the pace and quality of execution, which subsequently impacts financial viability and project sustainability [12]. Labour remains indispensable to maintaining progress and achieving efficient construction delivery.

Labour productivity, which quantitatively measures the output achieved per unit of labour input, has emerged as a principal indicator of construction performance [12]. Enhanced labour productivity supports timely completion, cost control, and

profitability [13], while inefficiencies lead to delays, rework, and resource waste. Improving productivity therefore contributes directly to national economic growth and sustainable development in the construction sector [14].

Given that sustainable construction already demands optimization of materials, energy, and environmental resources, the need to enhance labour productivity becomes significantly more pressing. This relationship establishes the critical foundation of this research, which focuses on understanding and mitigating labour-related risks that hinder progress within sustainable construction projects, particularly within the evolving construction context of Pakistan.

1.2 Project Motivation

Sustainable construction is gaining global attention as it promotes efficient resource use, minimizes environmental impacts, and ensures long-term project viability [15]. In Pakistan, the need for sustainable construction practices has become more pressing due to rapid urbanization, increasing environmental degradation, and the growing demand for energy-efficient and eco-friendly infrastructure. Despite these advancements, one of the major challenges facing the construction industry is low labour productivity [13], which directly affects project timelines, costs, and quality. Labour productivity is a critical factor in achieving sustainability goals, yet it remains one of the most overlooked aspects in both research and practice.

In many cases, workers are inadequately trained in sustainable construction techniques, lack awareness about modern methods and technologies, and often operate under unsafe or non-conducive working conditions. Poor management practices, insufficient motivation, and lack of proper risk management further reduce workforce efficiency [16]. These labour-related issues not only slow down project progress but also compromise the overall sustainability objectives of the construction process. While several studies have explored sustainability in terms of materials, design innovation, and environmental management, very limited research has specifically focused on the labour dimension of productivity within sustainable

construction projects, particularly in developing countries like Pakistan.

This identified gap underscores the necessity for a comprehensive risk assessment of factors influencing labour productivity, along with the formulation of effective mitigation measures. Accordingly, this study is driven by the objective of identifying, evaluating, and mitigating productivity-related risks in sustainable construction projects. Addressing these issues is expected to improve operational efficiency, project reliability, and the overall effectiveness of sustainable construction practices in Pakistan, thereby supporting both economic growth and environmental sustainability.

1.3 Problem Statement

Labour is one of the most essential components contributing to the success and sustainability of construction projects [17]. While global research has increasingly focused on achieving sustainability through improved methods, materials, technologies, and management systems, much of the attention has centered around general project factors such as cost, time, quality, and scope.

However, the labour aspect, which directly influences all these parameters, has received comparatively limited attention. The performance, motivation, and efficiency of the workforce remain crucial determinants of project success, yet they are often underestimated in sustainability discussions.

In the context of Pakistan, where the construction industry is labour-intensive and sustainability practices are still evolving, the role of labour productivity becomes even more significant. Workers frequently face challenges and these issues collectively reduce productivity [18], delay project completion, and increase costs ultimately hindering the realization of sustainability goals.

Therefore, this study is designed to analyze the risks and factors that affect labour productivity in sustainable construction projects. The prioritization of risks, strategies and mitigation will help the professionals and policy makers to phase out necessary steps to reduce severity of problems associated with labour.

1.4 Research Questions

- i. What are the key risk factors influencing labour productivity in sustainable construction projects?
- ii. What risk management strategies can be developed to mitigate these risks effectively in the construction industry of Pakistan?

1.5 Overall Goal

This study is part of construction management research group of Civil Engineering Department and is meant to add an overview of labour, its role and steps needed to improve its productivity in Construction Industry of Pakistan.

1.6 Specific Aim

The specific aim of this research is to identify and rank the factors that affect the labour productivity in sustainable construction projects in Pakistan and to develop mitigation strategies to overcome these challenges. The study will be based on factors identification from literature, pilot survey and main survey from stake holders of construction industry. The study will focus professionals working in Islamabad and Rawalpindi and have good experience on building projects.

1.7 Scope of Work

The scope of works for this research are as under:

- i. To identify and categorize critical risks affecting labour productivity in sustainable construction.
- ii. To propose a practical guideline for risk management that integrates sustainability and productivity improvement.

- iii. To assess the severity and likelihood of these risks.

1.8 Limitations

The study is limited to the Pakistan construction industry with a focus of input from Islamabad/Rawalpindi, and the results may not be directly generalizable to other countries. Only one aspect of sustainability has been taken into consideration and that is the labour (social aspect).

1.9 Research Impact on Industry

Risk management strategies developed in this study will help minimize delays, cost overruns, and quality issues in sustainable construction projects due to labour component.

1.10 Methodology

The methodology that would be followed is as under:

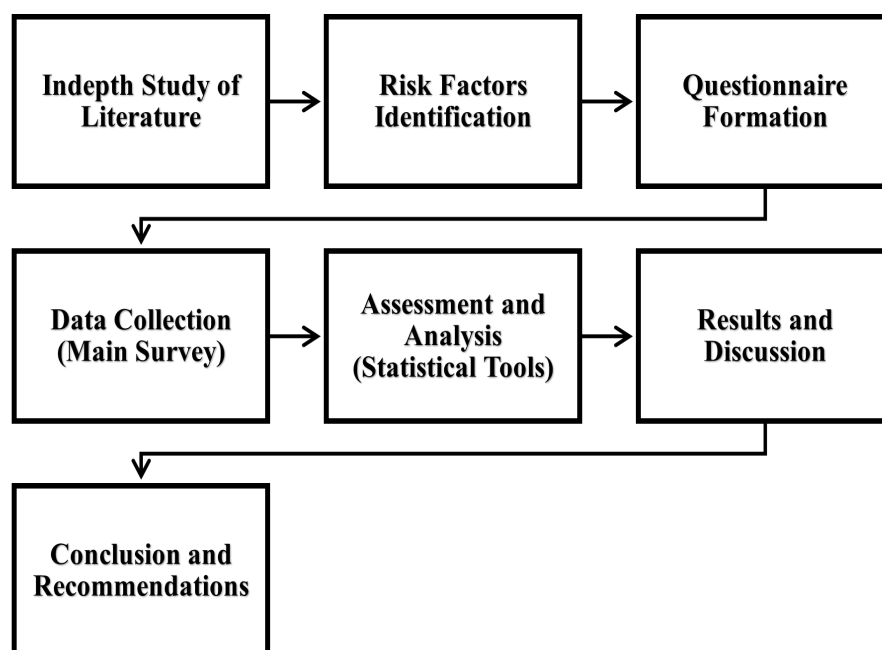


FIGURE 1.1: Methodology Chart

1.10.1 In-depth Study of Literature

The study commences with an extensive review of relevant literature concerning labour productivity, sustainable construction, and risk management.

This phase enables the identification of research gaps, the evaluation of existing approaches, and the establishment of a strong theoretical foundation. It also facilitates the identification of commonly reported risk factors influencing labour productivity in construction projects at both global and national levels.

1.10.2 Risk Factors Identification

Based on the literature review and expert opinions, the major risks that influence labour productivity in sustainable construction projects are identified.

By categorizing and documenting these factors it is insured that the study is grounded in real-world challenges.

1.10.3 Data Collection Main Survey

To validate and rank the identified risk factors, data were gathered through surveys, questionnaires, and interviews conducted with construction professionals, including engineers, project managers, and site supervisors.

This evidence offers insight into the occurrence and impact of each risk factor within the context of Pakistan's construction industry.

1.10.4 Questionnaire Formation

After conducting a detailed literature review and identifying the key factors, a structured questionnaire is developed to collect relevant data for the study. The questionnaire is designed based on these identified factors to ensure accurate and reliable responses from the participants. It ensures consistency across all collected participant responses.

1.10.5 Assessment and Analysis Using Statistical Tools

The collected data is analyzed using two different softwares which include SPSS and Microsoft Excel. The tests performed on this stage include reliability test, normality test and Relative Importance Index (RII) test. This stage ensures that the most critical risks are highlighted and addressed, enabling data-driven decision-making.

1.10.6 Conclusion and Recommendation

Finally, the study presents practical recommendations for contractors, policymakers, and key industry stakeholders. These recommendations focus on the application of the proposed guidelines to improve labour productivity, minimize associated risks, and support the achievement of sustainable construction goals. The conclusion consolidates the main findings and emphasizes the overall significance of the research.

Chapter 2

Literature Review

2.1 Importance of Construction

The construction industry plays a pivotal role in the socio-economic development of any country and is widely recognized as a key driver of national growth and infrastructure development [19]. It contributes significantly to gross domestic product (GDP), employment generation, urban development, and the provision of essential facilities such as housing, transportation networks, healthcare institutions, and educational infrastructure [19].

In developing countries such as Pakistan, the construction industry holds even greater importance due to rapid urbanization, population growth, and increasing demand for sustainable infrastructure [20]. The sector provides employment opportunities to a large segment of both skilled and unskilled labour, thereby reducing unemployment and supporting poverty alleviation [21]. Furthermore, it stimulates several allied industries, including cement, steel, transportation, and manufacturing, thereby creating a multiplier effect on the national economy [22].

The significance of the construction industry has also expanded with the global shift towards sustainable development [23, 24]. Modern construction practices now emphasize energy efficiency, environmental protection, and resource optimization, aligning with sustainable development goals [25].

However, these evolving demands introduce complex challenges, particularly related to labour productivity, resource management, and risk mitigation [13]. Therefore, understanding the importance and dynamics of the construction industry is essential for assessing the factors influencing labour productivity and developing effective strategies for sustainable project execution.

The construction industry plays a foundational and multifaceted role in global economic development, societal progress, and the physical realization of infrastructure essential for modern life [5, 26]. This industry is not merely about erecting structures but encompasses a vast range of activities, from initial planning and design to the maintenance and demolition of facilities, influencing nearly every other sector of the economy [27]. Its importance is underscored by its significant contribution to Gross Domestic Product (GDP), employment creation, and the provision of critical infrastructure such as housing, transportation networks, and utilities [28].

One of the fundamental contributions of the construction sector lies in its direct influence on economic growth. Numerous studies have established a strong link between construction activities and overall economic development, particularly within developing economies [29].

For example, the construction industry contributes roughly six percent to global gross domestic product and maintains strong linkages with nearly all other sectors of the economy [12]. In countries like India and China, the construction industry is a major driver of employment, providing labour-intensive work to a large portion of the population [28, 30].

New infrastructure construction, in particular, acts as a solid foundation for urban comprehensive service functions, fostering economic prosperity, social progress, and environmental quality improvement [31, 32]. Research on the "Belt and Road Initiative" shows that infrastructure construction can promote economic growth and per capita output, while also improving income distribution [22]. Evidence from regions such as Liaoning Province in China further illustrates this complex linkage, where urban construction land expansion and economic growth exhibit a long-term, bidirectional causal relationship [33].

Beyond direct economic contributions, the construction industry is vital for achieving national socio-economic development goals by providing shelter and supporting infrastructure [34]. The development of public infrastructure, facilitated by construction, has a mediating effect on urban economic growth [35]. Effective utilization of infrastructure is crucial for developing countries to achieve both economic and societal growth, although poor policy decisions can impede these benefits [8, 36]. Infrastructure projects have a significant potential to drive social and economic development, involving a wide range of stakeholders and fostering investment opportunities [37].

Digitalization and smart technologies are also transforming the construction sector. Extended Reality (ER) and Building Information Modeling (BIM) are increasingly recognized as essential tools for effective project management, enabling real-time collaboration and immersive virtual environments for information sharing and coordination [21, 38]. The application of Artificial Intelligence (AI) in civil engineering offers advantages such as enhanced data acquisition, improved sustainability assessment, and increased productivity, thereby steering construction practices toward greater sustainability [39]. Innovations in material science are also evident in studies on phosphogypsum-based supersulfated cement (PSSC) paste, investigating its microstructure under different CO₂ concentrations to understand carbonation mechanisms [40].

2.2 Sustainable Construction

Sustainable construction adopts a comprehensive approach to building practices by incorporating environmental, social, and economic considerations across the entire building life cycle, from material sourcing to demolition and waste management [7, 24, 41]. This approach is crucial given the construction industry's significant contribution to global environmental challenges, including resource depletion, energy consumption, greenhouse gas emissions, and waste generation [15]. The overarching goal is to minimize environmental impact, optimize resource utilization, and enhance overall sustainability [42, 43].

A key aspect of sustainable construction is the emphasis on innovative and eco-friendly materials [44–46]. These materials often possess properties such as low embodied energy, recyclability, local sourcing potential, and biodegradability, which collectively reduce the carbon footprint of construction activities [45]. Examples include recycled steel, green concrete, bamboo, straw bales, cross-laminated timber, bio-based composites, and self-healing materials [47–49]. Green concrete, for instance, can incorporate alternative binders or recycled aggregates, lessening its environmental impact compared to conventional concrete [49, 50]. The use of locally sourced materials is also vital as it reduces transportation emissions associated with bringing materials to the construction site [51]. Materials like polyurethane foam waste can even be integrated into gypsum-based products, offering eco-efficient alternatives to conventional options [52]. The adoption of these materials is driven by the necessity to avoid depleting energy resources and raw materials while reducing carbon emissions [23].

In addition to materials, sustainable construction integrates energy-efficient designs and state-of-the-art technologies [3]. This includes green building designs that prioritize energy efficiency, optimize natural light and ventilation, and incorporate renewable energy sources such as solar, wind, and hydro power [46, 51, 53, 54]. Technologies like 3D-printed concrete, photocatalytic concrete, and smart materials contribute to improved performance and reduced environmental impact [50]. The concept extends to smart sensing technologies and earthquake-resistant designs, which enhance both sustainability and resilience [47]. Building energy systems can benefit from advanced modeling techniques like grey-box identification frameworks and neural network disturbance predictors to optimize performance and account for unmeasured disturbances like occupancy-induced heat [55]. Virtual reality tools, such as RadVR, are also being developed for daylighting analysis, combining immersive real-time renderings with physically correct simulations to inform sustainable design choices [56].

Waste management is another critical component of sustainable construction [47]. The industry is a significant contributor to waste generation, and effective waste management practices are essential to minimize environmental degradation, resource depletion, and landfill overflow [57]. This involves the promotion of a

circular economy, where waste materials like recycled concrete, glass, and plastic are given new life in construction, thereby reducing environmental harm and conserving resources [58, 59]. Life cycle assessment (LCA) is frequently employed to evaluate the environmental benefits of recycling construction solid waste compared to traditional landfill methods [58, 59].

