Enhancing Labor Productivity in Construction Management: Influential Factors and Contributions

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Submitted to the
Institute of Graduate Studies and Research
in partial fulfillment of the requirements for the degree of

Master of Science
in
Civil Engineering

Eastern Mediterranean University
December 2023
Gazimağusa, North Cyprus

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ABSTRACT

Labor productivity in the construction sector remains a largely overlooked field of study. Enhancing productivity can save costs without large investments, crucial for profitable construction projects. Measuring labor productivity is challenging but vital. Resource efficiency and high reduction in expenses is significant concern with respect to the construction sector. Developed countries view it as fostering growth and welfare, while developing nations see it as a way to tackle unemployment, inflation, and improve citizens' lives amid resource scarcity.

The primary objective this review aims to pinpoint are the key parameters influencing labor productivity in construction and classify them in relation to their relative significance from the perspective of contractors. Questionnaires were used to collect data for this study. The evaluation of 46 factors examined through a survey reveals that certain primary factors adversely impact labor productivity. These include Physical fatigue of the labor, unclear instructions to the labors, lack of labor discipline, lack of appropriate labor inspection or supervision, and lack of labor experience/ skills. The study showed that the factors affecting labor productivity were categorized into 7 groups some of which are Labor related factors, Site related factors, External related factors, Motivational related factors and more. In addition, it was also revealed that Labor related factors had the most effect on labor productivity with its relative importance index of 72.75 while External related factors had the least effect on labor productivity having relative importance index 66.92. Contractors and construction professionals can benefit from this study in understanding factors affecting labor productivity and help to take required measures.

Keywords: labor productivity, construction sector, contractors, building projects, productivity.

ÖZ

Günümüzde hala daha inşaat sektörü bağlamında işgücü verimliliği oldukça göz ardı edilen bir çalışma alanı olarak ortaya çıkmaktadır. Oysaki işgücü verimliliğinin arttırılması ile birlikte; büyük yatırımlar sonucu ortaya çıkabilecek mali kayıpların önüne geçilerek bu tasarruf aracılığı ile karlı inşaat projeleri gerçekleştirilebilecektir. İşgücü verimliliğinin ölçülmesi oldukça zorlayıcı olsa da maliyet tasarrufu ve kaynak verimliliğinin sağlanması açısından oldukça önemli ve göz ardı edilmemesi gereken bir faktördür. İşgücü verimliliği; gelişmiş ülkeler tarafından büyümeyi ve refahı teşvik eden bir araç olarak kullanılırken, gelişmekte olan ülkeler için işsizlik, enflasyon ve kaynak kıtlığı durumları ile baş edebilmede vatandaşların yaşamını iyileştirici bir araç olarak görülmektedir.

Bu çalışmanın amacı; inşaat projeleri bağlamında işgücü verimliliğini etkileyen faktörleri belirlemek ve bu faktörleri müteahhitlerin bakış açısından göreceli önemlerine göre sıralamaktır. Bu çalışmada nicel yöntem ve veri toplama aracı olarak anket kullanılmıştır. Bir anket aracılığıyla incelenen 46 faktörün analizi, bazı temel faktörlerin işgücü verimliliğini olumsuz yönde etkilediğini ortaya koymaktadır. Bu faktörler; işçilerin fiziksel yorgunluğu, işçilere yönelik net olmayan talimatlar, işçilerin iş disiplini eksikliği, uygun iş denetimi ve gözetimi eksikliği ile işçilerin iş deneyimi/becerilerinin eksikliğini içermektedir. Bu çalışma sonucunda işgücü verimliliğini etkileyen faktörlerin 7 gruba ayrıldığı tespit edilmiştir. Bu faktörlerden bazıları; İşgücü ile ilgili faktörler, Saha ile ilgili faktörler, Dış kaynaklarla/etkenlerle ilgili faktörler, Motivasyon ile ilgili faktörler ve daha fazlası şeklinde listelenmektedir. Ayrıca araştırma sonuçları incelendiğinde işgücü verimliliği

üzerinde, en fazla etkisi olan faktörün 72,75 göreceli önem endeksi ile İşgücü kaynaklı faktörlerin olduğu; en az etkisi olan faktörün ise 66,92 göreceli önem endeksi ile Dış kaynaklı faktörlerin olduğu tespit edilmiştir. Bu çalışma aracılığıyla müteahhitler ve inşaat profesyonelleri; işgücü verimliliği üzerinde etkili faktörlerin neler olduğunu daha iyi anlamlandırarak, bu çalışmanın sonuçlarından gerekli önlemlerin alınması konusunda yararlanabileceklerdir.

Anahtar kelimeler: işgücü verimliliği, inşaat sektörü, müteahhitler, inşaat projeleri, verimlilik.

DEDICATION

This thesis is dedicated to God Almighty, the author and finisher of my faith. This is also dedicated to those who have been a constant source of inspiration, love, and support throughout my academic journey.

To my parents, my siblings (KT and Tobi) and my loved one (Oluwatosin Oyekan) for their unwavering encouragement and belief in me, I dedicate this work. Your love and sacrifices have been the foundation upon which this thesis stands.

To my friends, who have stood by me through thick and thin, offering not only their camaraderie but also their belief in my abilities, I dedicate this thesis to you. Your friendship has been a source of strength and joy and has added color to my academic pursuits.

To my Sponsors, HABIT BRAND, DEFILOUD, my boss (Mr Vybes), Your help and support always kept me going. I dedicate this thesis to you. Your assistance and willingness to help me grow has been my source of inspiration.

To my thesis advisor, Ass Prof Dr. Tolga Celik, for their guidance, mentorship, and expertise, I dedicate this work. Your dedication to my academic growth has been a guiding light in this research endeavor.

To all the teachers, mentors, and individuals who have played a part in shaping my academic and personal growth, I dedicate this thesis to you. Your wisdom and guidance have been instrumental in my development.

Finally, to all those who seek knowledge and strive to make a positive impact in the world, may this thesis serve as a small contribution to the collective pursuit of understanding and progress.

ACKNOWLEDGEMENT

To everyone that helped me finish this thesis, I would want to extend my sincere gratitude.

First and foremost, My sincere gratitude goes out to Ass Prof Dr. Tolga Celik, my thesis advisor, for his steadfast support, direction, and mentorship during this scientific endeavor. His knowledge, tolerance, and dedication to quality have greatly influenced the course and caliber of this thesis.

I owe a debt of gratitude to the EMU teachers and researchers, particularly Iman, for their incisive criticism, thought-provoking conversations, and rich academic atmosphere that all contributed significantly to the improvement of the caliber of my work.

I want to express my gratitude to my family for their continuous love, support, and inspiration. Their confidence in me has always served as a source of inspiration.

To my friends, who have been there through the ups and downs of this academic endeavor, I am truly grateful. Your camaraderie and moral support have been a significant source of strength.

Special recognition goes to my brother from another mother, Victor for his outstanding efforts, help and motivation. I really appreciate.

I must also acknowledge the research participants, without whose cooperation and involvement, this study would not have been possible. Their contributions are deeply appreciated.

Lastly, I would like to thank all the individuals and resources, both at EMU and beyond, who have contributed to the development of this thesis in various ways.

This thesis is a culmination of collective efforts and support, and I am grateful to everyone who has played a part, no matter how big or small, in making this research a reality.

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Chapter 1

INTRODUCTION

1.1 Overview and Background

Labor productivity can be described as output per unit of input labor. While unit labor costs are defined as labor cost per unit of output. The economic growth of a sector can be as a result of a rise in employment or due to the efficient work carried out by the employed individuals.

There are various ways to explain productivity. The term "labor productivity" in the construction industry refers to the amount of work induced or placed each workday. The reverse of labor productivity, workday per unit (unit rate) is often used as well (Halligan et., 1994). Talhouni and Horner (Talhouni et al., 1998) expressed that “a well-known approach in the USA and steadily on the rise in the UK is the approach of earned hours. It is dependent on the formation of a number of regular outputs or patterns for every unit operation. Therefore, an amount of earned hours are determined by each unit of work done. Productivity can also be explained as the ratio of earned hours to available hours. The difficulty with this approach lies within the establishment of well-grounded patterns for setting up standards. It is also dependent on the system applied for measuring productivity and on the degree to which report is taken into consideration among every factor that influence it.”

Low productivity can be caused by the ineffective handling of the construction materials. Hence, it becomes essential for contractors as well as construction directors to accustom themselves with the techniques leading to assess the productivity of the equipment as well as the workers in various professions. To obtain the expected revenue from any construction project generally, there is a necessity to have a proper administrative hand on the factors of productivity which make up for the integrated production composition such as equipment, labor as well as cash flow and more. Productivity is commonly described as the ratio of work output to input Aramvareekul and Rojas (2003), in the case whereby output is equal to the level of production. In essence, the Construction Industry Institute (2006) pointed out that productivity was commonly implemented to indicate performance for evaluating a successful construction job due to the fact that productivity is considered to be the most critical and flexible metric used for similar evaluations. This happens because a lot of the activities across the construction field are distinctly labor-intensive, scientists regard labor productivity as part of the best measures of production effectiveness (Aramvareekul and Rojas, 2003; Maloney 1982). The metric is obtaining growing attention in construction while the industry experiences several difficulties associated to its labor force (Allmon et al., 2000; Aramvareekul and Rojas, 2003). In addition, labor productivity is a primary piece of information used to estimate and organize the operations of a construction project through a comparison between substantial and documented productivity. Notwithstanding, this comparison only produces a parallel rate of performance. For instance, if real productivity amounts for 95% of typical historical efficiency, generated rate of yield does not certainly imply that such action is effective, merely that it's performance during the action is corresponding using past or historical norms. In reality, the

functionality between then and now could become greatly ineffective if it's real productivity is less than the ideal productivity (Mani et al., 2014; Kisi., 2014). To prevent such case, a numerical and empirical measure would be beneficial to productivity evaluations. In relation to labor productivity, total productivity as well as optimal productivity, different researches have been conducted (Aramvareekul and Rojas, 2003; Rojas and Son, 2011; Sakarcan and Thomas, 1994).