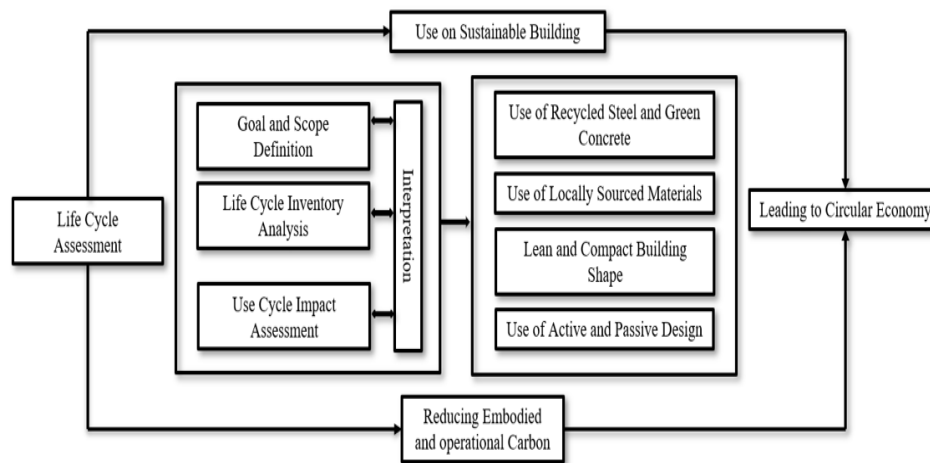


FIGURE 2.1: LCA Importance in Sustainable Buildings [51]

Figure 2.1 illustrates the central role of Life Cycle Assessment (LCA) in sustainable building practices by demonstrating how it informs material selection, supports circular economy principles, and contributes to the reduction of both embodied and operational carbon. The LCA process begins with defining the study's goal and scope, followed by life cycle inventory analysis to quantify inputs and outputs, and concludes with life cycle impact assessment to evaluate environmental impacts. The outcomes of these assessments guide the adoption of sustainable strategies such as recycled steel, green concrete, locally sourced materials, optimized building forms, and active and passive design approaches to enhance sustainability and minimize carbon emissions [51].

Life Cycle Assessment (LCA) is a crucial methodology for evaluating the environmental impacts associated with all stages of a product's life, from raw material extraction to disposal. It is a comprehensive approach that helps in making informed decisions to reduce the overall environmental burden of buildings [51, 60].

LCA allows for a comparative analysis of different materials and construction methods, highlighting those with lower environmental footprints. This includes assessing factors like energy consumption, carbon emissions, and resource depletion throughout a building's lifespan. The integration of LCA is depicted in the conceptual diagram of sustainable leadership practices, where it influences decision-making alongside green building design, renewable energy integration, and waste management [60].

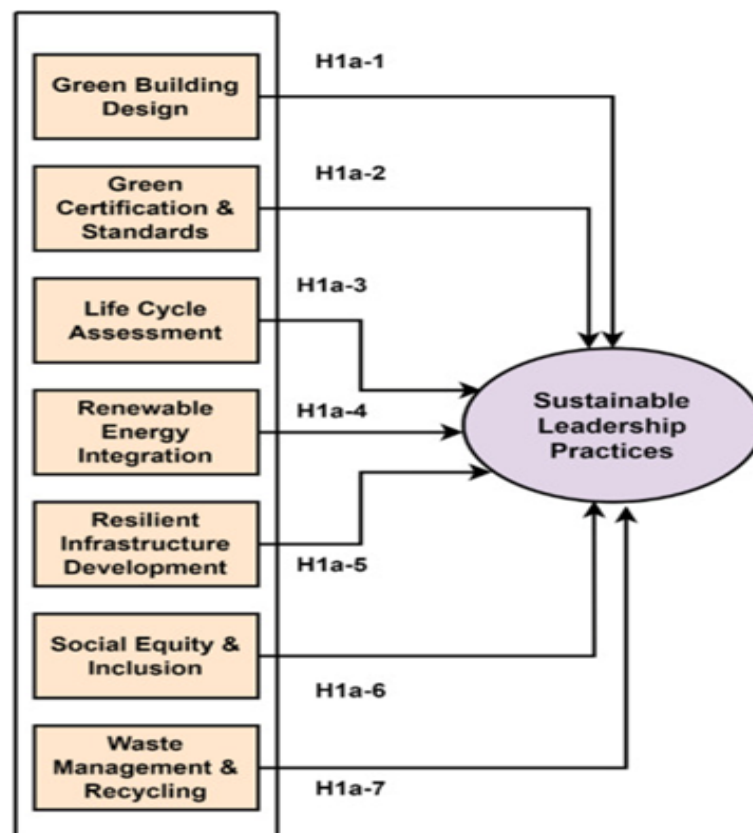


FIGURE 2.2: Influential Factors affecting Sustainable Leadership Practices [60]

Figure 2.2 illustrates that sustainable leadership practices are shaped by a range of interrelated factors, including green building design, certification and sustainability standards, life cycle assessment, renewable energy integration, resilient infrastructure development, social equity and inclusion, as well as waste management and recycling practices [60]. These elements collectively form a comprehensive framework for achieving sustainability in construction.

The benefits of sustainable construction extend beyond environmental protection to include economic and social advantages [61]. Economically, green buildings can

offer cost savings through reduced energy and water consumption, lower maintenance needs, and enhanced asset value. Socially, they contribute to improved indoor environmental quality, occupant health, and community well-being [62, 63]. For example, the use of non-toxic building materials can reduce indoor air pollution, thereby improving occupant health [63]. Sustainable construction also aligns with global Sustainable Development Goals (SDGs) by promoting good health and well-being (SDG 3), clean water and sanitation (SDG 6), affordable and clean energy (SDG 7), decent work and economic growth (SDG 8), industry, innovation and infrastructure (SDG 9), sustainable cities and communities (SDG 11), responsible consumption and production (SDG 12), climate action (SDG 13), and life on land (SDG 15) [63].

Despite the clear benefits, challenges remain in widespread adoption. These include the need for increased end-user awareness of the economic, social, and ecological benefits [25]. Additionally, the complexity of assessing sustainability performance, which involves contradictory aspects and a reliance on qualitative criteria, necessitates further research and standardization efforts [63]. The integration of green building practices with modular coordination also offers a pathway to enhance sustainability and project efficiency. Ultimately, sustainable construction requires continuous innovation in materials, technologies, and policy frameworks to address evolving environmental challenges and contribute to a resilient society [47, 60].

2.3 Risk Assessment and Management

Risk assessment and management have become essential components of modern construction project planning, particularly in environments characterized by uncertainty, resource constraints, and sustainability requirements[64–66].

In the construction industry, risk refers to any event or condition that has the potential to negatively affect project objectives such as cost, time, quality, safety, and productivity [67]. Due to the dynamic nature of construction activities, risks arise from numerous sources including workforce performance, site conditions, material

availability, financial limitations, environmental factors, and managerial practices [68].

Risk assessment is a structured process that involves identifying, analyzing, and evaluating potential threats that could affect project performance [64]. Researchers widely emphasize the use of structured frameworks such as qualitative assessments, quantitative models, probability impact matrices, and hybrid techniques to understand the likelihood and severity of risks [64, 66, 67, 69]. Effective risk assessment not only enhances decision-making but also supports proactive planning by ensuring that potential disruptions are recognized before they escalate [64].

Risk management, on the other hand, focuses on the development and implementation of strategies to mitigate, control, or eliminate identified risks [10]. It includes planning responses, monitoring project conditions, allocating responsibilities, and ensuring adequate communication among project stakeholders [70]. In the context of sustainable construction, risk management acquires even greater significance, as sustainability practices often introduce additional complexities such as energy-efficient design requirements, environmental compliance, and resource optimization [71]. These complexities can influence labour performance, productivity levels, and overall project stability.

Literature highlights that adopting robust risk management practices can enhance labour productivity by minimizing uncertainties, improving planning accuracy, and reducing delays caused by unforeseen events. Studies from countries, including Pakistan, point out that ineffective risk management is one of the primary reasons for low productivity, cost overruns, and schedule delays. Therefore, understanding and applying risk assessment and management principles is crucial for achieving successful project outcomes and ensuring sustainable construction practices.

2.4 Construction Productivity

Construction productivity is a central theme in project management research, as it directly influences project cost, duration, quality, and overall project success [72].

Construction productivity is commonly described as the relationship between the amount of work produced and the resources consumed, with labour performance frequently used as the primary measure due to the labour-intensive characteristics of the industry [73]. Unlike manufacturing, construction projects are executed in dynamic and unpredictable environments, where external conditions, site constraints, and workforce characteristics vary significantly [74]. These complexities make the measurement, evaluation, and improvement of construction productivity a challenging yet crucial task [74].

The literature identifies labour productivity as the most critical component of construction productivity because labour accounts for a substantial portion of project costs and is highly sensitive to environmental and managerial factors [68]. Numerous studies highlight that factors such as inadequate supervision, inefficient planning, material shortages, poor working conditions, communication issues, and lack of skilled labour are major contributors to low productivity [68, 75]. Additionally, socio-cultural factors, worker motivation, wage structures, and workforce stability have been shown to significantly influence labour output [76].

In the context of sustainable construction, productivity challenges become more pronounced due to the integration of sustainability requirements such as waste reduction, resource optimization, energy efficiency, and environmental compliance [15, 45]. While these practices contribute to long-term benefits, they often introduce additional tasks, specialized training needs, and stricter monitoring, which may initially hinder productivity if not properly managed [63]. As a result, achieving high productivity in sustainable projects requires effective planning, skilled labour, and robust risk mitigation strategies.

For countries like Pakistan, improving construction productivity is essential to meet growing infrastructure demand and support economic development [74]. Local studies consistently report low productivity levels due to traditional construction practices, inadequate technological adoption, limited worker training, and weak management systems. Thus, understanding construction productivity through lens of global literature and local challenges is vital for designing strategies that improve performance and support sustainable project delivery [75, 77, 78].

2.5 Factors Affecting Labour Productivity

Labour productivity in the construction sector is affected by a wide range of interrelated factors, which are commonly classified into several categories based on findings from extensive research [16, 79–81]. These factors significantly impact project duration, costs, and overall efficiency, making their understanding crucial for improving industry performance [16, 82].

2.5.1 Manpower Related Factors

Worker-centric attributes constitute a major category influencing labour productivity [79]. Skill level and experience of workers are paramount, with highly skilled and experienced labourers generally exhibiting higher productivity [81, 83]. Conversely, a workforce with low skill levels can lead to reduced productivity [84]. Training programs and opportunities for skill development are hence critical for enhancing capabilities [85]. Motivation and morale are also significant drivers; studies indicate that motivational factors, and conversely demotivational factors, directly affect labour's productivity [13, 81, 86]. Factors such as fair wages, safe working conditions, and recognition contribute positively to worker morale and productivity [68, 80]. Factors like absenteeism, lack of individual experience, and inadequate supervision are detrimental to productivity [87]. For instance, a study in Kuwait identified lack of experience, personal conflicts, and frequent changes in foremen as critical factors affecting productivity [88]. In India, internal factors i.e. worker skill, experience, and training significantly impact productivity [89].

2.5.2 Management and Supervision Factors

Effective management and supervision are consistently highlighted as critical for optimizing construction labour productivity [79, 90]. Poor planning and scheduling, inadequate supervision, and insufficient communication among project participants are frequently cited as causes for low productivity [85, 87]. A robust management strategy that includes clear communication, efficient resource scheduling,

and the use of advanced construction methods can significantly improve labour productivity [85]. The adoption of Building Information Modeling (BIM) facilitates the integration of design and construction processes, which contributes to improved productivity outcomes [84, 91]. For example, a BIM-integrated simulation framework can predict productivity dynamics by incorporating critical factors such as workability, number of objects, and workers' skill [91].

2.5.3 Work Conditions and Site Factors

The physical work environment and site-specific conditions play a substantial role in determining labour productivity [79, 80]. Factors such as uncomfortable weather conditions (e.g., extreme heat or cold), unsafe working environments, and inadequate personal protective equipment (PPE) can severely hinder efficiency [82, 87, 92].

Site layout, material availability, and equipment performance are also crucial. Delays in material delivery, equipment breakdowns, and poor access to work areas can lead to significant productivity losses [81, 87]. Studies have shown that factors like rework, lack of tools and equipment, and poor site layout are critical in affecting productivity [76, 88]. Furthermore, unexpected site conditions and natural environmental issues can also contribute to delays [93].

2.5.4 Project-Specific Factors

Characteristics inherent to the construction project itself, such as project size, complexity, and type, influence labour productivity [79]. Large and complex projects often present greater management challenges and can experience lower productivity if not managed effectively [83]. Design changes and errors during the construction phase are also significant impediments to productivity, leading to rework and delays [82, 87]. Financial management and project funding issues, including delays in payment, can impact a company's financial stability and, consequently, project productivity [93, 94]. These factors collectively determine overall project execution efficiency.

2.5.5 External Factors

Beyond the immediate control of project management, a range of external factors can affect construction labour productivity. Economic conditions, including inflation and market fluctuations, influence material costs and labour availability [80, 95]. Governmental policies, regulations, and bureaucratic processes can also impact project timelines and resource allocation [95]. For instance, a study in China highlighted the impact of internet applications on labour productivity in the rural sector, demonstrating how technological advances can influence productivity indirectly through changes in production methods and labour allocation [96]. Similarly, the COVID-19 pandemic significantly affected labour’s motivational factors and construction productivity due to health and safety concerns and imposed restrictions [86]. The availability of advanced technologies, such as robotics and automation, is becoming increasingly relevant for enhancing productivity, particularly in addressing labour shortages and improving efficiency [97, 98].

2.5.6 Critical Factors Ranking

Numerous studies have evaluated and ranked the key factors influencing construction labour productivity from a variety of perspectives. While the exact ranking can vary based on regional context and stakeholder perspectives (e.g., project managers versus contractors), some consistently emerge as highly influential [79, 81]. The table 2.1 below shows some of the factors that different researchers discussed in their papers:

TABLE 2.1: Factors Identified by Different Researchers

Title / Reference		Identified Factors
Factors Affecting Labour Productivity in the Construction Industry [11]		<p>Management Factors</p> <ul style="list-style-type: none"> • Lack of supervision on labour • Incentive scheme lacking • Working overtime • Construction manager’s lack of leadership

Table 2.1 continued from previous page

Title / Reference	Identified Factors
	<ul style="list-style-type: none"> • Payment delay • Unavailability of materials • Construction method • Lack of providing labour with transportation • Incompetent supervisors • Work-related accidents resulting from inadequate safety practices • Inappropriate or poorly planned material and equipment storage locations • Ineffective communication between site management personnel and labour teams • Issues related to delayed arrivals, early departures, and unplanned work breaks • Insufficient training opportunities provided to site operatives • Absence of formal systems for worker recognition and appreciation • Lack of access to required equipment and appropriate tools
	<p>Workforce Factors</p> <ul style="list-style-type: none"> • Labour motivation • Physical fatigue of labour • Experience and skills of labour
	<p>Technological Factors</p> <ul style="list-style-type: none"> • Construction technology • Coordination and integration among different design disciplines • Delays in addressing or responding to requests for information (RFIs)

Table 2.1 continued from previous page

Title / Reference	Identified Factors
Structural Equation Model of the Factors Affecting Construction Labour Productivity [90]	<ul style="list-style-type: none"> • Repetition of work due to errors or changes • Delays in inspections conducted by engineers • Overall quality and completeness of design documentation • Frequent modifications or variations during the execution phase • Complexity associated with design details and systems • Level of clarity provided in technical specifications • Size and skill composition of work crews
	Management and Control Factors
	<ul style="list-style-type: none"> • Effectiveness of supervision, performance monitoring, and control mechanisms
	<ul style="list-style-type: none"> • Skill level and professional competence of the project manager
	<ul style="list-style-type: none"> • Productivity losses resulting from change orders
	<ul style="list-style-type: none"> • Insufficient organizational capability of the contractor's site management team
	<ul style="list-style-type: none"> • Adequacy of planning procedures and risk management practices
	<ul style="list-style-type: none"> • Suitability and effectiveness of the selected construction methods
	<ul style="list-style-type: none"> • Overall project management approach and leadership style
	<ul style="list-style-type: none"> • Lack of coordination among the construction parties
<ul style="list-style-type: none"> • Unrealistic deadline for project completion set by client 	
<ul style="list-style-type: none"> • Client's over influence on the construction process 	

Table 2.1 continued from previous page

Title / Reference	Identified Factors
	<ul style="list-style-type: none"> • Project organizational culture
	<p>Workforce Factors</p> <ul style="list-style-type: none"> • Skill level and practical experience of the workforce • Degree of workforce motivation and commitment • Insufficient availability of site personnel • Familiarity of workers with assigned tasks and site conditions • Incidence of workforce absenteeism • Extent of workforce empowerment through training and adequate resources
	<p>Finance Factors</p> <ul style="list-style-type: none"> • Insufficient availability or high cost of key resources, including labour, materials, equipment, and financial capital • Rework arising from construction errors at the site level • Delays in wage or payment disbursement
	<p>Project Factors</p> <ul style="list-style-type: none"> • Physical site conditions, including access constraints, subsoil characteristics, topography, and traffic conditions • Overall project complexity in terms of size and design requirements • Design approaches that limit constructability and ease of execution
	<p>Material and Equipment Factors</p> <ul style="list-style-type: none"> • Lack of tools and equipment in the market • Suitability or adequacy of the plant and equipment employed

Table 2.1 continued from previous page

Title / Reference	Identified Factors
Analyzing Influencing Factors Affecting Labour Productivity in Construction Projects in Remote Areas, Egypt [12]	<ul style="list-style-type: none"> • Adequacy of technology used • Material shortage at project site
	External Factors
	<ul style="list-style-type: none"> • Poor weather conditions • Slow local authority approval • Stop-work orders due to infringement of government regulations • On-site accidents or acts of God • Unrealistic deadline for project completion set by client • Client's over influence on the construction process
	Human Factors
	<ul style="list-style-type: none"> • Experience and skill of the workers employed • Leadership skills and proficiency in site management • Communication skills and clarity of instructions • Skill in managing and following up on subcontractors • Worker absenteeism and irregular attendance • Physical strength and health of workers • Educational level of workers
	Administrative Factors
	<ul style="list-style-type: none"> • Availability of materials on-site • Availability of all executive and detailed drawings • Selection of qualified and adequate supervisory staff • Availability of necessary tools and equipment • Continuity of workflow and effective planning • Length of working hours per day

Table 2.1 continued from previous page

Title / Reference	Identified Factors
	<ul style="list-style-type: none"> • Availability of essential site services (water, electricity, sanitation) • Type of business ownership (private or governmental) • Type of work contract (daily wage, lump sum, etc.) • Daily rest hours during work • Incentive and reward programs • Overtime work conditions • Crisis management ability (e.g., political unrest, natural disasters) • Style of business management (individual vs. corporate) • Social insurance, medical care, and worker welfare services
	<p>Technical Factors</p> <ul style="list-style-type: none"> • Work interruptions due to design or specification changes • Architectural and structural design complexity • Accuracy and quality of project specifications • Construction technique or technology (traditional, prefabricated, etc.) • Quality and efficiency of equipment • Quality and suitability of materials used • Delays or stringency in inspection by engineers • Ease of preparing and processing materials • Amount of daily workload available • Frequency of rework • Type of project (residential, industrial, service, etc.)

Table 2.1 continued from previous page

Title / Reference	Identified Factors
Critical Factors Affecting Construction Labour Productivity: A Systematic Review and Meta-Analysis [18]	<p data-bbox="651 349 911 383">External Factors</p> <ul style="list-style-type: none"> <li data-bbox="651 409 1374 495">• Difficulty of access to the project site for workers and materials <li data-bbox="651 521 1374 555">• Availability of construction materials in the market <li data-bbox="651 580 1374 613">• National economic situation (inflation, high prices) <li data-bbox="651 638 1123 672">• Funding availability for projects <li data-bbox="651 696 1374 781">• Availability and competition of labour in the market <li data-bbox="651 806 1299 840">• Lack of utilities such as water and electricity <li data-bbox="651 864 1374 898">• Political and security conditions (theft, instability) <li data-bbox="651 922 1318 956">• Weather conditions (heat, cold, rainfall, wind) <li data-bbox="651 981 1374 1066">• Physical location and environment (desert, highlands) <li data-bbox="651 1090 1374 1176">• Procurement limitations in selecting contractors or suppliers <li data-bbox="651 1200 1374 1285">• Trade-off between quality and speed of implementation <li data-bbox="651 1310 1235 1344">• Governmental policy or priority changes <li data-bbox="651 1368 1374 1453">• External work pressures, especially in politically sensitive projects <li data-bbox="651 1478 1374 1563">• Technological limitations (poor connectivity, lack of digital tools) <li data-bbox="651 1588 1214 1621">• Public holidays and religious vacations
	Materials and Equipment
	• Timely availability of construction materials
	• Access to adequate tools and equipment required for site operations
	Project Type
	• Ease and feasibility of construction execution (constructability)

Table 2.1 continued from previous page

Title / Reference	Identified Factors
	<ul style="list-style-type: none"> • Overall size and magnitude of the project
	<p>Work Motivation</p> <ul style="list-style-type: none"> • Level of worker satisfaction • Job stability and occupational security • Availability of incentive schemes and performance bonuses • Degree of enthusiasm and engagement at work • Opportunities for career advancement and promotion • Systems for employee recognition and appreciation
	<p>Labour-Related Factors</p> <ul style="list-style-type: none"> • Shortage of labour • Skills and experience level of labour • Fatigue and exhaustion • Worker age and education level • Training and skill development • Sense of responsibility • Absenteeism • Crew size and composition • Wage levels and salary delays • Overtime work and workload intensity
	<p>Site Management</p> <ul style="list-style-type: none"> • Clarity of instructions and communication • Incompetent supervisors • Lack of leadership among construction managers • Unsuitable material storage locations • Lack of transportation and poor site layout • Work interruptions and interferences • Inspection and quality control practices

Table 2.1 continued from previous page

Title / Reference	Identified Factors
	<ul style="list-style-type: none"> • Competition levels and quality of site management
	Stakeholder and Communication Factors
	<ul style="list-style-type: none"> • Delays in responding to information requests • Cooperation between project participants • Poor communication and coordination • Reporting and problem-sharing practices • Worker participation in decision-making • Level of subcontracting
	Macro Factors
	<ul style="list-style-type: none"> • Political conditions • Economic environment • Cultural context
	Climatic Conditions
	<ul style="list-style-type: none"> • Weather variations • Temperature, humidity, wind, and rainfall
	Techniques and Methods
	<ul style="list-style-type: none"> • Use of advanced technologies • Construction methods and design complexity • Sequence of work and clarity of specifications
	Schedule Planning and Rework
	<ul style="list-style-type: none"> • Unrealistic scheduling • Frequency of rework • Poor planning • Change orders during execution
	Site Working Conditions
	<ul style="list-style-type: none"> • Safety at work • Ground conditions and congestion • Confinement of workspace • Site accessibility and accident frequency

Table 2.1 continued from previous page

Title / Reference	Identified Factors
Study of Significant Factors Affecting Labour Productivity at Construction Sites in Jordan [99]	Social Welfare
	• Worker insurance and healthcare benefits
	Labour Group
	• Shortage of skilled workers
	• Limited availability of labour in the market
	• Requirement for excessive overtime work
	• Insufficient availability of tools
	• Absenteeism among workers
	• Personal or domestic issues affecting labour performance
	• Work stoppages resulting from site-related accidents
	• Poor labour–management relations
	Technical Factors
	• Ineffective planning and scheduling practices
	• Deficiencies in site management performance
	• Rework resulting from construction-related errors
• Insufficient experience of supervisory personnel	
• Delays in responses from consultants	
• Frequency and extent of variations or change orders during execution	
• Degree of complexity in design requirements	
• Inadequate coordination and communication among construction parties	
• Clarity and completeness of technical specifications	
Project Factors	
• Interruptions in power and water supply services	
• Project locations situated far from material and equipment suppliers	
• Adverse or unfavorable weather conditions	

Table 2.1 continued from previous page

Title / Reference	Identified Factors
Critical Factors Affecting Labour Productivity Within Construction Project Implementation [100]	<ul style="list-style-type: none"> • Limited site drilling capacity or groundwork capability • Congestion within the construction site • Unsatisfactory or challenging site conditions • Overall size and scale of the project
	Financial Factors
	<ul style="list-style-type: none"> • Delays in payments made to suppliers • Insufficient financial incentives to motivate workers • Financial constraints faced by contractors • Low wage levels for labour • Weak financial capacity of contracting firms • Delayed payments from clients
	Material and Equipment Factors
	<ul style="list-style-type: none"> • Material shortage on project site • Equipment shortage • Old and inefficient equipment • Low quality of raw material • Unsuitable material storage location • Construction methods
	Manpower Factors Group
	<ul style="list-style-type: none"> • Work discipline • Labourers' experience and skills • Age of labourers • Physical strength and fitness of labourers • Absenteeism • Personal problems
	Management Factors Group
	<ul style="list-style-type: none"> • Capability and effectiveness of construction management

Table 2.1 continued from previous page

Title / Reference	Identified Factors
	<ul style="list-style-type: none"> • Financial strength and stability of project stakeholders • Inadequate level of supervision on site • Availability of labour resources • Availability of construction materials • Site management • Rework • On-site storage • Availability of equipment and tools • Lack of supervisors' experience • Working overtime • Communication • Construction methods
	<p>Motivation Factors Group</p> <ul style="list-style-type: none"> • Timeliness of remuneration • Amount of remuneration • Work satisfaction • Promotion opportunities • Rewards and punishments • Motivation of labourers • Lack of labour recognition programs • Creating competition
	<p>Work Condition Factors Group</p> <ul style="list-style-type: none"> • Accidents • Health and safety conditions • Work security • Height of work site
	<p>Project Factors Group</p> <ul style="list-style-type: none"> • Design changes

Table 2.1 continued from previous page

Title / Reference	Identified Factors
Factors Affecting Construction Labour Productivity: Iran Case Study [101]	<ul style="list-style-type: none"> • Project effectiveness • Drawing quality • Project location • Design complexity • Sub-contractors • Project type
	External Factors Group
	<ul style="list-style-type: none"> • Economic conditions • Weather conditions • Regulations and laws • Social culture • Geological and hydrological conditions
	<ul style="list-style-type: none"> • Age-related limitations affecting work performance • Insufficient professional experience • Lack of commitment or loyalty among workers • Substance abuse issues, including drug or alcohol dependency • Worker absenteeism • Miscommunication or misunderstanding among labour personnel • Rework arising from errors or changes • Delays in control, supervision, or decision-making processes • Incomplete or inadequate design drawings • Delays in payment • Conflicts or disputes with project owners • Unsatisfactory site conditions • Unavailability of required construction materials • Lack of appropriate tools or equipment

Table 2.1 continued from previous page

Title / Reference	Identified Factors
	<ul style="list-style-type: none">• Use of inadequate or unsuitable construction methods• Insufficient water supply at the site• Excessive overtime work• Weather conditions• Construction accidents• Ambiguity of project objectives

Chapter 3

Methodology

3.1 Background

The methodology of this study is structured to systematically investigate the risk factors affecting labour productivity in sustainable construction projects in Pakistan. Since labour productivity is shaped by a wide range of managerial, financial, technical, motivational, environmental, and workforce related dynamics, it is essential to adopt a structured and evidence-based approach. The background of this methodology rests on the need to combine theoretical insights with practical industry perspectives, ensuring that the findings are credible, comprehensive, and contextually relevant. To establish a strong foundation, the study begins with an extensive review of scholarly literature obtained from research papers. This review enables the identification of well-recognized labour productivity risk factors reported in various countries, including Pakistan, thereby supporting the formulation of an initial list of factors suitable for further investigation.

Recognizing that sustainable construction projects often involve additional complexities such as resource efficiency requirements, environmental considerations, and operational constraints a refined methodological strategy becomes necessary. The study therefore incorporates expert judgment through the Delphi technique to validate and refine the initially identified factors. This step ensures that the questionnaire reflects actual field conditions and professional experiences within

the Pakistan construction industry rather than depending solely on theoretical assumptions. The use of quantitative data collection and statistical analysis further allowed to measure the significance and priority of each factor objectively, ultimately contributing to the development of practical mitigation guidelines. Overall, the methodology adopted in this research remains grounded in academic rigor, systematic inquiry, and professional validation, ensuring that the results provide meaningful insights for enhancing labour productivity in sustainable construction projects in Pakistan.