1.2 Problem Statement

The construction industry assumes a crucial role in driving economic advancement, improving infrastructure, and enabling urban growth. Within this domain, the effectiveness of labor holds significant importance in shaping project consequences, including achievements, cost-effectiveness, and timely project completion. However, numerous factors impact labor efficiency within the sphere of construction management. To confront these challenges and enhance labor efficacy, it becomes vital to thoroughly analyze the fundamental elements that influence labor productivity in the context of construction management.

Irrespective of the several efforts put into the research, challenges experienced by present ones are as follows:

- The need to tackle the several and concurrent factors influencing productivity.
- The lack of ability to support internal assessment of named factors.
- The dependence and desire for sizable data collections used in the model, enhancement and sampling as well as the inflexibility in adjusting models to fit several project conditions and various factors.

The complex interplay of factors such as project management strategies, workforce competencies, integration of technology, allocation of resources, communication approaches, and external environmental conditions profoundly shape labor efficiency and efficacy in construction endeavors. Gaining a comprehensive understanding of the interconnections between these factors and assessing their individual importance empowers stakeholders in the construction sector to formulate targeted approaches aimed at amplifying labor productivity and attaining comprehensive project success.

This study aims to provide construction managers, contractors, clients, consultants, and academic researchers with useful insights by thoroughly examining these essential components. These revelations have the capacity to direct the creation of informed plans and ideal procedures. This investigation's ultimate goal is to promote construction management techniques, which will lead to increased worker productivity, decreased project delays, more effective resource utilization, and improved project outcomes. Availability of resources, absenteeism, availability of health and safety training, delay in the movement of equipment or material and availability of power tools were discovered to have a great effect on labor productivity (Ahmed et al., 2014). The safety measure is almost impractical with the absence of management dedication (Thanet and Hadikusumo, 2008). In general, substandard working condition as a result of safety and health related problems influence labor productivity (Abrey and Smallwood, 2006). In addition, financial challenge faced by the owner, delay in availability of resources, repairs and repletion of projects and unfavorable weather will bring about terrible effect on labor productivity on site (Attar et al., 2012).

1.3 Research Questions

The overall cost of a project is significantly impacted by labor productivity (Liu et al. 2011). Increasing worker productivity is crucial to completing construction projects successfully and creating significant value for both the client and the business. It will as well help the company to improve total production, because of this, boost commitment to development of the national financial system. Thus, this thesis intends to tackle the following questions:

1.What are the factors that affect construction labor productivity?

2. What impact does the identified Factors on labor productivity have on Construction Workers?

3.What are possible guidelines to enhance labor productivity?

1.4 Aim of Study

Factors which influence labor productivity needs to be examined and analyzed to enhance construction standard in relation to labor and management problems as well (Chandana et al. 2012; Mahesh, 2012). Therefore, to the best of Author's knowledge there is an evident gap in previous literature and eventually, this study aimed at identifying, examining and analyzing factors which influence labor productivity on building projects. This would be done through reviewing several previous articles on labor productivity. Furthermore, to investigate whether there were strong relationships between these factors and productivity. A questionnaire would be implemented to highlight the relationships between the factors found and how they affect labor productivity. In addition, to rank the mentioned factors according to their severity. Rank analysis will be applied to indicate how much impact each factor discovered has on labor productivity. According to previous studies, the most notable

factors which influenced labor productivity were motivation, the technical skill of the worker as well as other related factors with respect to management.

1.5 Structure of Thesis

This thesis will be divided into five main chapters:

Chapter 1 examines the context, several definitions, ways of measuring, problem statement, and relevant facts pertaining to productivity.

Chapter 2 delves into a comprehensive review of prior research on examining construction labor efficiency by drawing insights from academic articles and literature. This precisely enumerates the diverse factors influencing productivity and further reveals the potential determinants that shape productivity in the construction industry.

In Chapter 3, the research technique is examined, with particular attention to the survey strategy that was used.

Chapter 4 elaborates on the technique of analysis for the study and presents the findings acquired from the web survey.

The conclusions, recommendations, and ideas for additional research are covered in Chapter 5.

Chapter 2

REVIEW OF LITERATURE

2.1 Definition of Productivity in Construction Industry

The term "productivity" embodies the connection between the results produced and the resources invested (Borcherding and Liou, 1986). The interpretation of output and input varies among different industries, and the understanding of productivity adapts when applied to distinct segments within the same industry. In the realm of construction, labor emerges as a fundamental necessity. Typically, labor productivity pertains to the interplay between labor expenses and the quantity of outcomes generated. Stated differently, labor productivity is the amount of commodities and services that are produced by workers in a specific amount of time (Drewin, 1982). Littre's definition of productivity, initially proposed in 1883, was "capacity to produce," which is essentially "the tendency to generate." In 1950, productivity was defined differently by the Organization for European Economic Cooperation (OEEC), which said that it was the output divided by one of the production components (Sumanth, 1984). Various definitions of productivity might be applied, contingent on the particular objectives of the evaluation and the data's accessibility. Productivity, for instance, was defined as "the value of output per hour of labor input" by the US Department of Commerce (Adrian, 1987).

2.1.1 Impact of Labor Productivity on Construction Industry

Productivity holds immense significance within the construction sector. Labor productivity constitutes a significant portion of the input required for production in

construction projects. The construction industry deals with a variety of variables, both internal and external, that are consistently changing and challenging to forecast. This variability leads to continuous fluctuations in labor productivity. Ensuring that a decline in productivity doesn't impact the project plan and schedule becomes crucial to avoid any disruptions. The consequences of such disruptions have the potential to result in substantial financial setbacks. Moreover, substantial cost reductions can be attained by improving productivity, as accomplishing the same tasks with fewer workers can effectively decrease overall labor costs (Thomas, 1991).

Several researchers have presented different explanations with respect to productivity. According to the economic-based model, productivity is referred to as the total factor productivity (TFP), which is the proportion of overall outputs to overall inputs both measured in dollars. While the overall productivity is the ratio of outputs in a physical component to inputs measured in dollars as well defines the project specific-based model. Although the activity-based model is related to the second model, the inputs state is working hours rather than in dollars (Mochtar and Arditi, 2000; Oglesby et al., 1989). El Gohary et al. (2017) carried out a survey for predicting and enhancing the construction labor productivity, this productivity was calculated through the division of overall labor days put in to conclude a project. The above-mentioned definition makes it simple to estimate the total manpower cost. The productivity of construction labor was defined by Park et al. (2005) as input (work hour) per output (quantity). The output rate per unit time or effort unit is how the American Association of Cost Engineers International (AACE International) (2004) defines construction labor productivity. Consequently, all activities are divided into three categories: idle time, direct work, and indirect work (Picard et al., 2004). Several researchers have recognized the factors influencing the construction labor

productivity, which is said to be local and could vary in different projects (Olomolaiye et al., 1998). In addition, the factors affecting construction labor productivity in developing countries are different from the factors affecting this in developed countries (Arditi and Polat, 2005).

2.2 Inputs of Construction

In practical applications, various building methods can be employed, such as Steel framework, precast reinforced concrete structure, cast-in-situ reinforced monolithic concrete, or load-bearing brickwork. Enshassi (2007) identifies key elements influencing the construction process, including Raw materials, workforce, financial resources, machinery and equipment, entrepreneurial efforts, and technology. These aspects play a crucial role in determining productivity outcomes and serve as the primary areas where Project managers have the ability to proactive measures to improve productivity (Heizer, 1990).

Evaluating increased effectiveness in the construction industry involves considering two perspectives: that of the client and the contractor. When analyzed from the client's viewpoint, there is a noticeable rise in productivity translates to cost reduction, shorter construction timelines, better value for money, and improved returns on investments. For the contractor, heightened efficiency results in greater client satisfaction, a competitive edge, faster project completion, and higher profits. (Horner, 2001).

2.3 Outputs of Construction

The construction process on-site results in significant outcomes, including fostering economic growth, promoting capital formation, generating wealth, and creating employment opportunities.

The construction industry in developing countries is anticipated to experience a positive growth trend. This is attributed to the fact that the industry's production capacity is projected to expand in line with the rising demand for physical infrastructure, which typically escalates as the developing country advances (Bon, 1992). Inadequate investment in workforce skills development has contributed to unfavorable productivity outcomes due to a mismatch between the predominantly unskilled labour supply and the increasing demand for skilled workers (RoK, 2003). Kwakye (2000) states that effective supervision by a supervisor is essential to lead, coordinate, and direct the workforce towards achieving group goals. This requires a range of skills, including supervision, human interaction, management, leadership, motivation, and communication. With proficient supervision, site activities are conducted efficiently and cost-effectively, leading to optimal performance from both the plant and labour workforce.