3.2 Study Area

The study area for this research is not restricted to a single geographical location, as the focus is on construction professionals with diverse project exposure across Pakistan. The pilot study is conducted in the twin cities of Islamabad and Rawalpindi, where initial feedback is obtained from professionals to refine the questionnaire and validate the identified factors.

However, the main survey is not limited to these cities. Since the questionnaire is distributed through Google Forms, it allows participation from professionals located in various regions of Pakistan, as well as those working abroad with experience in the Pakistan construction sector.

This wide geographic reach ensures that the responses represent a broad spectrum of professional insights, reflecting different project environments, organizational settings, and regional construction practices across the country.

3.3 Research Methodology

The research methodology for this study is structured to systematically investigate the risk factors that influence labour productivity in sustainable construction projects in Pakistan. The complete methodological flow chart, including the sequence of processes are illustrated in Figure 3.1.

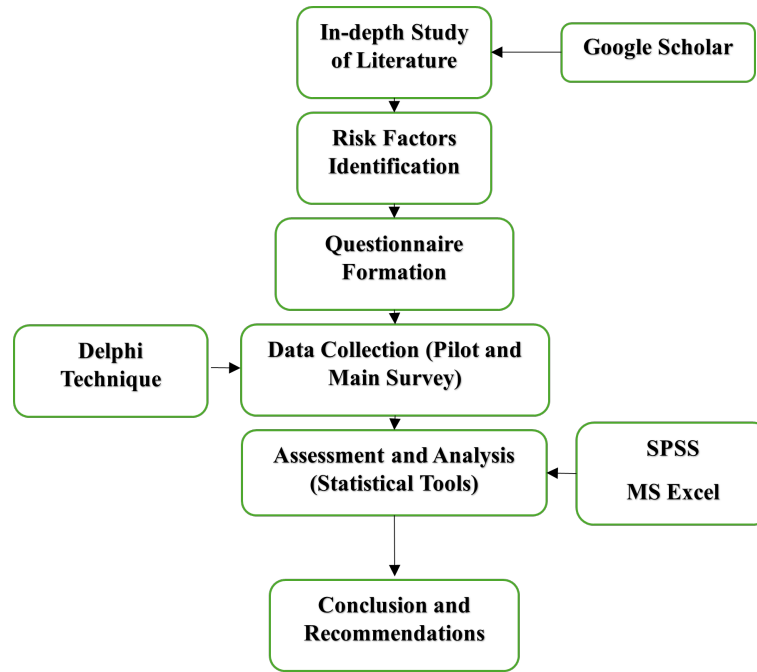


FIGURE 3.1: Methodology Chart

The process begins with an in-depth study of existing literature sourced from reputable scholarly platforms, with Google Scholar serving as the primary database. This comprehensive review facilitates the identification of labour related risk factors reported in previous national and international studies, forming the foundational basis for the subsequent stages of the research.

Following the extraction of relevant factors, a structured questionnaire is developed to transform the identified concepts into measurable statements suitable for quantitative assessment. To ensure the clarity, relevance, and validity of these statements, the study incorporates expert evaluation through the Delphi technique. Industry professionals review the questionnaire and provide feedback, enabling refinement of the instrument before it is utilized for the main survey.

The finalized questionnaire is then distributed for data collection, targeting construction professionals directly involved in sustainable construction projects. The responses obtained from the main survey constitute the primary dataset for statistical evaluation.

The assessment and analysis of the collected data are conducted using MS Excel and SPSS, where various statistical tools are applied to measure reliability, rank

factors, and examine response patterns. These analyses support the prioritization of the most critical labour-related risk factors affecting productivity.

The methodological framework concludes with the formulation of conclusions and recommendations grounded in empirical evidence.

3.4 Questionnaire Formation

During this stage, a comprehensive review of relevant literature is conducted to identify the key factors directly associated with labour productivity in construction projects. Based on the identified factors, a preliminary questionnaire is then developed to systematically capture the selected labour-related variables. This preliminary questionnaire is subsequently used in the Delphi technique to obtain expert opinions for refining the instrument. The methodology adopted after this stage is discussed in detail under the subsequent headings of this chapter.

3.5 Execution of Survey

The conduct of the survey in this study is carried out in two distinct phases to ensure the validity, refinement, and accurate representation of the labour productivity risk factors identified through the literature review.

The first phase involves the administration of a pilot survey, while the second phase encompasses the execution of the main large-scale survey distributed to construction professionals through Google Forms.

3.5.1 Pilot Survey Delphi Technique

The Delphi technique is employed as a crucial preliminary stage to ensure the validity, clarity, relevance, and completeness of the initially developed questionnaire. This technique is particularly valuable in studies related to labour productivity and sustainable construction, where expert judgment is required to evaluate complex

and context-specific risk factors. During this phase, a panel of experienced construction professionals is purposefully selected based on their extensive knowledge, practical experience, and involvement in labour management and sustainable construction projects within the industry.

The selected experts are requested to review the first draft of the questionnaire in detail and critically assess the identified risk factors, measurement items, and overall structure of the instrument. Their evaluation focuses on the appropriateness of the listed factors, the clarity of the wording, the logical flow of the questions, and the adequacy of coverage of all relevant dimensions related to labour productivity risks. Experts are encouraged to suggest revisions, recommend the inclusion of additional factors, or propose the removal of redundant or irrelevant items to improve the overall quality of the questionnaire.

A key advantage of the Delphi technique is that it enables experts to provide their opinions independently and anonymously, thereby minimizing bias and preventing the dominance of any single viewpoint. This independent feedback mechanism allows participants to express their professional judgments freely, resulting in more objective and reliable input.

The responses collected during this stage are systematically reviewed and analyzed to refine the questionnaire by rephrasing unclear statements, eliminating ambiguities, and incorporating essential risk factors that may have been overlooked in the initial development. Consequently, the application of the Delphi technique enhances the robustness of the data collection tool and ensures that the finalized questionnaire is well-aligned with the research objectives and the practical realities of sustainable construction projects.

3.5.2 Main Survey

Following the completion of the above phase, the finalized questionnaire is transformed into an online format using Google Forms for ease of distribution and data collection. The main survey is then circulated among a broader group of construction professionals, including project managers, site engineers, consultants, and

individuals with direct involvement in sustainable construction projects. Respondents are requested to evaluate the finalized set of labour productivity risk factors using a Likert scale, providing quantitative data that captures their perceptions and professional judgments.

The use of Google Forms ensures efficient distribution, accessibility, and automatic recording of responses, enabling a structured and streamlined data collection process. The responses obtained from this main survey form the core dataset used for subsequent statistical analysis, including reliability testing, RII computation, normality testing, and overall factor assessment. This phase ensures that the research findings are grounded in actual industry perspectives and reflective of the current state of sustainable construction practices in Pakistan.

3.6 Sample Size

In this research, the sample size is determined using the formula proposed by Harris (1985), which is widely recognized in survey-based studies involving multiple factors. This formula has also been adopted in previous research for determining adequate sample size in construction management and related studies [102]. According to this formula, shown in equation (3.1), the required sample size (N) is calculated as:

$$N = 50 + p \quad (3.1)$$

where:

N = Required sample size

p = Number of factors included in the study

This approach provides a practical and efficient means of estimating the minimum number of respondents necessary to capture reliable and valid data for all considered factors. It ensures sufficient representation across variables while maintaining statistical validity and robustness in analysis outcomes.

3.7 Likert Scale Application

The Likert scale technique is employed in this study as a standardized measurement tool to quantify respondent perceptions regarding the identified risk factors affecting labour productivity in sustainable construction projects. This approach facilitates the conversion of qualitative opinions into quantitative data, enabling accurate statistical analysis and comparison. The use of the Likert scale ensures uniformity in responses, minimizes ambiguity, and improves the reliability and validity of the collected data. Following was the criteria that was implemented. The table 3.1 is shown for further details.

TABLE 3.1: Likert Scale [103]

Sr. No:	Description	Score
1	Strongly Disagree	1
2	Disagree	2
3	Neutral	3
4	Agree	4
5	Strongly Agree	5

3.8 Assessment and Analysis Statistical Tools

The collected data is analyzed using quantitative statistical techniques to evaluate and prioritize the identified risks. The Reliability Test, Normality Test and Relative Importance Index (RII) is applied to determine the ranking and significance level of each risk factor based on respondent's ratings. This method allows for easy comparison and prioritization of risks according to their impact on labour productivity.

3.8.1 Reliability Test Application

To verify the consistency and reliability of the questionnaire, a reliability assessment is performed using Cronbach's Alpha. This test evaluates the internal consistency of the questionnaire items and confirms whether the statements consistently measure the underlying construct associated with labour productivity risks.

A Cronbach's Alpha value of 0.70 or higher is considered acceptable, indicating that the questionnaire items demonstrate satisfactory reliability and consistency. This process ensures that the collected data is dependable, reduces measurement errors, and enhances the overall credibility of the research findings.

By incorporating the reliability test, the study strengthens the validity of the survey instrument and confirms that the responses obtained can be confidently used for further statistical analysis and decision-making.

The table 3.2 shows the consistency depending of the Cronbach's alpha values.

TABLE 3.2: Cronbach's Alpha Values [104]

Cronbach's alpha	Internal consistency
$\alpha \geq 0.9$	Excellent
$0.9 > \alpha \geq 0.8$	Good
$0.8 > \alpha \geq 0.7$	Acceptable
$0.7 > \alpha \geq 0.6$	Questionable
$0.6 > \alpha \geq 0.5$	Poor

3.8.2 Normality Test

In this study, a normality assessment is conducted to examine the statistical distribution of the questionnaire responses prior to performing inferential analysis. The purpose of this assessment is to determine whether the collected data conform to the assumptions required for parametric statistical procedures. The normality test evaluates the extent to which the response values deviate from a normal distribution by analyzing their probability values. A significance level of 0.05 is adopted as the decision criterion, where data yielding a p-value equal to or greater than 0.05 are treated as normally distributed, while values falling below this threshold indicate a departure from normality.

The results obtained from the normality assessment play a decisive role in guiding the selection of suitable statistical techniques for data analysis. When the data demonstrate normal distribution characteristics, parametric statistical methods are considered appropriate due to their higher statistical power and ability to analyze mean differences and linear relationships. Accordingly, techniques such

as the Independent Samples t-test, One-Way Analysis of Variance (ANOVA), and Pearson's correlation coefficient are applied to evaluate relationships and variations within the dataset.

Alternatively, in cases where the data do not meet the normality assumption, non-parametric statistical methods are adopted as they do not rely on strict distributional requirements. These methods are particularly useful for analyzing ordinal data or skewed distributions. Consequently, tests such as the Mann–Whitney U test, Kruskal–Wallis test, and Spearman's rank correlation coefficient are utilized to ensure the reliability and validity of the analytical results. The findings of the normality assessment, along with the justification for the selected statistical techniques, are presented and interpreted in the subsequent section of the study.

3.8.3 Relative Importance Index

The Relative Importance Index (RII) technique is adopted in this study as a systematic approach to rank and prioritize the risk factors influencing labour productivity in sustainable construction projects. This method is extensively utilized in construction management and project performance research due to its ability to quantify subjective opinions and convert them into measurable indices. By applying the RII method, the study effectively captures respondents' perceptions regarding the relative significance of each identified risk factor and establishes a clear hierarchy based on their impact.

The Relative Importance Index (RII) values are calculated using the mathematical expression presented in Equation (3.2), which has been widely applied in previous construction-related studies to evaluate and compare multiple influencing factors [105]. The formulation of the index incorporates the assigned weight of each response, ensuring that variations in respondents' judgments are accurately reflected in the final ranking. The equation is expressed as follows:

$$\text{RII} = \frac{\sum W}{A \times N} \quad (3.2)$$

where:

W represents the weight assigned to each factor by respondents, ranging from 1 to 5.

A denotes the maximum possible weight, which is 5.

N indicates the total number of respondents.

The computed RII values range between 0 and 1, where higher values indicate a greater level of influence of a particular factor on labour productivity within sustainable construction projects. Factors with elevated RII scores are therefore interpreted as having a more pronounced impact on project performance and are given higher priority in the risk assessment process. The application of the RII method enables the study to present a clear and objective ranking of productivity-related risks, providing a reliable basis for discussion, conclusions, and the development of targeted mitigation strategies.

3.9 Summary

This study is grounded in an extensive literature review that examines the factors affecting labour productivity in sustainable construction projects in Pakistan. The aim is to determine and analyze the key productivity-related risks that hinder the achievement of sustainability objectives in construction projects, ultimately contributing to improved planning, resource utilization, and overall project efficiency. A survey-based approach is employed to collect data through questionnaires distributed to construction professionals, including project managers, engineers, site supervisors, and other technical personnel involved in building projects. The research adopts descriptive methods to evaluate the current state of labour productivity practices within the sector. The Delphi technique is utilized during the pilot phase to validate and refine the identified productivity factors, ensuring that the questionnaire reflects practical field conditions. Harris's formula is applied to determine an appropriate sample size based on the number of identified factors, allowing for statistically meaningful data collection. The main survey is adminis

tered through Google Forms, enabling participation from professionals across Pakistan and abroad. A series of statistical tests including reliability analysis, normality testing, and RII testing are used to analyze the collected data, leading to well-supported findings and actionable recommendations for mitigating labour productivity risks in sustainable construction projects.

Chapter 4

Results and Discussion

4.1 Background

This chapter presents the results of a questionnaire-based survey aimed at examining the risk factors influencing labour productivity in sustainable construction projects in Pakistan, followed by a structured analysis and interpretation of the findings in relation to the study objectives.

The questionnaire was developed based on an extensive review of construction management literature and validated through expert input to ensure its relevance to practical site conditions. The survey instrument comprised structured Likert-scale statements, enabling respondents to express their professional judgment on the severity and significance of labour productivity risks using a five-point scale ranging from “strongly disagree” to “strongly agree.” This quantitative measurement approach was adopted to capture consistent and comparable data reflecting the perceptions of construction professionals involved in planning, execution, and management of sustainable construction projects.

Following data collection, the responses were coded and processed using the Statistical Package for Social Sciences (SPSS) to ensure accuracy and analytical rigor. Initial analysis involved descriptive statistics to summarize respondent demographics, including professional designation, years of experience, and project exposure

etc. These characteristics provide essential contextual insight, allowing the interpretation of results within the framework of construction project delivery and workforce management practices.

Subsequent statistical analyses were conducted to evaluate data reliability, assess distribution characteristics, and prioritize labour-related risk factors.