2.4 Productivity in Construction

The construction industry is considered to be the biggest industrial employer across the continent, hiring over 7% of Europe’s labour force (Proverbs et al., 1999). Similar to Europe, the United States' construction industry contributes roughly 14% of the country's GDP and 8% of all jobs (Thieblot, 2002). Turkey's construction industry, which is regarded as one of the most inefficient, continues to use labor-intensive management practices. This leads to extraordinarily high costs for the construction system Gambao et al. (2000), and labour becomes a more crucial input as production moves along. But according to Buchan et al. (1993); Zakeri et al. (1997); Kaming et al. (1998), labour costs account for 20% to 50% of project costs overall. These costs can be effectively managed and decreased by increasing productivity (Kometa et al., 1998). Similarly, the success of a construction firm in

the present-day competitive market is greatly dependent on specific estimation of productivity Ersoz (1999), as well as a moderately proper evaluation of the cost of labour is essential to the efficiency of any rate (Proverbs et al., 1999). Labor productivity is also regarded as one of the most vital risks in construction projects (Tah and Carr, 2001). Labor identifies even the most notable risk to contractors, according to Hanna et al. (1999). Construction sectors in lots of developed and developing nations alike suffer from delays as well as excessive cost as a result of labor productivity (Yates, 1993; Assaf et al., 1995; Kaming, 1997; Chad and Kumaraswamy, 2002; Odeh and Battaineh, 2002). In Turkey, poor labour productivity is regarded as part of the primary reasons for delays (Gurdamar et al., 1985). On the other hand, earlier delays in projects were not often expected. The national economy is significantly boosted by the building sector (Naoum, 2016; Alaghbari et al., 2017). According to Statistics New Zealand (2015), the industry generated 5.2% of the GDP in New Zealand in 2013; in Australia, on the other hand, it contributed roughly 7.7% of the GDP in 2015 (Department of Industry, Innovation and Science, 2015). These figures demonstrate how important the construction industry's productivity is to the expansion and growth of any country's economy (Naoum, 2016). Consequently, through the efficient use of labour and other resources, the construction industry must improve its performance (Thorpe and Hughes, 2014). The construction industry had obtained notable developments through the implementation of modern technologies, resources as well as heavy equipment (Grau et al., 2009; Caldas et al., 2015; Goodrum et al., 2009). Irrespective of these developments, labor productivity still seems complicated; for a period of time, the industry has been faced with the challenges of how to enhance its labor

productivity (Eslamdoost and Heravi, 2015). The construction sector plays a pivotal part in every developed and developing nations alike.

2.5 Influential Factors that Affect Labor Productivity

This table shows the influential factors from previous studies, highlighting several researchers' findings. In this part, the most influencing factors were outlined, the year the survey was taken, the country that was discussed and the total number of factors that were used in the particular study. In addition, this revealed that the number of factors reviewed in each study varied. furthermore, this also showed that some of the top influencing factors were similar across different authors and their survey.

Table 2.1 Influential Factors That Affect Labour Productivity

The top most influencing factors	Author, year	Country	The total of factors
i)Material insufficiency ii)Incomplete drawings iii)Incompetent supervisors iv)Insufficient tools and equipment v) Absenteeism	Arun Makulsawatudom, Margaret Emsley and Kuldej Sinthawanarong (2004)	Thailand	23
i) Labor skill ii) Materials shortage iii) Labor supervision iv) Insufficient experienced labor v) Communication between site management and labor force	Abdulaziz M. Jarkas, Charles Y. Kadri & Jamal H. Younes (2012)	Qatar	35
i) Management (inspection delay) ii) Equipment and tools (lack of adequate tools and equipment) iii) Workers (work safety) iv) External factors (site circumstances and lack of materials)	Emmanuel Bamfo-Agyei et al., (2022)	Ghana	20
i) Material shortage	Enshassi et al.	Gaza	45

ii) Lack of experience iii) Poor supervision iv)Misunderstanding between labor and supervision v) Change orders	(2007)		
i) Payment delay ii) Rework iii) Lack of financial incentives iv) Change orders v) Incompetent supervisors	Jarkas and Radosavljevic (2013)	Kuwait	23
i) Lack of materials ii) Shortage power/water iii) Accidents iv) Lack of machinery v) Poor site conditions	Gundecha (2013)	USA	40
i) Poor planning ii) Material shortage iii) Equipment shortage iv) Lack of labor v) Poor site management	Bekr (2017)	Jordan	37

First step was providing the table above and then elaborating the factors as shown in the table 2.5.

Some of these influential factors include:

i) Employee Training

Employee training benefits are often undervalued. According to Jordan (2006), the US Department of Labour found that apprenticeship training yields an impressive $54 return for every dollar invested. Despite this substantial return on investment, contractors are hesitant to take their workers away from their tasks to allow for

proper training. Additionally, contractors are reluctant to allocate funds for training. As per Jordan's article, contractors spend only 1.83% of their payroll on training, while the industrial sector as a whole spends 2%. Jordan also references a specific study conducted by the University of Florida's Rinker School of Building Construction, which demonstrated a remarkable 42% increase in productivity for a company that implemented comprehensive training efforts (Cox, Issa, and Collins, 1998). Overall, investing in employee training programs would lead to increased productivity and a reduction in costs associated with rework and lost time.

ii) Management Skills

The goal of construction management is to schedule and arrange work and materials such that there are no delays due to labor shortages, material shortages, or incomplete jobs. A solid understanding of modern management practices is necessary for the successful administration of construction projects. Figure 2-4 lists the fundamental elements of a successful project management. It is essential to possess knowledge in general management principles and specialized domains, with additional benefits coming from expertise in supporting disciplines like computer-based information systems (Hendrickson, 1998). Research conducted at the Center for Construction Industry Studies at the University of Texas at Austin revealed that poor management accounted for more than half of the time wasted on a construction site. The presence of efficient management is crucial for a construction project to achieve profitability and success (Tucker, 1999). Effective management skills involve adopting a performance-based approach, which includes prioritizing improvements, implementing cost-efficient and user-friendly methods, fostering a supportive labour-management relationship, and finding ways to reduce costs while increasing profits (Alfred, 1988).

iii) Site related factors

Accidents exert significant influence on labor efficiency. Diverse types of accidents transpire at the construction site, including incidents leading to fatality that trigger a complete halt in work for several days. Injuries demanding hospitalization also result in reduced workforce capacity for the affected team. Minor mishaps stemming from elements like nails and steel wires can bring work to a standstill, consequently diminishing overall productivity (Sanders and Thomas, 1991). Inadequate lighting similarly results in reduced productivity as it hampers efficient work due to the necessity of proper illumination and the adverse effects of insufficient lighting. The engagement of a safety officer aids workers in comprehending essential safety protocols and adhering to them, ultimately curbing accident occurrences and elevating productivity levels.

iv) Workforce Optimization Strategies

The workforce in an organization represents the human aspect, encompassing intelligence, proficiency, and skillsets which give distinctive identity to the organization. These human elements have the capacity to learn, adapt, innovate, and provide creative energy, which, if appropriately motivated, ensures the organization's long-term survival. As per Armstrong (2006, p.259), strategic management entails implementing, adjusting, and guiding processes in a manner that equips individuals and teams with the necessary skillsets, insight, and competences to handle both current and future organizational tasks. Management strategies aim to enhance labour productivity by promoting a culture of learning that fosters constant development within the construction sector. This can be accomplished by enhancing managers' capabilities by training, leading to creation of knowledge as well as an overall broadening of the overall learning capacity within the organization. Various parties

like contractors, sub-contractors, consultants, and clients are involved in a construction project. Effective coordination among these distinct parties is essential for smooth operation. According to Assaf et al. (1996), challenges in coordinating among these parties contribute to a decline in labour productivity. For instance, delays in issuing revised construction drawings to subcontractors can lead to construction errors and subsequent rework, which negatively impacts labour output and project efficiency. Sambasivan and Yau (2007) point out that in developing countries like Malaysia, many workers in the construction industry have limited formal education. Therefore, effective coordination becomes even more crucial to guide and instruct them properly to perform their work accurately. Without proper coordination, construction projects can suffer from low productivity due to rework and inefficiencies.

v) Temperature/ Humidity

Weather can be somewhat unpredictable, and when not appropriately scheduled, it can lead to delays and damages, resulting in rework. Poor weather conditions can cause a decrease in productivity for various reasons. Certain construction processes are adversely affected by suboptimal weather, such as decreased efficiency in mortar and concrete usage. Moreover, labor is also hindered in unfavorable weather conditions, as workers may need to wear weather apparel like raincoats or heavy jackets, which can impede their work (Mincks and Johnston, 2003). Hot weather, in particular, has both physiological and psychological effects on workers, making them feel restless and irritable.

vi) Project related factors

In the course of projects, it's common to encounter alterations in design, drawings, and specifications during construction. If these drawings or specifications contain

errors or lack clarity, it's anticipated that productivity will decrease, as on-site labrers become uncertain about the tasks at hand. Consequently, tasks might face delays or even temporary cessation, awaiting clear instructions. When modifications to work are underway, a reduction of around 30% in productivity has been observed (Thomas et al., 1999). It is crucial for a supervisor to inspect the work, serving as an essential step for progress. For instance, before concrete can be poured, an examination of the formwork and steelwork is required to ensure proper execution, as this directly impacts labor efficiency (Zakeri et al., 1996). When tasks aren't carried out in alignment with specifications and drawings, supervisors might demand the reworking of particular assignments. The absence of supervisors can bring work to a complete halt for tasks necessitating their oversight, like concrete casting and backfilling. This absence further delays the assessment of completed tasks, subsequently postponing the commencement of new tasks and adding to overall project delays.

vii) External Factors

Weather conditions play a crucial role in the successful completion of construction projects. Unfavorable winter weather, characterized by elements like strong winds and heavy rainfall, can lead to decreased productivity, especially for outdoor tasks such as formwork, T-shape work, external painting, external plastering, external tiling and concrete casting. In some cases, adverse weather conditions can even bring the work to a complete halt (Sanders and Thomas, 1991).

viii) Labor related factors

Available literature highlights that a lack of labor experience negatively impacts labor productivity, emphasizing the crucial role of skilled labor in achieving positive productivity outcomes. Contractors should employ sufficiently skilled laborers in

order to increase productivity. If skilled labor is not accessible and there is a requirement for a contractor to deliver a particular assignment with less-skilled labor, the probability that productivity will be affected is high. Effective productivity within construction projects relies on contractors employing adequately skilled laborers. Should skilled labor be scarce and a contractor compelled to use less experienced workers for specific tasks, it becomes likely that productivity will suffer. The unavailability of any member of the crew can hinder the overall production rate of the team, given the limited resources and varied team composition, often leading to reduced production rates. Conflicts stemming from misunderstandings among laborers concerning responsibilities and work boundaries contribute to heightened errors and a decrease in labor productivity. Furthermore, insufficient compensation and advancing age of laborers exert adverse effects on labor productivity due to the gradual decline in speed, agility, and strength over a period of time, consequently reducing efficiency (Heizer and Render, 1990).

ix) Motivational factors

Motivation is considered to be a critical factor that significantly impacts the efficiency of construction labor. Successful motivation occurs when the personal goals of workers align with the company's aims. In this context, factors such as payment delays, the lack of a strong financial incentive structure, insufficient transportation arrangements, and a shortage of training opportunities are consolidated (DeCenzo and Holoviak, 1990).