The results are presented through well-structured tables and figures to facilitate clear visualization of trends, rankings, and comparative significance. The Relative Importance Index (RII) was employed as the principal analytical tool to rank the identified risks based on their impact on labour productivity performance in sustainable construction environments.

This chapter therefore provides a technically grounded assessment of labour productivity risks, forming a robust basis for the discussion, conclusions, and formulation of practical mitigation strategies.

4.2 Development of Questionnaire and Finalization

4.2.1 Questionnaire Coding

To facilitate systematic data analysis and interpretation, all questionnaire items were assigned specific codes prior to statistical processing. The identified labour productivity risk factors were grouped into logical categories based on their functional relevance to construction project execution.

Each category was denoted by an abbreviated code representing its factor group, followed by a numerical identifier for individual statements. Each category of the questionnaire includes a number of parameters/factors that are separated through numeric part of the code e.g. WF-1 stands for the 1st parameter/factor of the work force category.

Table 4.1 presents a total of six categories and their respective alphabetical codes

used in the questionnaire (Appendix-A)

TABLE 4.1: Categories and Alphabetical Codes of the Questionnaire

S.No	Categories	Alphabetical Codes	Number of Factors
1	Workforce Factors	WF	6
2	Management and Supervision Factors	MS	7
3	Motivation and Incentive Factors	MI	6
4	Material, Equipment, and Resource Factors	MER	7
5	Technical and Design Factors	TD	3
6	External and Environmental Factors	EE	3

4.2.2 Delphi Process and Pilot Survey Analysis

4.2.2.1 Delphi Process

The Delphi technique was adopted to refine and validate the factors affecting labour productivity in sustainable construction projects. Initially, a set of labour productivity risk factors was identified through a comprehensive review of relevant literature, and a preliminary questionnaire was developed. This preliminary instrument was then shared with ten(10) experienced construction industry professionals for expert evaluation. Based on their professional experience and practical exposure to construction projects, several additional factors were suggested, while certain factors were recommended for exclusion due to limited relevance. All expert opinions were carefully considered, and consensus was achieved through iterative refinement of the questionnaire. The finalized questionnaire, approved by all participating experts, was subsequently adopted for the main study and is presented in the Annexure.

After finalizing the questionnaire through the Delphi process, a pilot survey was conducted to assess its clarity, consistency, and suitability for data collection. The pilot survey was administered to the same group of ten construction professionals who participated in the Delphi technique, ensuring continuity and informed evaluation.

4.2.2.2 Pilot Survey-Demographic and Reliability

The demographic characteristics of the pilot respondents and the results of the applied tests are presented in the following sections.

The distribution of respondents based on the type of organization shows that the majority of participants (70%) are associated with contracting firms, followed by clients (20%) and consultants (10%). This indicates that the collected data are primarily informed by professionals with direct construction and site-based experience, while also incorporating input from other key stakeholders.

The professional background of respondents indicates that the most participants (90%) are Civil Engineers, while 10% are others. This reflects that the survey responses are largely based on the perspectives of technically qualified professionals, with additional insight from construction practitioners.

In terms of gender distribution, the results indicate that 90% of the respondents are male, while 10% are female. This reflects a predominantly male representation within the survey sample.

The respondents demonstrate a wide range of professional experience. Half of the participants (50%) have 10–15 years of experience, while 40% possess more than 20 years of experience. Only 10% fall within the 5–10 years category, indicating that the sample largely consists of experienced and senior-level professionals.

Regarding educational qualifications, 50% of the respondents hold a Bachelor's degree, 40% possess a Master's degree, and 10% fall under other qualifications. This indicates that the majority of participants have formal academic training relevant to the construction industry.

The location of projects undertaken by respondents were multi-places, highest involvement is in federal level projects (90%), followed by projects in Punjab (70%). Moderate experience is observed in Khyber Pakhtunkhwa, Balochistan, and international projects (40% each), while Sindh (20%) and Kashmir (10%) show lower representation. Overall, the respondents demonstrate professional exposure across multiple regions and project types.

Pilot Survey showed reliability (α) of 0.879 which indicated questionnaire's suitability for main survey.

4.3 Main Survey

In this part the results of the main survey obtained are discussed in details.

4.3.1 Sample Size

The sample size formula given in Eq. (3.1) is used to determine the required questionnaire sample size. The sample size for the main survey is calculated as follows:

From Eq. (3.1):

$$N = p + 50 \quad (4.1)$$

Substituting the number of factors ($p = 32$):

$$N = 32 + 50 = 82 \quad (4.2)$$

From the above calculation, the minimum required sample size for the study is 82 respondents.

A total of 127 participants were invited to provide feedback through in-person distribution and Google Forms shared via WhatsApp. A total of 113 responses were received, resulting in a response rate of 89%. Out of these 113 responses, 22 were excluded because the respondents had less than five years of professional experience, while this study considers only professionals with a minimum of five years of experience. After applying this exclusion criterion, 91 valid responses were retained for the final analysis. These responses were then carefully reviewed and organized to ensure completeness, consistency, and suitability for subsequent statistical evaluation and interpretation. The finalized dataset was considered adequate for performing reliable and meaningful analysis of the study variables.

4.3.2 Demographic Data

The demographic data provides an overview of the respondents' background characteristics, including their organizational affiliation, experience, and role in construction projects.

This information is essential to contextualize the findings, ensuring that the analysis of labor productivity factors reflects the perspectives of a representative sample of industry professionals. The data obtained from the main survey is demonstrated as under.

The respondents in this study represent a variety of organizations involved in construction projects. As shown in figure 4.1 the largest portion, comprising approximately 58.24%, belongs to contractors, indicating that the majority of the surveyed sample are actively involved in on-site project execution.

Consultants form the second-largest group at about 19.78%, reflecting their advisory and supervisory roles within construction projects.

Organizations categorized as "Other" constitute 14.29% of the respondents, which may include suppliers, sub-contractors, or regulatory bodies.

Finally, clients make up around 7.69% of the respondents, representing the project owners or developers. This distribution highlights that the survey captures perspectives from both execution and oversight levels, with a strong emphasis on contractor insights.

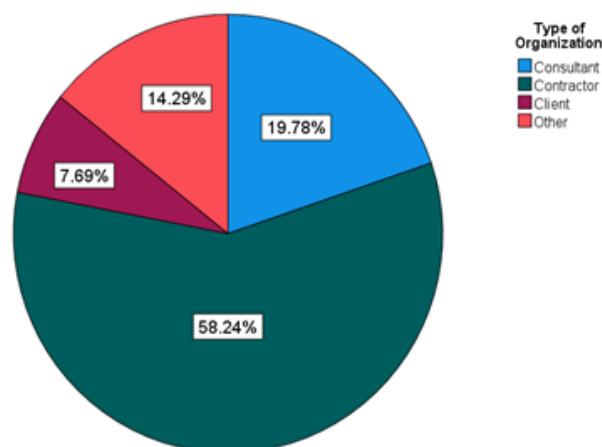


FIGURE 4.1: Distribution of Respondents Based on Type of Organization

Such a composition is beneficial for analyzing labor productivity, as contractors are directly responsible for workforce management and project implementation.

The inclusion of consultants and clients provides a broader understanding of supervisory and decision-making influences on productivity.

The respondents' professional background demonstrated in figure 4.2 shows a predominant representation of civil engineers working as site engineers, construction managers, planning engineers, resident engineers etc., who make up approximately 75.82% of the sample. This indicates that the study heavily captures the insights of professionals directly involved in planning, executing, and supervising construction activities. Contractors account for about 9.89%, contributing perspectives from the practical, on-site management side, while designers constitute roughly 5.49%, representing the planning and technical design viewpoint. The remaining 8.79% fall under "Other," which may include surveyors, or support staff associated with construction projects.

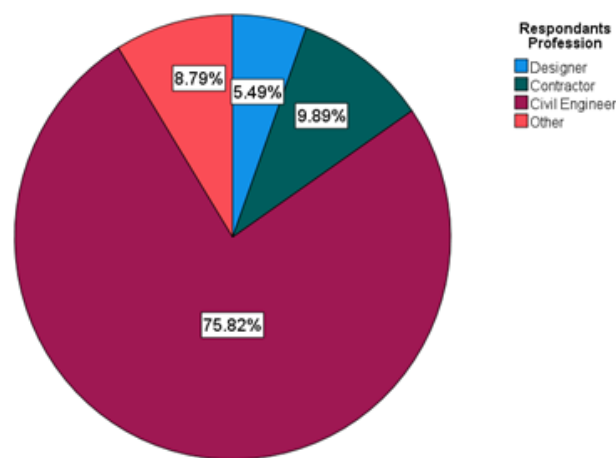


FIGURE 4.2: Distribution of Respondents Based on Profession

The gender distribution of the respondents shown in figure 4.3 indicates a predominance of male participants, comprising approximately 74.73% of the sample, while female participants represent about 25.27%.

This reflects the general workforce composition in the construction industry, which is traditionally male-dominated, especially in on-site and supervisory roles. Despite the lower proportion of female respondents, their inclusion provides valuable perspectives, particularly in areas such as design, management, and project over

sight, where female professionals are increasingly contributing.

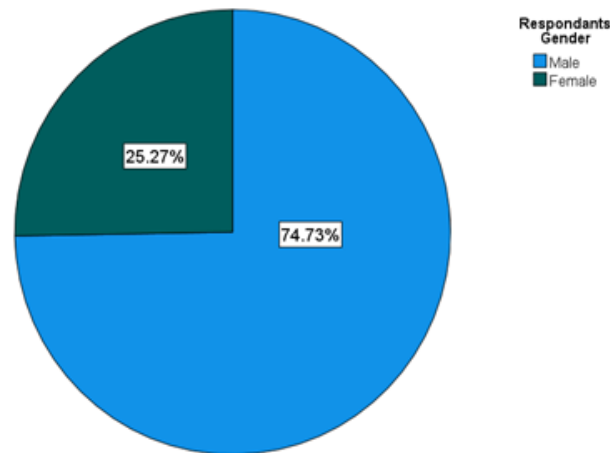


FIGURE 4.3: Distribution of Respondents Based on Gender

In this research, the respondents' professional experience varies across different ranges, reflecting a balanced mix of early-career and senior professionals can be seen in figure 4.4. The largest portion of the sample, approximately 46.15%, has between 5 to 10 years of experience, indicating that nearly half of the participants are relatively early to mid-career professionals who are actively engaged in on-site and project management tasks. Around 23.08% of the respondents have 10 to 15 years of experience. While 14.29% fall in the 15 to 20 years range, representing professionals with substantial experience and expertise in construction projects. Additionally, about 16.48% of the respondents have more than 20 years of experience, reflecting senior-level professionals with extensive exposure to construction practices, labor management, and project planning.

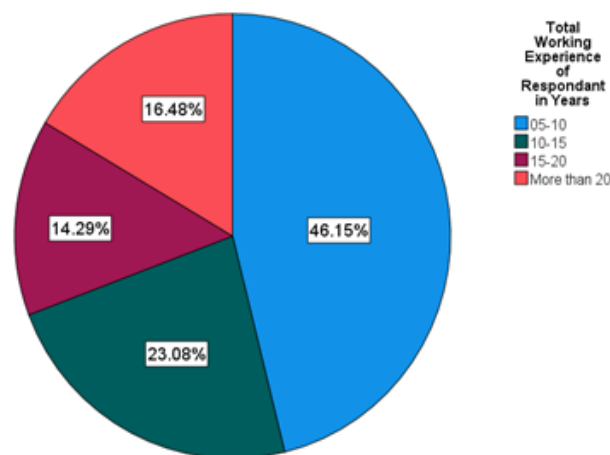


FIGURE 4.4: Distribution of Respondents Based on Work Experience

In this research, the educational qualifications of the respondents vary, reflecting a workforce that is largely academically qualified, as seen in the figure 4.5. The majority of the respondents, approximately 63.74%, hold a bachelor's degree, indicating that most participants have the foundational academic knowledge required for construction and engineering roles. Around 29.67% of the respondents possess a master's degree, representing professionals with advanced knowledge and specialized expertise in their respective fields. Only a small portion, about 6.59%, fall under the "Other" category, which may include diploma holders or professional certifications.

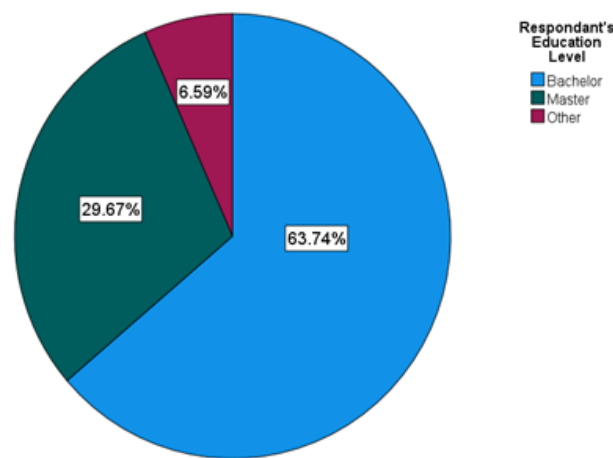


FIGURE 4.5: Distribution of Respondents Based on Education Level

The respondents showed their location of projects i.e. working in multiple regions of the country. As shown in table 4.2, majority has worked in Islamabad and

TABLE 4.2: Location of Projects Frequency

Project Locations	N	Percent
Federal Projects	79	86.8%
Punjab Projects	44	48.4%
Sindh Projects	14	15.4%
KPK Projects	25	27.5%
Balochistan Projects	12	13.2%
Kashmir Projects	12	13.2%
Gilgit Baltistan Projects	1	1.1%
International Projects	11	12.1%

Punjab followed by KPK and other regions showed in table. This indicates that most participants have exposure to projects in highly developed and active construction regions. It also reflects a diverse geographical distribution.

4.3.3 Reliability Test

The reliability of the main survey questionnaire is assessed to examine the internal consistency of the responses related to labor productivity in sustainable construction projects. Cronbach's alpha is used as a widely accepted statistical measure to evaluate the reliability of multi-item scales.

TABLE 4.3: Reliability Test Results

Reliability Statistics	
Cronbach's Alpha	N of Items
0.899	32

The analysis of the main survey data produces a Cronbach's alpha value of 0.899 as shown in the table 4.3, which indicates a very high level of internal consistency among the questionnaire items and respondents. So, on the basis of very high internal consistency, further analysis/tests are performed.

4.3.4 Normality Test

The normality of the survey data is assessed using the Kolmogorov–Smirnov test with Lilliefors correction and the Shapiro–Wilk test for all questionnaire items based on responses from 91 participants. These tests are conducted to examine whether the distribution of each labour productivity factor conforms to the normality assumption required for parametric statistical analysis.