According to Cooper (2004), motivation serves as the propelling force that guides individuals' actions at work, acting as the catalyst behind their desire to fulfill the requisites and desires of the workplace. Effective leaders often consider factors that evoke inspiration, such as commendation, acknowledgment, and self-respect.

Motivation molds people's conduct, nurturing a committed and enthusiastic atmosphere within the work milieu. Cooper (2004) suggests various approaches to amplify workplace motivation, encompassing ensuring a secure work environment, recognizing positive behavior and achievements, expressing gratitude, fostering collaborative teamwork through cooperation and coordination, addressing employees' self-esteem, ensuring job security to alleviate concerns and enhance enthusiasm, establishing feasible objectives, setting up equitable compensation systems, and providing comprehensive training schemes. The triumph of an organization relies on members' motivation to optimally exploit their skills, channeling their endeavors toward relevant duties. Various factors can contribute to employee demotivation. One strategy for cultivating employee motivation involves empowerment. Lacking enthusiasm among employees can lead to reduced productivity, marked by extended periods of inactivity and decreased focus. Each organization is committed to discovering strategies for sustaining heightened performance levels through its workforce.

2.6 Identification of the Most Influential Factors Related to Labor Productivity

Several surveys have been carried out in relation to construction labor productivity. According to Mincks and Johnston (2010), different variables can have an impact on the labor productivity of a project. There are a number of 13 factors which influence productivity, according to Naoum (2016). The work percentage done by subcontractors, site design, construction data complexity as well as managerial quality were all part of the 13 criteria which is referred to as the management component. With respect to the workers, it is necessary to take into consideration their degree of training and professionalism and also their total size, structure as well

as the number of projects they carry out while at work. An essential factor in building a supportive working environment is influencing the way workers carry out their day-to-day projects and the time duration.

Five factors have been identified as factors that influence labour productivity which include employees (safety at work), tools and equipment (shortage of required tools and equipment), management (assessment delay), and also external factors such as site conditions and insufficient resources. As mentioned by the authors of Hanna et al. (2005), the most notable risk to the constructors is the probability of losing output as a result of a shortage of required resources, labour force and equipment. Construction productivity in Thailand is greatly influenced by several factors which include a disorganized site structure, long instruction periods, also a shortage of complete drawings, long assessment hours as well as insufficient materials and shortage of efficient administrators as highlighted in (Makulsawatudom and Emsley, 2003; Sinthawanarong et al., 2004). When it came to deciding what components were the most significant, it was limited by insufficient equipment and tools, absence of workers and work-based settings for remodel. According to Soekiman et al. (2011), the following factors have been identified to greatly affect labour productivity like delays in the arrival of materials and the lack of such materials, which were underlined as two challenges in this category. There were several problems, in terms of management, like work strikes, a shortage of oversight, changes in design, inconclusive instructions assigned to workers, financial problems as well as administrators who were more probable to be unavailable than the employees themselves.

The availability and quality of equipment and tools was found to affect productivity. A survey of the factors which influence the worker efficiency in construction was carried out by Ayodele et al. (2011). There exists a solid agreement in Nigeria that administration and leadership (insufficient payment settlement done, insufficient experience and administrative training) and resources (lack of resources as a result of changes in schedule, extended wait times, and product shipment. ambiguity as well as insufficient logistics) are important factors affecting productivity. Worker administration, the lack of leadership from project supervisor, and the level of modification requests during the performance were identified as the three organizational elements which had the most effect on labour productivity as stated by the authors Gupta and Kansal (2014), who gave attention to the relative importance index. The construction technique was integrated in the work-based setting component. Payment's delay, lateness, employee fatigue, leaving early and consistent unplanned breaks, and labour skill as well as the presence of professional workers were all identified as factors which has an effect on the productivity of the labour force. According to Shashank et al. (2014), five key components affect the fluctuation of productivity in the labour force. Equipment, tools, workers, administration, resources as well as work-based settings were part of this. The discoveries connected with labor productivity across the construction sector are greatly dependent on surveys in developed nations; not so much knowledge concerning labour productivity in developing nations. This is observable by the use of task frameworks generated in Thomas and Sakarcan, (1994) and the modeling systems generated in Zayed and Halpin (2005). Furthermore, in comparison to researches carried out in rich countries, the few researches that focused on developing nations does not seem to efficiently provided an analysis of the concept

of labour productivity. With relation to efficiency of labor in construction within emerging nations, irregularities will appear in the discoveries and the use of frameworks created for growing nations which are also employed in evolving countries (Cetindamar and Kilitcioglu, 2013). In the construction industry, skilled labour plays a crucial role as it integrates all available resources to manufacture diverse construction products such as roads, dams, and buildings. Thomas (2004) highlighted that only a portion of an operative's time, ranging from a third to one and a half, is spent directly on productive work, while the remaining time is spent awaiting the arrival of materials, equipment, and directions received from supervisors. Effective labour control becomes pivotal for any organization, as labour costs are highly susceptible to fluctuations, elevating it into a competitive advantage recognized as "Intellectual capital.". Productivity, Generally, it is widely defined as the correlation between the output generated by a system and the amount of input factors employed to achieve this outcome (Mbiti, 2008). The result can be any outcome of a procedure, such as a service or product, contributing elements encompass the human and physical resources used in the procedure. Enhanced efficiency within the construction sector yields benefits for both consumers and contractors. From the consumer's viewpoint, increased productivity leads to cost reduction, shorter construction schedules, improved value for money, and better returns on investments. For contractors, increased productivity results in higher customer satisfaction, a competitive edge, quicker project completion, and augmented revenue (Horner, 2001).

Labor productivity, according to Jergeas (2009), refers to the relationship between the actual labor utilized and the resulting output during service provision or product manufacturing.

Alum and Lim (1995) assessed several factors that have an effect on construction productivity in Singapore and outlined the following as the most notable: unavailability of qualified managers, insufficiency of skilled labour, work absence, high rate of work turnover as well as communications with foreign workers. Zakari et al. (1996) identified the five following factors as critical to operational effectiveness when highlighting the constraints on Iranian construction productivity: insufficient materials, weather and site conditions, equipment malfunction, drawing deficiencies or order changes, and insufficient tools and equipment. When Kaming et al. (1997) looked at what factors affected the productivity of skilled workers in Indonesia, they found that a lack of necessary instruments, rework, absence of operators, and resource scarcity were among the most important ones. According to Alinaitwe et al. (2007), some factors were shown to have the greatest influence on the productivity of skilled workers in Uganda.Rojas (2003) conducted a study on factors impacting labor productivity in the U.S. construction industry, revealing that the most influential factors on labor productivity are management systems, strategies, and manpower considerations. Rojas' research indicates that the factors affecting labor productivity differ significantly between developed and developing countries. In developed nations, management factors strongly influence labor productivity, while in developing countries, the lack of training and skills is the predominant factor. Another U.S. researcher, Schwarzkopf, explored productivity-related aspects like rework, worker performance, and motivation, underscoring the significance of labor efficiency in construction, which is defined as the amount of work achieved for every unit of labor.

Accurate measurement of construction productivity is vital for assessing tasks and determining the cost per labor hour. Higher productivity implies increased

production with the identical input. As per Olomolaiye (1998), construction site managers serve as crucial decision-makers influencing labor productivity. Worker efficiency is substantially impacted by management strategies related to supervision, motivation, and the prompt delivery of materials and equipment. Adequate training of site management personnel in skills such as planning, scheduling activities, and resource coordination can positively affect these aspects.

Wachira (1999) identifies several systemic issues plaguing the Kenyan construction industry, including flawed management practices, inadequate wages, unskilled labor, communication breakdowns, delayed material deliveries, insufficient welfare provisions, worker demotivation, skill gaps, and a lack of research and development. He proposes comprehensive training for the site management personnel, including contractors, site managers and foremen to address these issues. This training should focus on enhancing management skills in planning, scheduling, project coordination, supervision, control and worker motivation.

Makulsawatudom (2001) identified eight critical factors that significantly impact labor productivity in the Thai construction industry, including inadequate materials supplies, incomplete construction plans, excessive worker congestion, substandard site conditions, ineffective supervisory practices, rework due to defects and communication breakdowns.

Kaming (1997) identified eleven factors influencing productivity in developing countries like Indonesia, including the lack of materials and proper tools, equipment breakdowns, rework, changes in workforce, extended working hours, employee

disturbances, changes in foremen, delays in supervision, congestion, and employee absenteeism.

In Tanzania, Lema (1995) examined elements influencing the efficiency of construction workers in the field of building construction and found that financial incentives, degree of automation, wages, level of expertise, non-financial incentives, and the effectiveness of on-site management were key factors impacting productivity.

Barrie (1992) discovered that construction labour productivity can greatly vary depending on qualitative factors such as differences in geographic and local factors, the curve of acquiring knowledge, work timetable and guidelines, ecological consequences, crew proficiency, and managerial considerations.

Thomas et al. (2004) identified productivity factors in their analysis comparing the labour productivity in seven countries as it affects different projects. Part of these factors included manpower and labor supply, total workload, design characteristics, environmental elements and weather conditions, construction methods, project organization, project traits, management protocols and supervision, and daily documentation.

In addition, the five following factors were outlined to be the most important: shortage of skills, shortage of tools and equipment, rework, ineffective administrators as well as poor construction techniques. Dai et al. (2009) evaluated skilled workers' viewpoint of 83 factors which influenced their productivity in nationwide research that involved 1996 skilled workers across the United States. Emphasis was placed on

factors related to resources, tools, and consumables, as well as the management of engineering drawings and construction equipment. as having the prominent effect on productivity from the skilled workers' point of view. Heravi and Kheirieh (2011, 2010) recognized 45 factors with the most effect on labour productivity in the South Pars Gas Field development of Iran and classified them into four primary groups: human, management, technical as well as external factors. Hence, it is essential to explore several researches to discover the influencing factors in various projects. El Gohary et al. (2017) examined the factors impacting the construction labour productivity in shuttering and supporting steel attaching crafts for several types of the strengthened concrete foundation of private and commercial buildings. They discovered an estimated 29 affecting factors which include incentive programs, skill and work experience, availability of the required resources and ability to handle them as well as leadership and efficiency of construction organization and these are regarded as the most essential ones for formwork crafts. Bitar and Jarkas (2012) explored about 45 factors, separated into four primary groups affecting the construction labour productivity on construction sites in Kuwait. Their results showed that administration, tools, weather, planning, motivation and incentives and resources have the greatest influence on labour productivity. From the factors assessed, the following 10 were mentioned to be the most important in their impacts on labour productivity: the level of variation/change orders during application, shortage of labour management, level of design complexity, coordination level among design control, clarity of technical details, shortage of incentive program, inadequacy of construction manager's leadership, delay in response to information requests, rate of work subcontracted and tight observation by the engineer. Heravi and Eslamdoost (2015) provided a much more comprehensive analysis and review of

literature from researches through discovery and assessment of factors influencing construction labour productivity.

2.7 Gaps of Previous Study

The previous literatures that were studied, mainly discussed factors that affect labor productivity. This paper highlighted and discussed the most influential factors and it suggests that focusing on the most influential factors would greatly help in improving labour productivity. There are no current studies on factors that affect labour productivity with regard to TRNC and as a result, this paper greatly focused on the construction management in TRNC. While the examination of existing literature offers understanding into diverse elements that impact labour efficiency within the construction sector, this study identifies the existing distinct factors or obstacles particular to the TRNC's construction industry such as the extreme weather conditions and more.

Chapter 3

METHODOLOGY

3.1 Introduction

The examination of the influential components contributing to labor efficiency within the scope of construction management represents a foundational cornerstone of this thesis. As the construction sector undergoes continuous evolution, understanding the factors shaping labor efficacy progressively emerges as a pivotal factor for achieving positive project outcomes. This chapter outlines the methodology employed to investigate and analyze the intricate factors that impact labor productivity in the realm of construction management.

The primary objective of this research is to uncover the complex interplay of factors that affect labor productivity and to identify strategies that can be employed to enhance effectiveness in construction projects. To achieve this objective, a systematic research framework has been developed, encompassing the stages of data collection, analysis, and interpretation. This section provides a summary of the research design, methods of data collection, approaches to data analysis, and the comprehensive strategy undertaken to explore the pivotal influences on labor productivity within the context of construction management.

By utilizing a comprehensive approach, this research endeavors to present significant viewpoints within the construction management field. Its objective is to deliver an

encompassing understanding of the elements driving labour efficiency in construction projects, bringing advantages to practitioners, academics, and stakeholders. The subsequent segments delve into the specific measures and techniques embraced to achieve the research objectives, shedding light on the fundamental factors impacting labour productivity within the context of construction management. In this chapter, the approach employed for gathering, examining, and presenting data is expounded upon. The discussion is structured into three subsections, which include population, sampling and research design.

Figure 3.1: Research Flowchart

3.2 Review of Literature

A study was carried out with regards to labor productivity in construction industry. From this study, the literature is analyzed and the different factors influencing labor productivity are outlined. Furthermore, these factors are used to create a questionnaire to be discussed in later parts.

Table 3.1: Factor Group and Factors of Relevant Literature

Factor group		Factors	Relevant Literature
Labour	i.	Physical fatigue of the labour	(Enshassi et al., 2006) (Jarkas and Bitar 2012), (Durdyev et al. 2018), (Hwang et al. 2017), (Kazaz et al. 2008)
	ii.	Lack of labour discipline	
	iii.	Lack of Labour Experience/ Skills	
	iv.	Working Without Days Off	
	v.	Extra overtime working	
	vi.	Age of Labour	
	vii.	Labour Low Education Level	
Technology / Construction / Material	i.	Poor choice of material quality	(Elias Boutros Sayah, 2017), (Enshassi et al. 2007), (Durdyev et al. 2018), (Soekiman et al. 2011) (Jarkas and Bitar 2012), (Hwang et al. 2017), (Soekiman et al. 2011)
	ii.	Inexperienced machinery operatives	
	iii.	Lack of labour adoption with new technologies	
	iv.	The inefficiency of equipment used on the construction site	
	v.	Inappropriate supply chain	
Site related factors	i.	Inappropriate site layout planning	(Ghoddousi and Hosseini 2012), (Durdyev et al. 2018) (Enshassi et al. 2007) (Olomolaiye et al., 1987)
	ii.	Inappropriate storage place on the site	
	iii.	Inappropriate resting place for labours	
	iv.	Lack of transportation facility to the site location	
	v.	Quality of lighting at the construction site	
	vi.	Adverse weather conditions	
	vii.	Poor ventilation at the construction site	
	viii.	Working within a confined space	
Project related factors	i.	Inaccurate provision of project's specifications and readable drawing	(Olomolaiye et al., 1987) (Hai & Van Tam, 2019) (Srinavin &
	ii.	Project complexity	
	iii.	Repeated rework due to the contractors, consultants, or	

		client's fault	Mohamed, 2003)
External factors	i. ii. iii. iv.	Volatile economic and political environments Labour absenteeism Impact of other workforce members on the productivity of other labours Labour strike	(Lim and Alum, 1995) (Hiyassat et al. 2016), (Durdyev et al. 2018), (Abdul Kadir et al. 2005)
Management	i. ii. iii. iv. v. vi. vii. viii. ix. x. xi. xii. xiii. xiv.	Lack of labour training sessions Lack of labour surveillance/ Supervision Emphasizing following the health and safety precautions Lack of supervisors experience Communication issues with foreign workers Late inspection of Completed sub-projects Unclear instructions to the labours Lack of periodic meetings with the labours Unrealistic scheduling and expectation of labours performance Inappropriate selection of crew size and composition Unexpected variation or Change-order during execution Delay in responding to labour request for information Difficulties in exchanging information between the site management and the workers Lack of appropriate labour inspection or supervision	(Ghoddousi and Hosseini 2012), (Durdyev et al. 2018), (Hiyassat et al. 2016), (Elias Boutros Sayah, 2017), (Soekiman et al. 2011), (Abdul Kadir et al. 2005)
Motivation	i. ii. iii. iv.	Lack of Promotion opportunities Lack of creating competition among labours Lack of enough attention to the labour personal issues Lack of provision of a satisfactory environment for labours	(Shiru et al., 2020) (Lim & Alum, 1995) (Mahamid et al., 2013) (Van Tam et al., 2018) (Srinavin &

	v. Lack of incentive and recognition programs	Mohamed, 2003)

3.2.1 Population

In line with Mugenda and Mugenda's (2003) definition, the term "population" refers to a comprehensive collection of individuals, events, or objects sharing common observable traits. This study's target population, the specific group to which the findings are intended to be generalized, comprises contractors operating in the united states, the United Kingdom, Nigeria, the Turkish Republic of Northern Cyprus (TRNC), and Cyprus. A total of 140 contractors engaged in on-site labor agreements or working on sites in these countries participated in the survey. The on-site survey involved technical staff from these contractors, including construction managers and consultants.

3.2.2 Sample Size

The methodology employed in this study involved a non-random purposive sampling approach, which allowed for the intentional selection of specific individuals whose characteristics aligned with the research objectives. The initial plan was to have a sample size of 300 (across contractors, construction managers, clients, academic experts and consultants) from the construction industry, chosen based on factors such as manageability, feasibility, and statistical reliability. However, the final sample size surpassed the target, reaching a total of 335 participants. This increase in participants strengthened the research data's robustness and representativeness. Among these participants, there was a diverse representation of the construction industry…. This breakdown of participants further enriched the study, facilitating a comprehensive examination of the factors which affect labor productivity;

$$n = n'/[1 + n'/N)] \quad (1)$$

Where:

- n: The overall population
- N: Number of Sample drawn from a limited population
- n': The Sample size drawn from an endless population
- S2 /V S 2 : Variance of the population elements and
- V : The sampling population standard error

The equation represents the relationship between the sample size from a finite population (N) and the sample size from an infinite population (n') based on the variance of the population elements (S^2) and the standard error of sampling population (V).

3.3 Design of Questionnaire

A structured questionnaire design was created to support research and data collection efforts, involving the construction of an organized set of questions intended to gather information from participants. The questionnaire consisted of some questions with a clear format and others with more flexible responses which were distributed among contractors and construction managers on active building projects. This approach aimed to gather comprehensive and elaborate information, providing a broad basis for describing the variables under consideration. The questionnaire was designed to ensure the collection of sufficient, complete, and unbiased information, thereby optimizing the data's reliability.

The researcher created surveys that included some open and closed questions alike. This approach aimed to gather comprehensive data that covered various aspects and offered a strong foundation for describing the variables being studied. The collected

information was unbiased, complete, and accurate, enhancing the data's reliability. Thus, the aim was to guarantee the clarity of the questions, relevant, and capable of generating accurate and meaningful data. The factors influencing labor productivity within construction projects were determined by analyzing existing research literature. To ensure accurate comprehension by respondents during primary data collection, a pilot survey was carried out. Based on feedback from pilot study participants, some adjustments were made to the questionnaire. Certain questions were revised, added, or removed based on insights gained from the pilot study. The questionnaire was divided into two sections: Section 1 gathered responses related to respondents' background, including experience, job profile, and education level, while Section 2 covered the assessment of 46 factors influencing labor productivity in construction.

The structured questionnaire was composed of two main parts which delved into respondents' background characteristics and factors likely to impact management strategies for construction site productivity.