The results shown in table 4.4 indicate that the p-values for all items are below the threshold of 0.05 in both tests, demonstrating a systematic deviation from normal distribution across the dataset. This finding confirms that the response patterns for all labour productivity variables exhibit non-normal characteristics.

Consequently, the violation of the normality assumption necessitates the adoption of non-parametric statistical methods for subsequent analyses.

The Kruskal–Wallis test was specifically selected because the data obtained from the questionnaire were measured using a Likert scale, which produces ordinal data, and the normality test results indicated that the dataset did not follow a normal

TABLE 4.4: Normality Test Results

Coded Factors	Kolmogorov–Smirnov			Shapiro–Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
WF-1	0.452	91	0.000	0.582	91	0.000
WF-2	0.360	91	0.000	0.643	91	0.000
WF-3	0.464	91	0.000	0.550	91	0.000
WF-4	0.444	91	0.000	0.573	91	0.000
WF-5	0.300	91	0.000	0.745	91	0.000
WF-6	0.283	91	0.000	0.799	91	0.000
MS-1	0.412	91	0.000	0.647	91	0.000
MS-2	0.229	91	0.000	0.881	91	0.000
MS-3	0.343	91	0.000	0.693	91	0.000
MS-4	0.333	91	0.000	0.718	91	0.000
MS-5	0.295	91	0.000	0.776	91	0.000
MS-6	0.205	91	0.000	0.889	91	0.000
MS-7	0.277	91	0.000	0.756	91	0.000
MI-1	0.363	91	0.000	0.708	91	0.000
MI-2	0.410	91	0.000	0.626	91	0.000
MI-3	0.204	91	0.000	0.905	91	0.000
MI-4	0.318	91	0.000	0.705	91	0.000
MI-5	0.268	91	0.000	0.756	91	0.000
MI-6	0.389	91	0.000	0.672	91	0.000
MER-1	0.357	91	0.000	0.703	91	0.000
MER-2	0.344	91	0.000	0.704	91	0.000
MER-3	0.255	91	0.000	0.804	91	0.000
MER-4	0.297	91	0.000	0.722	91	0.000
MER-5	0.243	91	0.000	0.805	91	0.000
MER-6	0.288	91	0.000	0.777	91	0.000
MER-7	0.369	91	0.000	0.677	91	0.000
TD-1	0.388	91	0.000	0.665	91	0.000
TD-2	0.287	91	0.000	0.806	91	0.000
TD-3	0.319	91	0.000	0.751	91	0.000
EE-1	0.356	91	0.000	0.697	91	0.000
EE-2	0.291	91	0.000	0.747	91	0.000
EE-3	0.229	91	0.000	0.883	91	0.000

distribution. Under such conditions, parametric tests such as ANOVA are not appropriate. The Kruskal–Wallis test is a suitable non-parametric alternative to one-way ANOVA, used to determine whether there are statistically significant differences between two or more independent groups. In this study, it was used to examine whether respondents from different professional groups had significantly different perceptions regarding the factors affecting labour productivity. The results shown in table 4.8 reveal that certain categories exhibited a high level of consensus across all respondents, as all their factors retained the null hypothesis.

Specifically, the Work Force (WF), Management and Supervision (MS), and Material/Equipment/Resource (MER) categories showed no statistically significant differences, indicating that respondents, regardless of background, consistently agreed on the importance of these factors. This suggests that basic operational essentials such as skilled and well-rested workers, effective supervision, realistic scheduling, and the availability of adequate materials and equipment are universally recognized as critical to labor productivity. The Likert-scale responses for these factors were predominantly “Agree” or “Strongly Agree,” reflecting strong uniform acknowledgment.

In contrast, several factors within the Motivation and Incentive (MI), Technical and Design (TD), and External and Environmental (EE) categories rejected the null hypothesis, indicating significant differences in perception among respondents. These factors included MI-2 (opportunities for promotion), MI-5 (a competitive but fair environment), MI-6 (payment delays), TD-1 (clarity of design drawings), TD-2 (complexity of designs), EE-2 (political instability or strikes), and EE-3 (public holidays and religious events).

The observed differences may stem from variations in respondents’ roles, experience levels, and exposure to project conditions. For example, payment delays (MI-6) are likely to impact lower-level labor more severely than managerial staff, while opportunities for promotion (MI-2) may be perceived as more motivating by younger or less experienced workers.

Similarly, complex designs (TD-2) may be challenging for laborers on site, whereas engineers may find them manageable. External factors such as political instability and public holidays (EE-2 and EE-3) can affect respondents differently depending on their regional context or organizational flexibility. Despite these differences, the majority of responses for the rejecting factors were still rated as “Agree” or “Strongly Agree,” highlighting that while the perceived impact varies, all factors are considered important to productivity.

These results underscore that while operational essentials are universally recognized, motivational, technical, and external factors are subject to varying perceptions, emphasizing the need for tailored management interventions to enhance

labor productivity.

TABLE 4.5: Kruskal-Wallis Test Results

Hypothesis Test Summary					
Coded Factors	Sig.^{a,b}	Decision	Coded Factors	Sig.^{a,b}	Decision
Work Force Factors					
WF-1	0.52		WF-4	0.224	
WF-2	0.06	Retain the null hypothesis.	WF-5	0.139	Retain the null hypothesis.
WF-3	0.593		WF-6	0.706	
Management and Supervision Factors					
MS-1	0.202		MS-5	0.14	
MS-2	0.078	Retain the null hypothesis.	MS-6	0.347	Retain the null hypothesis.
MS-3	0.102		MS-7	0.356	
MS-4	0.211				
Motivation and Incentive Factors					
MI-1	0.053	Retain the null hypothesis.	MI-4	0.165	Retain the null hypothesis.
MI-2	0.038	Reject the null hypothesis.	MI-5	0.004	Reject the null hypothesis.
MI-3	0.249	Retain the null hypothesis.	MI-6	0.03	Reject the null hypothesis.
Material, Equipment, and Resource Factors					
MER-1	0.262	Retain the null hypothesis.	MER-5	0.166	Retain the null hypothesis.

Table 4.5 continued from previous page

Coded Factors	Sig. ^{a,b}	Decision	Coded Factors	Sig. ^{a,b}	Decision
MER-2	0.106		MER-6	0.156	
MER-3	0.752	Retain the null hy- pothesis.	MER-7	0.057	
MER-4	0.187	Retain the null hy- pothesis.			
Technical and Design Factors					
TD-1	0.017	Reject the null hy- pothesis.	TD-3	0.111	Retain the null hy- pothesis.
TD-2	0.004				
External and Environmental Factors					
EE-1	0.841	Retain the null hy- pothesis.	EE-3	0.029	Reject the null hy- pothesis.
EE-2	0.015	Reject the null hy- pothesis.			

4.3.5 Frequency Analysis

Frequency analysis is used to examine respondents' perceptions of various labor productivity risk factors in sustainable construction projects. It identifies the distribution of responses across the Likert scale and highlights which factors are considered more or less critical. This analysis is carried out separately for each category of risk factors, allowing a clear understanding of how respondents evaluate the importance of each factor. The results further assist in prioritizing key risk factors that require focused attention in project planning and management. This provides a strong basis for subsequent quantitative and comparative analysis.

4.3.5.1 Work Force Factors

The results in table 4.6 show that most respondents strongly agree or agree with the majority of workforce factors, indicating their high importance in influencing labor productivity. WF-1, WF-3, and WF-4 receive the highest levels of agreement, reflecting strong consensus on their impact, whereas WF-5 shows a higher number of disagreement responses, suggesting it is perceived as less influential. WF-2 and WF-6 also show substantial agreement, confirming their role in enhancing workforce performance overall.

TABLE 4.6: Frequency Table of WF Category

Coding	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
WF-1	0	0	2	22	67
WF-2	0	2	0	35	54
WF-3	0	0	4	17	70
WF-4	0	0	0	27	64
WF-5	1	46	20	3	21
WF-6	0	2	11	51	27

Figure 4.6 is the visual representation of the table 4.6.

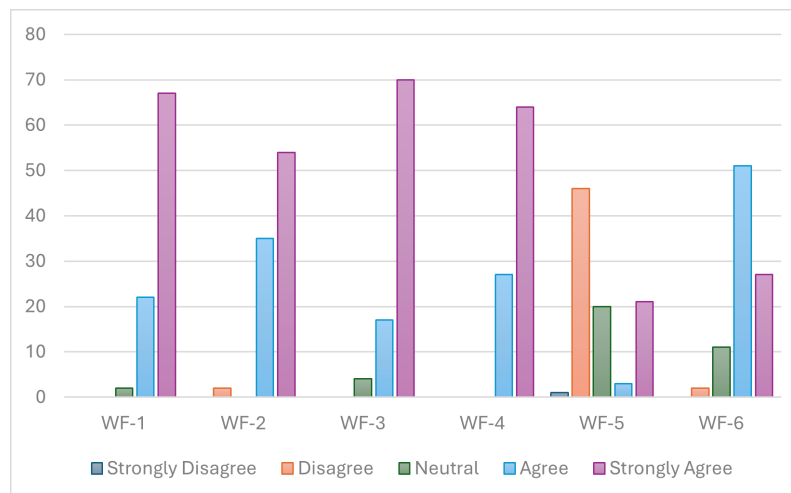


FIGURE 4.6: Work Force Category Frequency Analysis

4.3.5.2 Management and Supervision Factors

The results in Table 4.7 show the frequency distribution of respondents' perceptions regarding management and supervision factors affecting labor productivity.

Most respondents strongly agree or agree with several factors, indicating that effective management practices and supervision play a significant role in improving workforce performance.

MS-1, MS-3, MS-4, MS-5, and MS-7 receive high levels of agreement, reflecting strong consensus that these factors positively influence labor productivity. In contrast, MS-2 and MS-6 show notable disagreement and neutral responses, suggesting that these factors are perceived as less consistently influential or context-dependent.

TABLE 4.7: Frequency Table of MS Category

Coding	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
MS-1	0	0	5	25	61
MS-2	11	30	12	21	17
MS-3	0	1	2	38	50
MS-4	0	0	4	40	47
MS-5	0	2	11	34	44
MS-6	17	21	14	26	13
MS-7	0	3	6	40	42

Figure 4.7 is the visual representation of the table 4.7.

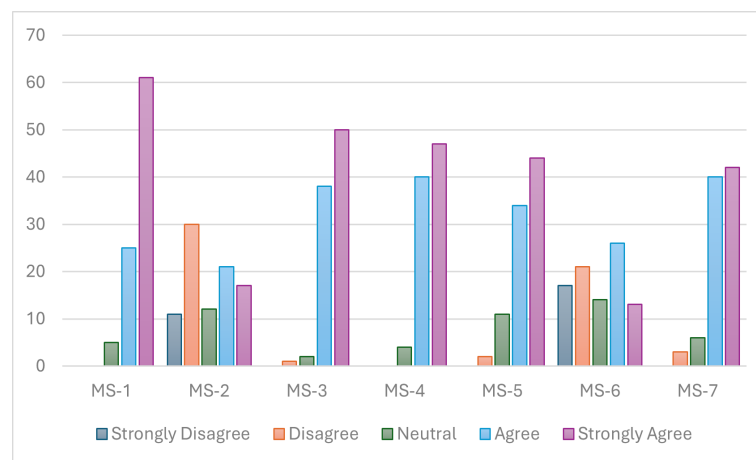


FIGURE 4.7: Management and Supervision Category Frequency Analysis

4.3.5.3 Motivation and Incentive Factors

The results in table 4.8 show the frequency distribution of respondents' perceptions regarding motivation and incentives factors. Overall, most respondents agree

or strongly agree with several factors, indicating that motivation and incentives are key drivers of labor productivity. MI-1, MI-2, MI-4, MI-5, and MI-6 receive high levels of agreement, showing strong consensus on their positive impact on labor performance. MI-2 stands out as the most strongly endorsed factor, with 63 respondents selecting Strongly Agree. In contrast, MI-3 shows a higher number of neutral and disagreement responses, suggesting that this factor is perceived as less consistently influential compared to other MI factors.

TABLE 4.8: Frequency Table of MI Category

Coding	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
MI-1	0	0	7	31	53
MI-2	0	4	7	17	63
MI-3	7	13	36	20	15
MI-4	2	4	6	28	51
MI-5	0	3	5	48	35
MI-6	0	2	8	22	59

Figure 4.8 is the visual representation of the table 4.8.

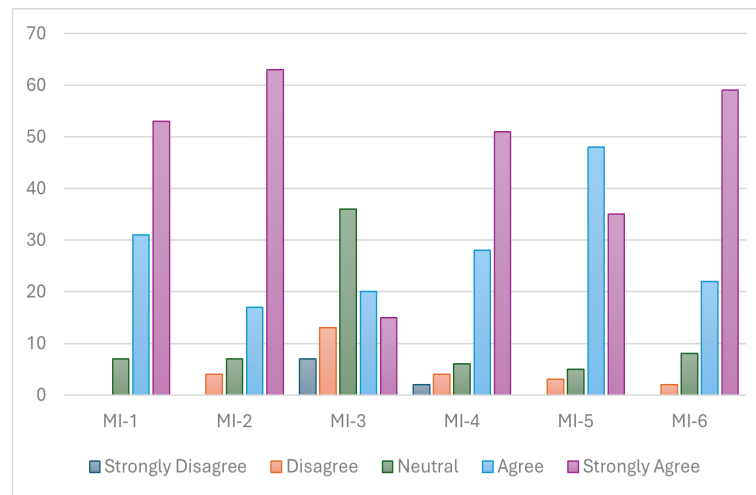


FIGURE 4.8: Motivation and Incentive Category Frequency Analysis

4.3.5.4 Material, Equipment, and Resource Factors

Table 4.9 shows the survey responses for Material/Equipment/Resource (MER) factors affecting labor productivity. It is evident that most respondents agreed or strongly agreed with all factors, indicating their high relevance. MER-7, MER-1, and MER-4 received the highest number of “Strongly Agree” responses, suggesting

that availability and adequacy of materials and equipment are critical for maintaining productivity. MER-5 and MER-3 had slightly higher neutral or disagree responses, reflecting some variation in perception among participants. Overall, the results highlight that material and equipment-related factors are significant contributors to labor productivity in construction projects

TABLE 4.9: Frequency Table of MER Category

Coding	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
MER-1	0	2	6	29	54
MER-2	0	4	6	28	53
MER-3	0	5	13	34	39
MER-4	0	2	3	42	44
MER-5	0	11	12	30	38
MER-6	0	2	10	36	43
MER-7	0	2	4	29	56

Figure 4.9 is the visual representation of the table 4.9.

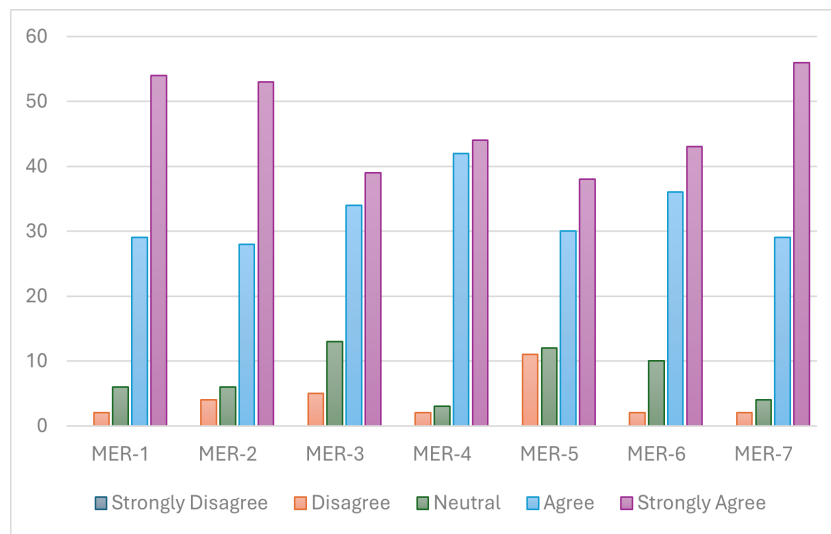


FIGURE 4.9: Material, Equipment and Resource Category Frequency Analysis

4.3.5.5 Technical and Design Factors

Table 4.10 shows the survey responses for Technical and Design (TD) factors affecting labor productivity. It can be observed that most respondents agreed or strongly agreed on their impact. TD-1 and TD-3 received the highest “Strongly Agree” responses, indicating that clear technical specifications and accurate design play a significant role in enhancing labor productivity. TD-2 shows a more

mixed response, with several “Disagree” and “Neutral” selections, suggesting some variation in perception regarding design-related issues.

TABLE 4.10: Frequency Table of TD Category

Coding	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
TD-1	0	2	6	24	59
TD-2	0	13	8	40	30
TD-3	0	2	9	32	48

Figure 4.10 is the visual representation of the table 4.10.

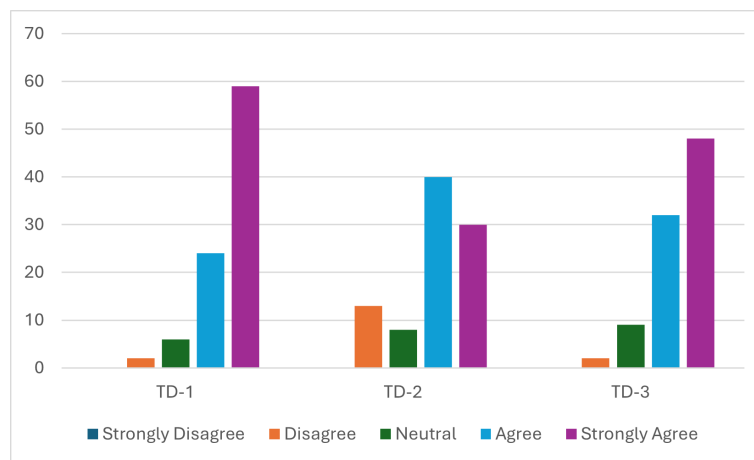


FIGURE 4.10: Technical and Design Category Frequency Analysis

4.3.5.6 External and Environmental Factors

Table 4.11 shows the survey responses for External/Environmental (EE) factors affecting labor productivity. It is evident that EE-1 and EE-2 received a majority of “Agree” and “Strongly Agree” responses, indicating that factors such as weather conditions, site environment, and external support significantly influence productivity. In contrast, EE-3 shows more variation, with substantial “Neutral,” “Disagree,” and even “Strongly Disagree” responses, suggesting that its impact is

TABLE 4.11: Frequency Table of EE Category

Coding	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
EE-1	0	6	8	22	55
EE-2	0	0	6	45	40
EE-3	4	10	37	18	22

perceived as less consistent among respondents. Figure 4.11 is the visual representation of the table 4.11.

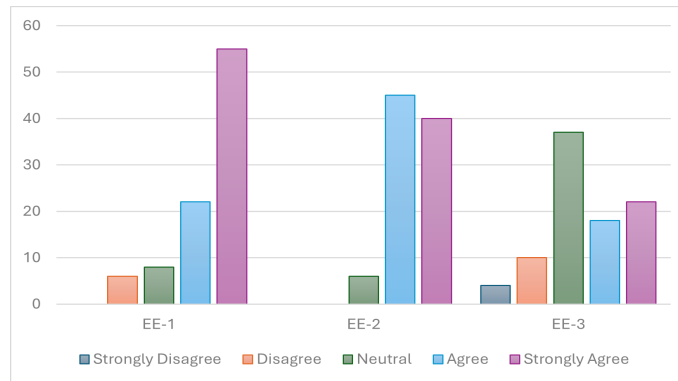


FIGURE 4.11: External and Environmental Category Frequency Analysis

4.3.6 Relative Importance Index Test

In the main survey, the Relative Importance Index (RII) method is employed to evaluate and prioritize the factors influencing labour productivity. The RII values facilitate a systematic assessment of the relative significance of each factor based on respondents' perceptions, enabling the ranking of factors to identify the most critical contributors to labour productivity.

Table 4.12 presents two types of rankings for the labor productivity factors. The first ranking shows the position of each factor within its respective category, while the second ranking provides the overall position of each factor among all 32 factors considered in the study. This dual ranking approach allows for a clear understanding of the relative importance of each factor both within its category and in the broader context. For instance, within the Work Force category, the factor WF-1 is ranked second among the factors in its category, and it also emerges as the most significant factor overall, holding the second rank among all 32 factors.

4.3.6.1 Factor Wise Ranking

Among workforce-related aspects, WF-3 (0.945), WF-1 (0.943), and WF-4 (0.941) emerge as the most influential. This highlights that workers who clearly understand their roles, are skilled, and collaborate effectively with teammates are critical

for maintaining high productivity levels, minimizing errors, and ensuring smooth workflow. WF-2 (0.910) is moderately high, reflecting that adequate rest and experience also support consistent performance. On the lower end, WF-6 (0.826) and WF-5 (0.593) indicate that personal or family issues and lack of familiarity with site conditions have comparatively limited influence on daily output.

TABLE 4.12: Ranking of Factors

Coded Factor	RII Values	Rankin Within Category	Over -all	Coded Factor	RII Values	Rankin With -in	Over -all
Work Force Factors							
WF-1	0.943	2	2	WF-4	0.941	3	3
WF-2	0.910	4	4	WF-5	0.593	6	28
WF-3	0.945	1	1	WF-6	0.826	5	22
Management and Supervision Factors							
MS-1	0.923	1	11	MS-5	0.864	5	19
MS-2	0.607	6	27	MS-6	0.593	7	29
MS-3	0.901	2	9	MS-7	0.866	4	17
MS-4	0.895	3	12				
Motivation and Incentive Factors							
MI-1	0.901	4	10	MI-4	0.868	3	18
MI-2	0.905	1	6	MI-5	0.853	5	25
MI-3	0.651	6	26	MI-6	0.903	2	8
Material, Equipment, and Resource Factors							
MER-1	0.897	2	11	MER-5	0.809	6	23
MER-2	0.886	3	14	MER-6	0.864	5	20
MER-3	0.835	5	21	MER-7	0.905	1	7
MER-4	0.881	4	13				
Technical and Design Factors							
TD-1	0.908	1	5	TD-3	0.877	2	15
TD-2	0.791	3	24				
External and Environmental Factors							
EE-1	0.877	1	14	EE-3	0.697	3	30
EE-2	0.875	2	16				

In this category, MS-1 (0.923), MS-3 (0.901), and MS-4 (0.895) rank highest, demonstrating that effective supervision, monitoring, and planning directly enhance workforce efficiency. Mid-level factors like MS-7 (0.866) and MS-5 (0.864) suggest that motivation through managerial support and schedule adjustments contributes to productivity but is slightly less critical. Lower-ranked factors, MS-2 (0.607) and MS-6 (0.593), reveal that compliance with labor laws and leadership by example are important for regulatory or morale reasons but have limited imme

diate effect on output.

Motivational aspects are led by MI-2 (0.905) and MI-6 (0.903), emphasizing that timely payments and opportunities for promotion significantly drive labor effort. MI-4 (0.868) and MI-5 (0.853) also moderately influence productivity through recognition, appreciation, and fair competition. At the lower end, MI-3 (0.651), representing strict disciplinary measures, has minimal impact on daily performance.

In Material, Equipment and Resource Factors, MER-7 (0.905), MER-1 (0.897), and MER-2 (0.886) dominate, highlighting that reliable machinery, timely material supply, and resource availability are essential for continuous workflow. Mid-ranking factors such as MER-4 (0.881) and MER-6 (0.864) indicate the importance of logistics, accommodation, and utilities, while MER-3 (0.835) and MER-5 (0.809) have a moderate but supportive role in sustaining operations.

Technical clarity is paramount, with TD-1 (0.908) and TD-3 (0.877) leading the category. This suggests that clear drawings and effective design management enable workers to execute tasks efficiently and reduce errors. TD-2 (0.791) has moderate influence, reflecting that complex designs or approval delays can slow productivity but are less critical than clarity and coordination.

In this category, EE-1 (0.877) and EE-2 (0.875) show moderate-to-high impact, indicating that weather conditions and political interruptions can affect productivity. Public holidays (EE-3, 0.697) are less significant, as their effects are temporary and predictable.

4.3.6.2 Overall Ranking

The overall ranking provides a clear hierarchy of factors influencing labor productivity across all categories in sustainable construction projects. As shown in table 4.13 at the top of the overall ranking, WF-3 (RII = 0.945, 1st), WF-1 (0.943, 2nd), WF-4 (0.941, 3rd), WF-2 (0.910, 4th), and TD-1 (0.908, 5th) emerge as the most critical determinants of labor productivity. The dominance of workforce-related factors highlights the fundamental role of human capital in

construction operations. Specifically, WF-3 emphasizes the importance of workers clearly understanding their assigned roles, which directly enhances task accuracy, reduces errors, and ensures seamless coordination. WF-1, representing skilled and trained labor, complements this by facilitating efficient task execution and minimizing rework. Team cohesion and cooperation, captured by WF-4, reinforce the workforce's ability to work collectively, ensuring that interdependent activities proceed without disruption. WF-2, indicating adequate rest and work experience, sustains consistent daily output, preventing fatigue-related errors and maintaining overall efficiency. The inclusion of TD-1, clear and detailed design drawings, underscores the critical intersection between workforce capability and technical guidance, demonstrating that even highly skilled labor requires precise and understandable technical instructions to operate at peak productivity.

Factors with moderate overall influence include MI-6 (0.903, 8th), MS-3 (0.901, 9th), MI-1 (0.901, 10th), MS-1 (0.923, 11th), MS-4 (0.895, 12th), MER-4 (0.881, 13th), MER-2 (0.886, 14th), TD-3 (0.877, 15th), EE-1 (0.877, 14th), EE-2 (0.875, 16th), MI-4 (0.868, 18th), and MS-5 (0.864, 19th). These factors, although not at the very top of the hierarchy, are essential in supporting sustained productivity. They represent management efficiency, motivation, material availability, and environmental stability. For instance, MS-3 and MS-4 reflect effective monitoring and scheduling practices that ensure tasks are organized and resources optimally allocated. MER-2 and MER-4 indicate the criticality of timely material supply, machinery, and logistical coordination, which enable uninterrupted workflow. Motivation factors, such as MI-1 and MI-6, illustrate the role of recognition, timely payments, and career incentives in maintaining labor engagement and commitment. Environmental factors (EE-1, EE-2) moderate productivity by accounting for weather conditions and political or social disruptions, which, while not always direct, can temporarily reduce effective working hours. TD-3 further highlights the significance of operational continuity and approval processes in technical execution. Collectively, these moderately ranked factors act as enablers that sustain efficiency when the primary workforce and technical factors are in place.

At the lower end of the ranking, factors including WF-5 (0.593, 28th), MS-6 (0.593, 29th), EE-3 (0.697, 30th), MS-2 (0.607, 27th), MI-3 (0.651, 26th), and

TD-2 (0.791, 24th) exert a limited direct influence on labor productivity. These factors primarily affect operations indirectly or under specific conditions. For example, WF-5 reflects workers' unfamiliarity with site conditions, which may temporarily hinder output but can be mitigated through supervision or orientation. MS-6 and MS-2, leadership by example and legal compliance, are necessary for morale and regulatory adherence but do not immediately accelerate daily work performance. MI-3, representing strict disciplinary measures, has minimal impact on productivity and can even have counterproductive effects on motivation. EE-3, representing public holidays, has predictable and transient effects on output. TD-2, although a technical factor, indicates design complexity that can occasionally slow work but is less critical when clear instructions and skilled labor are available.

Chapter 5

Conclusion and Recommendations

5.1 General

This research investigated the risks affecting labour productivity in sustainable construction projects in Pakistan using a structured and empirical approach. The study combined an extensive literature review, expert validation through the Delphi technique, and quantitative analysis of industry perceptions to identify and prioritize the most influential productivity-related factors. The findings provide evidence-based insights into the key drivers of labour productivity within the context of Pakistan's labour-intensive construction industry.

5.2 Conclusion

The findings of this study clearly demonstrate that labour productivity in sustainable construction projects is not influenced equally by all categories of factors. An examination of the Relative Importance Index (RII) values and overall rankings reveals a distinct hierarchy among the categories. The most influential category identified is Work Force Factors, followed by Technical and Design Factors, Motiv

ation and Incentive Factors, Material, Equipment and Resource Factors, Management and Supervision Factors, while External and Environmental Factors were found to be the least influential. This hierarchy indicates that productivity is predominantly driven by human-related and project-internal conditions rather than external or uncontrollable influences.