The first section contained background information which included the number of years of experience, professional background, and status within the firm. The analysis of background information was based on frequency percentages. The respondents were provided with options to choose from. The Likert scale is a tool used to gauge agreement or disagreement with various statements. The scale chosen for this study was 1 to 5 due to the research level and participant background. This section of the questionnaire instructed participants to rank the factors affecting labor productivity using a scale where a rating of "1" represented negligible impact, "2"

indicated minor impact, "3" denoted moderate impact, "4" reflected significant impact, and "5" signified severe impact.

The surveys were distributed to respondents at construction sites, offices and also distributed to online respondents via email. Respondents completed the questionnaires themselves, contributing to a high response rate.

Surveys are valuable for quantifying beliefs and actions or for statistically comparing perceptions and behaviors across diverse groups in a representative sample. Self-administered questionnaires are popular due to their ease and the freedom they provide respondents to express their views openly.

3.3.1 Survey Administration

The data was collected from distributing the questionnaire to respondents who took part in the survey both from onsite and online. The online method was adopted so as to reach larger number of respondents.

3.3.2 Descriptive Analysis of the Collected Data

The first section of the questionnaire that was focused on background information which included the number of years of experience, professional background, and status within the firm. The analysis of background information was based on frequency percentages. The research implemented Frequency analysis to get information of socio demographic profile of respondents.

3.4 Rank analysis

Rank analysis involves the evaluation of the relative significance or importance different items or choices listed. It is a method used to organize and rank items based on their perceived importance. Participants are invited to rank items based on their

preferences, allowing researchers to determine the most and least favored selections. This method provides valuable insights into both individual and group preferences, assisting in decision-making, conducting market research, and understanding tendencies across various fields.

In this study, the several factors affecting labor productivity in construction industry as discussed were selected, grouped and ranked from highest to least in order of the severity of its impact on labor productivity.

3.5 Calculate Relative Importance Index

The method applied to analyze the findings of the survey was Rank analysis. Placing the various factors in ranks with respect to their significance, and determining their Relative Importance Index (RII).

The study calculated the relative importance index based of the responses from each factor group received using the formula;

$$\text{Relative Importance index } (\text{RII}) = \Sigma w / \text{A} \times \text{N} \quad (2)$$

Where:

W = weighting as assigned by each respondent on Likert's scale, ranging from 1 to 5, with 1 representing negligible impact, 2 representing minor impact, 3 representing Moderate impact, 4 representing significant impact and 5 representing severe impact,

A = the highest weighting assigned among all respondents and

N = the total number of respondents.

3.5.1 Relative Importance Index for Factor Groups

To find the relative importance index for each of the factor group, there was a summation of all the values from each of the groups and then the average of each

factor group was calculated and then ranked the importance according to the values gotten from highest to lowest.

3.5.2 Prioritization of the Influential Factors

In this section, after calculating the relative importance index using Excel, the values gotten were used to rank each of the factors influencing labor productivity in each of the factor groups, 46 factors were discussed and ranked in this study. Using the values gotten from each of the factors affecting labor productivity to rank the general factor group which were 7 of them discussed in this paper.

3.6 Summary of Methodology

The research in this paper utilized a survey methodology, specifically an illustrative pattern. The selection criteria for those to participate in this survey were based on their expertise in the construction field, which was obtained from collection of biodata before administering questionnaires. Contractors involved in active projects in road/transportation, building/structure, and water management were included in the sample. To gather labor-related data, information on task performance and planning, essential for job productivity and policy matters, was collected from contractors and operatives. According to Mugenda and Mugenda (2003), a survey is characterized as an endeavor to gather information from a community of people with the aim of assessing the present condition of the population concerning one or more variables. Surveys offer significant advantages as they give out data about the population of people with minimal efficiency and cost-effectiveness. Analysts can obtain data from a subset that represents the entire group of people.

This chapter expounded upon the pattern of the research, methods of gathering data, and analytical processes employed in the analysis. The methodological steps

encompassed aspects such as defining the population selected for the study, determining the appropriate sample size, and selecting suitable methods for sampling. These processes collectively laid a robust groundwork for obtaining credible and dependable data. The subsequent chapter will disclose the outcomes of the data analysis garnered from the fieldwork. The quantitative analysis involved utilizing Statistical Packages, with Microsoft Excel 2016 (Windows version) being specifically employed to create graphs, tables, and pie charts. This aided in depicting response frequencies as percentages, facilitating interpretation and comprehension. As for the qualitative data, an approach encompassing description, organization, categorization, and thematic grouping was used for analysis. The findings were then presented through frequency tables indicating percentage distributions and a variety of visual aids such as charts and figures.

Chapter 4

ANALYSIS, RESULTS AND DISCUSSIONS

4.1 Introduction

The purpose of this study was to investigate the critical factors that hinder labor productivity in the construction industry. To achieve this goal, a comprehensive methodology combining a literature review and evaluation of construction projects was employed. This chapter delves into the findings derived from analysis of the dataset, interpreting them in accordance with the study's objectives.

4.2 Demographic Data of the Participants in Construction Sites

In this section, the demographic data of the participants is illustrated under the category of Gender, Age, Level of Education, Position in the construction field, Experience Level and Sector.

Table 4.1 Number of Participants Based on their Gender

Gender	Frequency(f)	Percentage(%)
Male	297	88.7
Female	38	11.3
Total	335	100

From the findings of Table above, it shows that majority of the respondents are Males having a percentage of n=88.7%, while the females are n=11.3%. This tables shows that more male participated in the study than females.

Table 4.2 Number of Participants Based on their Age

Age	Frequency(f)	Percentage(%)
Below 30	103	47.2
30-40	158	30.7
40-50	45	13.4
Above 50	29	8.7
Total	335	100

In Table above, the age distribution of the participants is depicted. From the response that was given by the respondents, the age range of 30-40 had the highest percentage of n=47.2%, below 30 had a percentage of n=30.7%, 40-50 had a percentage of 13.4% and finally, above 50 had a percentage of n=8.7%.

Table 4.3 Number of Participants Based on their Educational Level

Educational Level	Frequency(f)	Percentage(%)
Bachelor Degree	268	80.0
Master's Degree	56	16.7
Ph.D. or higher	11	3.3
Total	335	100

In table above, the level of education is depicted. From the response from the respondents, it can be seen that majority of those that participated in the research had attained at least a Bachelor's degree with a percentage of n=80%. Following this, Master's degree had a percentage of n=16.7%, and finally, Ph.D. or higher had n=3.3%.

Table 4.4 Number of Participants Based on their Company Position

Company Position	Frequency(f)	Percentage(%)
Construction manager	137	40.9
Consultant	65	19.4
Client	46	19.4
Contractor	65	13.7
Academic Expert	22	6.6
Total	335	100

This data presents the categories of positions occupied by respondents that participated in the survey. The findings reveal that Construction managers had the most responses, accounting for 40.9% of the total responses. This is followed by a tie between Consultants and Contractors with 65 respondents, representing 19.4% of the total equally, and Clients with 46 respondents, making up 13.7% of the total. In contrast, Academic experts have the lowest number of respondents with only 22 responses, representing only 6.6% of the total.

Table 4.5 Number of Participants Based on their Experience Level

Experience Level	Frequency(f)	Percentage(%)
Less than 1 year	15	4.5
1-5 Year	144	43.0
6-10 Years	86	25.7
11-15 Years	49	14.6
Over 15 Years	41	12.2
Total	335	100

This data displays the Experience level attained by respondents that participated in the survey. The findings reveal that 1-5 years had the most responses, accounting for 43% of the total responses. This is followed by 6-10 years and 11-15 years with 86 respondents, representing 25.7% of the total and 49 respondents with 14.6% respectively, and over 15 years with 41 respondents, making up 12.2% of the total. Respondents with 15 responses, representing only 4.5% of the total had less than 1 year of experience.

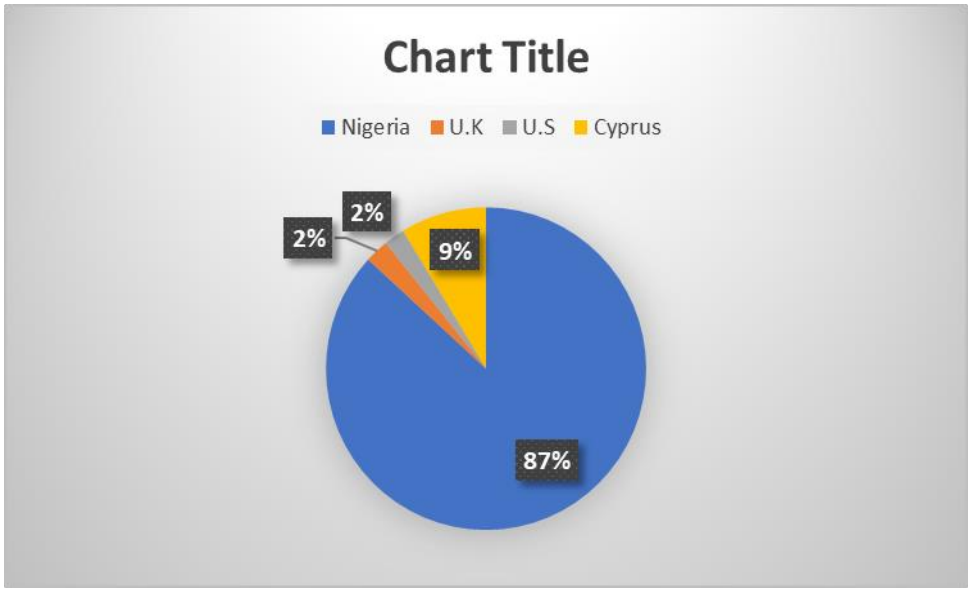

Figure 4.1: Pie Chart Showing the Nationality of Participants

Table 4.6 Percentage of Participants Based on their Nationality

Nationality	Percentage(%)
Nigeria	86.83
U.K	2.4
U.S	2.10
Cyprus	8.68

In Table above, the country of the participants is shown. From the response that was given by the respondents, Nigeria had the highest percentage with n=86.83%, Cyprus had a percentage of n=8.68%, U.K had a percentage of 2.40% and finally, U.S had a percentage of n=2.10%.

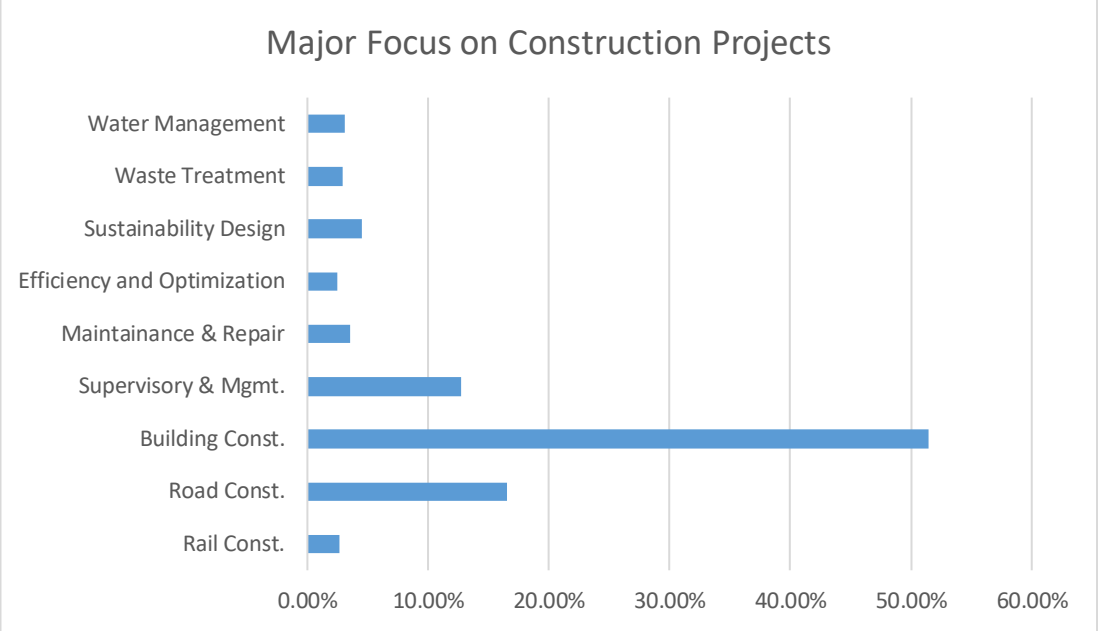

Figure 4.2: Bar graph Showing the Major Focus on Construction Projects

Table 4.7 Number of Participants Based on their Focus on Construction Projects

Construction Project	Frequency(f)	Percentage(%)
Rail Construction	12	2.68
Road Construction	74	16.55
Building Construction	230	51.45
Supervisory and Management	57	12.75
Maintenance and Repair	16	3.58
Efficiency and Optimization	11	2.46
Sustainability Design	20	4.47
Waste Treatment	13	2.91

Water Management	14	3.13
Total	335	100

According to the data, the major focus for most the respondents was Building Construction, with 51.45% of respondents aligning with this option. The second most responses are on Road Construction, with 16.55% of respondent stating this as their focus. Other focused include Supervisory and Management (12.75%), Sustainability Design (4.47%), Maintenance and Repair (3.58%), and Water Management (3.13%). The least focused on are Waste Treatment (2.91%), Rail Construction (2.68%) and Efficiency and Optimization (2.46%).

4.3 Factors Affecting Labor Productivity

In this section, 46 factors negatively affecting labor productivity in building construction have been identified and prioritized based on their respective significance. These factors have been organized into 7 distinct groups: Labor, Technology / Construction / Material, Site related factors, Project related factors, External factors, Management and Motivation.

4.3.1 Labor

Table 1 displays the ranks for the 7 factors in the Labor related group. The results demonstrate that the most important factor negatively influencing the productivity is Physical fatigue of the labor, and after that Lack of labor discipline, Lack of Labor Experience/ Skills, Working Without Days Off, Extra overtime working, Age of Labor and Labor Low Education Level.

Table 4.8 Ranking Factors Under Labor

Factors	Importance Index	Rank
Physical fatigue of the labor	76.22	1
Lack of labor discipline	76.18	2
Lack of Labor Experience/ Skills	74.87	3
Working Without Days Off	71.88	4
Extra overtime working	70.87	5
Age of Labor	70.57	6
Labor Low Education Level	68.18	7

The surveyed contractors ranked ‘physical fatigue of the labor in the top position, having an importance index value of 76.72. This was placed top among the 46 factors that have an adverse impact on labor productivity (Table 8), which reveals that physical fatigue of the labor has a significant impact on productivity. The finding is justified, as proper and adequate rest holds a significant part in the level of work one puts in to do deliver the required and desired result, physical fatigue affects both the mental and physical abilities of the labor which as a result decreases labor productivity. ‘Lack of labor discipline’ had a high impact on labor productivity, and was second within the Labor category, with an index of importance of 76.18. ‘Lack of labor discipline’ also placed third factor of 46 negatively impacting labor productivity (Table 8); Furthermore, the surveyed contractors placed ‘lack of labor experience/skills’ as the third ranking factor, having importance index of 74.87. Furthermore, the lack of labor experience ranked fifth among all 46 factors negatively impacting labor productivity (Table 8), emphasizing the significant impact of this factor productivity. This finding aligns with Paulson’s (1975) research,

which demonstrated the influence of craftsman experience on labor productivity. Heizer and Render (1990) also corroborated these results, confirming that workforce influences job site productivity. while ‘Extra overtime working’ during the work days has an average effect as this factor was ranked 22 among all factors negatively affecting labor productivity. Hinze (1999) confirmed these findings, stating that an increase in work days and hours impacts labor productivity. The reliability of these results is debatable, as extended working hours can negatively impact both the motivation and physicality of workers, thereby leading to a reduction in productivity. However, the consequences of working additional hours over a brief period may not become immediately apparent or could be non-existent.

This result is supported by instances of miscommunication among laborers, causing conflicts over duties and work boundaries, leading to numerous errors and as a result a decline in labor productivity. Additionally, survey results reveal that respondents from the contractor community considered the 'Age of labor' to have a moderate effect on labor productivity, ranking it 25th among all 46 factors negatively affecting productivity (see Table 8).

This conclusion is accurate, given that the speed, agility, and strength of laborers naturally decrease with time, contributing to an overall decrease in productivity. Labor low education level is regarded as less influential when compared to other factors; it holds the 35th position among all 46 factors that have an adverse impact on labor productivity. These findings could be valid, because low education level of the labor does not always equate to the level of work delivered by the labor which means it has little effect on labor productivity.

4.3.2 Technology / Construction / Material

Table 2 shows the grading of 5 factors within the Technology/Construction/Material group. Poor choice of material quality was ranked first; inexperienced machinery operatives held the second position; lack of labor adoption with new technologies was ranked third, the inefficiency of equipment used on the construction site was positioned at number 4 and inappropriate supply chain was fifth position. Poor choice of material quality significantly influences labor productivity with importance index 74.57 and rated number 6 among the 46 factors that alter labor productivity (Table 8). Findings are arguable, since the use of poor-quality material would affect the quality of labor produced thereby resulting in substandard work and productivity. Inexperienced machinery operative also affects labor productivity greatly (Importance index = 72.9), and rated 15. This finding could be valid, because if the person in charge of operating the machinery is not skilled or experienced enough to handle them, they cannot produce the required result or deliver on time which will therefore decrease labor productivity. New technologies are often created to automate tasks, streamline processes, and boost overall efficiency. If workers resist adopting these technologies, manual and less efficient methods may continue, resulting in a decrease in productivity in comparison to what could be achieved with the new tools. The surveyed companies tend to regard inefficiency of equipment as a significant factor in this group, attributing it to Importance index = 71.94. This observation is accurate by the lower productivity associated with unproductive machinery, which evidently affects labor productivity based of the tools in use.

Table 4.9 Ranking factors under Technology / Construction / Material

Factors	Importance Index	Rank
Poor choice of material quality	74.57	1
Inexperienced machinery operatives	72.90	2
Lack of labor adoption with new technologies	72.24	3
The inefficiency of equipment used on the construction site	71.94	4
Inappropriate supply chain	68.48	5

4.3.3 Site Related Factors

Table 3 presents the ordered placements of 8 factors in the Site-related group, arranged in descending order based on their respective levels of significance: Inappropriate site layout planning, Inappropriate storage place on the site, Inappropriate resting place for labors, Lack of transportation facility to the site location, Quality of lighting at the construction site, Adverse weather conditions, Poor ventilation at the construction site and Working within a confined space. Findings reveal that inappropriate site layout planning has great impact on labor productivity (Importance index = 70.87), and number 23. This outcome is arguable, because an organized and refined site layout is necessary for optimizing workflow, diminishing delays, and making sure the resources are used efficiently well; but when the site layout is inappropriate or poorly planned, it can result in several issues that hinder productivity. Subsequently, inefficient site layouts can cause unrestrained walking or movement for labors to get access to materials, equipment as well as workstations. This time wasted when summed up would show a decrease in the time spent on actual productive tasks. Contractors believed that Inappropriate storage place on the site affects labor productivity more than Inappropriate resting place for

labors, and ranked ‘Inappropriate storage place on the site’ in position 27 with importance index value of 69.85, while ‘Inappropriate resting place for labors’ was graded 31 with importance index value of 68.54. Proper site conditions are essential to labor, because this has a direct effect on their safety, health, overall well-being and ultimately their productivity. Creating a work environment that promotes favorable site conditions is very beneficial to both the labors and the organization. Lack of transportation facility to the site location and Quality of lighting at the construction site are not referred to as being as significant compared to other factors, placed at 36 and 37 with importance index value of 68.18 and 67.52 respectively among the factors negatively affecting productivity. Lema (1995) does not support this result and argues that non-financial benefits such as transportation, meals as well as uniforms have a great impact on labor productivity. These findings might become justifiable within places like the Gaza Strip since it has a compact space which indicates mobility to any location inside the region can be easily made accessible; hence it is not necessary to provide transportation for the labor. Also, the labor requires adequate illumination for efficient work, and consequently, insufficient illumination would create an adverse effect on labor efficiency.