Work Force Factors emerged as the most influential category, as this category contains the top four ranked factors overall, which clearly establishes its dominance. The presence of multiple high-ranking factors within a single category indicates a strong collective influence on labour productivity. The most influential factor across the entire study was WF-3, with an RII value of 0.945 and an overall rank of 1, which indicates that workers who clearly understand their roles perform their tasks with greater confidence, reduced errors, and improved efficiency. This finding emphasizes that role clarity is a fundamental driver of productivity in sustainable construction projects. Closely following this, WF-1 achieved an RII of 0.943 and ranked second overall, demonstrating that skilled and trained workers are able to complete tasks more accurately and quickly, thereby directly enhancing output quality and speed. WF-4 ranked third overall with an RII value of 0.941, highlighting that cooperation and teamwork among workers significantly improve daily output by enabling better coordination and smoother execution of interdependent activities. WF-2, which ranked fourth overall with an RII of 0.910, further reinforces the importance of workforce well-being, as adequate rest breaks help maintain physical endurance and consistent productivity levels. The lower-ranked factors within this category, such as WF-6 with an RII of 0.826 and an overall rank of 22, indicate that personal or family issues do affect labour focus but are perceived as less influential due to their limited controllability. WF-5 recorded a low RII value of 0.593 and ranked 28th overall, suggesting minimal perceived impact on productivity compared to other workforce-related factors.

After Work Force Factors, Technical and Design Factors were identified as the second most influential category. This ranking is justified by the presence of TD-1 among the top five factors overall, indicating that technical clarity plays a critical role in labour productivity. TD-1 recorded an RII value of 0.908 and an overall rank of 5, demonstrating that clear and detailed design drawings significantly

reduce on-site confusion, rework, and idle time, thereby enhancing productivity. TD-3 followed with an RII of 0.877 and an overall rank of 15, indicating that delays in drawing approvals disrupt workflow continuity and negatively affect labour efficiency. TD-2 ranked 24th overall with an RII of 0.791, suggesting that while complex project designs do reduce labour speed, their influence is comparatively lower when supported by proper documentation and planning.

The third most influential category identified was Motivation and Incentive Factors, which highlights the importance of financial reliability and positive reinforcement mechanisms. MI-2 ranked sixth overall with an RII value of 0.905, indicating that opportunities for promotion significantly enhance worker loyalty and performance by fostering long-term commitment. MI-6 achieved an RII of 0.903 and ranked eighth overall, demonstrating that payment delays create tension and reduce worker motivation, directly affecting labour productivity. MI-1 ranked tenth overall with an RII value of 0.901, confirming that recognition and appreciation encourage workers to exert greater effort. MI-4, with an RII of 0.868 and a rank of 18, indicates that job security contributes positively to productivity, though its influence is weaker than immediate financial and recognition-based incentives. Lower-ranked factors such as MI-5 and MI-3, with RII values of 0.853 and 0.651 respectively, suggest that competitive environments and punishment-based policies are perceived as less effective tools for improving productivity.

Material, Equipment and Resource Factors were ranked as the fourth most influential category, reflecting their role in maintaining uninterrupted site operations. MER-7 ranked seventh overall with an RII value of 0.905, highlighting that reliable electricity and water supply are essential for smooth daily operations and continuous labour output. MER-1 followed with an RII of 0.897 and an overall rank of 11, indicating that timely supply of construction materials supports workflow continuity. MER-4 and MER-2, with RII values of 0.881 and 0.886 respectively, demonstrate that efficient logistics and functional equipment are key contributors to productivity. Factors such as MER-6, MER-3, and MER-5, which ranked between 20 and 23 overall, indicate that transportation facilities, equitable resource allocation, and safety gear availability are important but secondary compared to core operational resources.

The fifth most influential category was Management and Supervision Factors, indicating a moderate impact on labour productivity. MS-1 recorded an RII value of 0.923 and an overall rank of 11, demonstrating that effective supervision ensures efficient task execution and minimizes idle time. MS-3, with an RII of 0.901 and a rank of 9, highlights that lack of timely decision-making by management significantly slows project progress. MS-4 ranked 12th overall with an RII of 0.895, emphasizing the importance of proper planning and scheduling. Other factors such as MS-7 and MS-5 showed moderate influence, while MS-2 and MS-6, with RII values of 0.607 and 0.593 and ranks of 27 and 29 respectively, indicate that labour law compliance and leadership by example are perceived as having limited direct influence on daily labour productivity.

Finally, External and Environmental Factors were identified as the least influential category due to their largely uncontrollable nature. EE-1 recorded an RII of 0.877 and ranked 14th overall, indicating that extreme weather conditions significantly reduce effective working capacity. EE-2 ranked 16th overall with an RII of 0.875, reflecting the disruptive impact of political instability and strikes. EE-3 ranked last overall with an RII value of 0.697, suggesting that public holidays and religious events, although affecting man-hours, are considered predictable and manageable through effective planning.

5.3 Guidelines

Based on the prioritized findings of this study, the following guidelines are proposed to enhance labour productivity in sustainable construction projects. These guidelines are structured to directly address the most influential categories and their associated factors.

- i. For contractors and project management teams, the foremost recommendation is to establish a structured, site-specific induction program supported by daily toolbox talks. Such practices ensure that workers clearly understand their assigned roles, daily objectives, work sequences, and safety responsibilities. This approach directly targets WF-3 by improving role clarity and

- WF-4 by strengthening coordination and teamwork among labour crews, thereby reducing confusion and rework at the site level.
- ii. To address workforce capability gaps, contractors should invest in certified skill development and structured mentorship programs. Collaborations with technical institutes or in-house training modules, combined with pairing less experienced workers with skilled foremen, will enhance execution accuracy and efficiency. This guideline directly targets WF-1 and indirectly reinforces collaborative work practices under WF-4.
 - iii. Productivity losses caused by design ambiguity should be mitigated through formal constructability review workshops prior to site mobilization. These workshops should involve key site personnel and design consultants to identify buildability issues early. Additionally, adopting a centralized digital system for managing drawings ensures that only the latest approved revisions are used on site. This recommendation directly targets TD-1 and TD-3 by reducing delays, design-related errors, and interruptions during execution.
 - iv. To maintain uninterrupted operations, contractors should designate a dedicated logistics and resource coordination role responsible for managing material supply, equipment readiness, and utility availability. Proactive planning of deliveries, preventive maintenance of equipment, and coordination with utility providers will reduce downtime and idle labour. This guideline directly addresses MER-1 and MER-7, ensuring a stable operational environment for the workforce.
 - v. Labour motivation should be enhanced by implementing a transparent and time-bound wage disbursement system along with a clearly defined, merit-based career progression structure. Timely payments and visible growth opportunities help build trust, reduce absenteeism, and encourage sustained effort from workers. This recommendation directly targets MI-6 and MI-2, while also supporting positive workforce morale.
 - vi. Supervisory effectiveness should be improved by empowering site supervisors with decision-making authority for routine operational matters. Reducing delays in approvals and issue resolution helps maintain workflow continuity

and prevents productivity losses. This guideline directly addresses MS-1 and MS-3.

- vii. To further enhance efficiency, project teams should adopt realistic planning and scheduling practices aligned with actual site conditions and resource availability. Avoiding unrealistic deadlines reduces work pressure and quality compromise while improving labour focus and output consistency. This recommendation targets MS-4 and MS-5.
- viii. Based on the observed low effectiveness of punitive control mechanisms, contractors are advised to avoid reliance on strict punishment-based labour management approaches. Instead, supportive supervision and recognition-oriented practices should be encouraged to maintain motivation and cooperation. This guideline responds directly to MI-3 and MS-6.
- ix. For academia and training institutions, it is recommended that construction workforce management, site productivity, and human factors be integrated into civil engineering curricula. Practical exposure to labour management challenges will prepare future engineers to design and manage projects with a stronger understanding of workforce-driven productivity constraints. This recommendation supports long-term mitigation of issues related to WF-1, WF-3, and TD-1.

5.4 Recommendations

The recommendations for the regulatory bodies, industry associates and clients are as under:

- i. The Pakistan Engineering Council (PEC), in collaboration with the National Vocational and Technical Training Commission (NAVTTTC) and industry bodies should develop a tiered, national certification for key sustainable construction trades (e.g., Certified Green Mason, Sustainable MEP Fitter). This institutionalizes the solution for WF-1 (Skilled Labour) at a national scale. A standardized certification ensures a baseline of quality, enhances workforce

mobility, and provides the structured career pathway (MI-2) that motivates workers. It elevates the profession from unskilled labour to recognized technical work.

- ii. Public sector clients (e.g., CDA, LDA, PHATA) should reform tender evaluation models. Introduce a technical scoring component (e.g., 15-20%) for bidders' demonstrated "Labour Productivity Management Plans," which should detail their approach to workforce training, induction, digital tool use, and financial management. This uses market forces to incentivize best practices. It rewards contractors who proactively address the core management (MS-1, MS-3) and human capital (WF factors) issues identified in the study, moving the industry away from a race-to-the-bottom price competition.
- iii. Industry associations should synthesize this research into practical, bilingual (Urdu/English) "Site Manager Handbooks" and produce video case studies of local projects that successfully improved productivity through better induction, supervision, or logistics. This bridges the gap between academic research and field practice. Providing simple, actionable checklists and real-world examples lowers the barrier to implementation for small and medium-sized enterprises, facilitating widespread adoption of evidence-based strategies.

5.5 Future Research Directions

The following research avenues are recommended:

- i. Conduct case-study-based research comparing productivity outcomes before and after applying mitigation strategies.
- ii. Extend analysis to infrastructure and industrial projects to compare sector-specific risk behaviour.
- iii. Use advanced modelling techniques (e.g., Fuzzy-AHP, SEM) to explore cause effect relationships among the highest ranked factors.

- iv. Integrate real productivity data (output per man-hour) with perception-based rankings to strengthen predictive validity.
- v. Explore the role of digital tools (BIM, mobile supervision apps, IoT monitoring) in reducing labour productivity risks in sustainable construction.

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Questionnaire

**CAPITAL UNIVERSITY OF SCIENCE AND TECHNOLOGY,
ISLAMABAD**

Department of Civil Engineering

**Risk Assessment and Mitigation of Labour Productivity in
Sustainable Construction Projects in Pakistan**

(QUESTIONNAIRE)

(Munim Lashari – MCE241005)

Labour productivity is a critical factor determining the success, efficiency, and sustainability of construction projects. In Pakistan, sustainable construction practices are gaining importance, yet numerous risks and challenges continue to affect worker performance. This study aims to assess the key factors influencing labour productivity and identify effective mitigation strategies to minimize associated risks. By understanding these factors, organizations can enhance project performance, reduce delays, and promote sustainable development in the construction sector. The feedback obtained from this questionnaire will contribute to formulating practical measures for improving labour productivity and achieving sustainable project outcomes.

Part-01: Demographic Data

1. Please specify your type of organization
 - Consultant

- Contractor
- Client
- Other (Specify): _____

2. Please specify your profession

- Designer
- Contractor
- Civil Engineer
- Architect
- Other: _____

3. Please specify your gender

- Male
- Female

4. Please specify your working experience (years)

- Less than 5
- 05–10
- 10–15
- 15–20
- More than 20

5. Please specify your educational qualification

- Bachelor
- Master
- PhD
- Other: _____

6. Please specify your area of projects during your professional life (You can tick more than one)

- Federal
- Punjab
- Sindh
- KPK
- Balochistan
- Kashmir
- Gilgit Baltistan
- International

Part-02: Technical Data

Labour productivity is influenced by multiple factors that directly affect the efficiency and performance of workers on construction projects. The technical factors listed below are based on organizational and project-specific variables. Kindly review each factor carefully and indicate your assessment by filling the corresponding response in the Likert scale provided.

Sr. No	Factor	SD	D	N	A	SA
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1. Workforce Factors

WF-1	Skilled and trained workers complete tasks more accurately and quickly.					
WF-2	Allowing adequate rest breaks during work hours improves worker productivity.					
WF-3	Workers who understand their roles clearly work more confidently.					
WF-4	Cooperation and teamwork among workers improve daily output.					
WF-5	Workers unfamiliar with site conditions can adapt work environment quickly.					
WF-6	Personal or family issues of labourers can influence their work focus.					

2. Management and Supervision Factors

MS-1	Effective supervision ensures that tasks are completed efficiently.					
MS-2	Labour laws are followed at construction sites.					
MS-3	Lack of timely decision-making by management slows down progress.					
MS-4	Proper planning and scheduling improve workforce performance.					

Sr. No	Factor	SD	D	N	A	SA
MS-5	Unrealistic deadlines reduce motivation and lead to poor quality work.					
MS-6	Managers who lead by example do not inspire labour to perform productively.					
MS-7	Ineffective monitoring of daily activities results in lowering productivity.					

3. Motivation and Incentive Factors

MI-1	Recognition and appreciation encourage workers to give their best effort.					
MI-2	Opportunities for promotion increase loyalty and performance.					
MI-3	Strict or punishment policies are needed to control labour.					
MI-4	Workers who feel secure in their jobs are more productive.					
MI-5	A competitive but fair environment among labourers enhances productivity.					
MI-6	Payment delays create tension and reduce worker motivation to work effectively.					

4. Material, Equipment, and Resource Factors

MER-1	Timely supply of construction materials supports continuous workflow and high morals of labourers.					
MER-2	Equipment breakdowns or outdated machinery slow down work.					
MER-3	Adequate allocation of resources minimizes disputes among teams.					
MER-4	Smooth logistics and supply chain improve labour continuity.					

Sr. No	Factor	SD	D	N	A	SA
MER-5	Shortage of safety gear and protective equipment affects worker morale and progress.					
MER-6	Adequate boarding and transportation help to improve labour productivity.					
MER-7	Reliable electricity and water services ensure smooth daily operations.					

5. Technical and Design Factors

TD-1	Clear and detailed design drawings reduce confusion on site hence increasing productivity.					
TD-2	Complex project designs require more effort and reduce labour speed of work.					
TD-3	Delays in approval of drawings affect continuity of operations.					

6. External and Environmental Factors

EE-1	Extreme temperatures or heavy rainfall delay construction activities, reducing workers' effective working capacity and lowering overall labour productivity.					
EE-2	Political instability or strikes can stop project work abruptly, causing interruptions that demotivate labour and decrease productivity levels.					
EE-3	Public holidays and religious events interrupt normal workflow, leading to reduced man-hours and lower cumulative productivity.					

Thank you for your valuable feedback for the research study.

(Optional Data)

Date: _____

Name: _____

Designation: _____

Firm: _____

(This information will be kept confidential and will not be used for any purpose except to authenticate input.)