Table 4.10 Ranking factors under Site Group

Factors	Importance Index	Rank
Inappropriate site layout planning	70.87	1
Inappropriate storage place on the site	69.85	2
Inappropriate resting place for labors	68.54	3
Lack of transportation facility to the site location	68.18	4
Quality of lighting at the construction site	67.52	5

Adverse weather conditions	66.51	6
Poor ventilation at the construction site	66.45	7
Working within a confined space	65.61	8

Furthermore, results show that adverse weather conditions are not considered to be as important as other factors with respect to labor productivity, and was placed 41st of all negative factors with importance index value 66.51. Thomas and Sanders (1991) endorse this finding in their analysis of elements affecting productivity within the US. Another instance is the Gaza Strip where the temperature is acceptable; thus, decrease and rise in temperature have a low impact on efficiency of labor. Although, in comparison to factors that affect labor productivity Poor ventilation at the construction site and Working within a confined space are not considered as top factors and placed in positions 43rd and 45th. Thomas and Sanders (1991) endorse this finding, as they highlighted that working in compact spaces is one of the common factors contributing to low productivity. This observation could be correct, as compact spaces restrict the free movement of labor leading to a subsequent decrease in productivity.

4.3.4 Project

The findings in Table 4 displays 3 factors related to the Project group ranked. Inaccurate provision of project's specifications and readable drawing was ranked first; Project complexity was ranked second; and Repeated rework due to the contractors, consultants, or client's fault was ranked third. Inaccurate provision of project's specifications and readable drawing significantly affects labor efficiency with Importance index value of 72.30, placed 16th (Table 8). The inaccurate provision of project specifications and poorly readable drawings can significantly

alter labor productivity in construction and other project-based industries. When the labors do not receive clear and accurate information about what needs to get done and the way it should be done, numerous issues could arise which would hinder productivity. Project complexity can have substantial impact on productivity of labor (Importance index = 70.99, and ranked in position 21 of all factors negatively affecting labor productivity. This result is justified, because the more complex a project is, the more challenging it becomes for the labors to carry out their tasks effectively. Finally, Repeated rework due to the contractors, consultants, or client's fault is not regarded as equally instrumental, rated 42nd. When rework is necessary due to errors or changes that are beyond the control of the workers, several negative consequences can arise. Having to repeatedly redo work as a result of factors beyond their control can demoralize the labors. It can bring about a sense of frustration and a perception that their efforts are not valued, potentially resulting to decreased productivity.

Table 4.11 Ranking factors under Project

Factors	Importance Index	Rank
Inaccurate provision of project's specifications and readable drawing	72.30	1
Project complexity	70.99	2
Repeated rework due to the contractors, consultants, or client's fault	66.51	3

4.3.5 External Factors

All factors have a great impact on productivity, and have been classified in accordance with their importance as follows: Volatile economic and political

environments; Labor absenteeism; Impact of other workforce members on the productivity of other labors; and Labor strike (Table 5). Volatile economic and political environments is the most influential factor in the external factors group, and is positioned 38th, having Importance index = 67.52. In volatile economic and political environments, businesses may become reluctant to invest in new projects or expand their operations. This uncertainty can result in a reduction in capital investment, which may lead to outdated equipment, technology, and infrastructure. Therefore, the efficiency of labor may suffer, leading to diminished productivity levels. Labor absenteeism is specifically low, placed at number 39 of the factors. This finding could be justifiable, based on the temporary character of the regional workforce and how easy the contractors in charge of the constructions could employ extra labor to make up for absenteeism.

Table 4.12 Ranking factors under External Factors

Factors	Importance Index	Rank
Volatile economic and political environments	67.52	1
Labor Absenteeism	67.22	2
Impact of other workforce members on the productivity of other labors	66.81	3
Labor Strike	66.15	4

The effect of other workforce members on the productivity of their colleagues can greatly impact overall labor productivity. This phenomenon is often regarded to as the "peer effect" or "social effect" on productivity. Furthermore, if some workers in a team display low motivation, poor work habits, or substandard performance, it can negatively affect the overall productivity of the group. The negative behavior could

spread, bringing about a decline in morale and productivity for the whole team. It's essential to note that not all strikes have negative effects on labor productivity. In some instances, labor strikes can lead to improvements in working conditions, wages, and benefits, which can ultimately enhance employee morale and productivity in the end.

4.3.6 Management

Table 6 displays the ranking of the 14 factors in the group related to Management. The results show that the most important factor negatively affecting the productivity is Unclear instructions to the labors, followed by Lack of appropriate labor inspection or supervision, Difficulties in exchanging information between the site management and the workers, Lack of supervisors' experience, Delay in responding to labor request for information, Unexpected variation or Change-order during execution, Emphasizing following the health and safety precautions, Lack of labor surveillance/supervision, Unrealistic scheduling and expectation of labors performance, Late inspection of completed sub-projects, Lack of periodic meeting with the labors, Lack of labor training sessions, Inappropriate selection of crew size and composition and Communication issues with foreign workers.

Unclear instructions to the labors have a very high impact on productivity and is the number 1 factor in management related factors group and is ranked number 2 among all 46 (Importance index = 76.60). Correct findings, because this issue can stem from various sources, such as poorly communicated plans, vague project requirements, or inadequate communication between management and workers. Laborers could end up spending more time trying to get clarification or attempting to understand ambiguous instructions. This inefficiency disrupts the smooth workflow, resulting in an overall reduced productivity. Lack of appropriate labor inspection

or supervision with importance index value of 75.52, and ranked 4th. This finding is justifiable, since lack of labor supervision causes a rise in mistakes by labor during work, and causing a delay with relation to corrective action for these mistakes. Proper communication is essential for making sure that workers have the necessary information and guidance to carry out their tasks effectively. When there are barriers to exchanging information that can lead to reduced efficiency. Inappropriate selection of crew size and composition and communication issues with foreign workers are not considered as top factors, at numbers 30 and 33 respectively. This could be correct, because the number of workers on a particular task does not necessarily equate to effective task completion, especially when the small number available are skilled and knowledgeable enough to carry out the given task efficiently.

Table 4.13 Ranking factors under Management

Factors	Importance Index	Rank
Unclear instructions to the labors	76.60	1
Lack of appropriate labor inspection or supervision	75.52	2
Difficulties in exchanging information between the site management and the workers	74.57	3
Lack of supervisors experience	74.51	4
Delay in responding to labor request for information	74.09	5
Unexpected variation or Change-order during execution	73.43	6
Emphasizing following the health and safety precautions	73.25	7

Lack of labor surveillance/ Supervision	73.01	8
Unrealistic scheduling and expectation of labors performance	71.46	9
Late inspection of Completed sub-projects	70.75	10
Lack of periodic meetings with the labors	70.51	11
Lack of labor training sessions	69.14	12
Inappropriate selection of crew size and composition	68.60	13
Communication issues with foreign workers	68.36	14

Table 4.14 Ranking factors under Motivation

Factors	Importance Index	Rank
Lack of provision of a satisfactory environment for labors	74.15	1
Lack of incentive and recognition programs	73.19	2
Lack of Promotion opportunities	69.67	3
Lack of enough attention to the labor personal issues	68.24	4
Lack of creating competition among labors	64.00	5

4.3.7 Motivation

Table 7 displays the grading of the 5 factors in Motivation group. Lack of provision of a satisfactory environment for labors was ranked first; Lack of incentive and recognition programs was ranked second; Lack of Promotion opportunities was ranked third, Lack of enough attention to the labor personal issues was positioned at number 4 and Lack of creating competition among labors was fifth position. Lack of

provision of a satisfactory environment for labors with importance index 74.15 at number 9 (Table 8).

4.4 Overall Ranks of All Factors Negatively Affecting Labor Productivity

Table 8 illustrates the 5 most important factors which are: physical fatigue of the labor; unclear instructions to the labors; lack of labor discipline; lack of appropriate labor inspection or supervision; and lack of labor experience/skills, with important index values of 76.72, 76.60, 76.18, 75.52, and 74.87 respectively. On the other hand, findings show that repeated rework due to the contractors, consultants, or client's fault, poor ventilation at the construction site, Labor strike, working within a confined space, and lack of creating competition among labors were the lowest with respect to labor productivity, important index of 66.51, 66.45, 66.15, 65.61, and 64 respectively.

Table 4.15 Overall Ranks of All Factors Negatively Affecting Labor Productivity

Factors	Importance Index	Rank
Physical fatigue of the labor	76.72	1
Unclear instructions to the labors	76.60	2
Lack of labor discipline	76.18	3
Lack of appropriate labor inspection or supervision	75.52	4
Lack of Labor Experience/ Skills	74.87	5
Poor choice of material quality	74.57	6
Difficulties in exchanging information between the site management and the workers	74.57	7
Lack of supervisors' experience	74.51	8

Lack of provision of a satisfactory environment for labors	74.15	9
Delay in responding to labor request for information	74.09	10
Unexpected variation or Change-order during execution	73.43	11
Emphasizing following the health and safety precautions	73.25	12
Lack of incentive and recognition programs	73.19	13
Lack of labor surveillance/ Supervision	73.01	14
Inexperienced machinery operatives	72.90	15
Inaccurate provision of project's specifications and readable drawing	72.3	16
Lack of labor adoption with new technologies	72.24	17
The inefficiency of equipment used on the construction site	71.94	18
Working Without Days Off	71.88	19
Unrealistic scheduling and expectation of labors performance	71.46	20
Project complexity	70.99	21
Extra overtime working	70.87	22
Inappropriate site layout planning	70.87	23
Late inspection of Completed sub-projects	70.75	24
Age of Labor	70.57	25
Lack of periodic meetings with the labors	70.51	26
Inappropriate storage place on the site	69.85	27
Lack of Promotion opportunities	69.67	28
Lack of labor training sessions	69.14	29

Inappropriate selection of crew size and composition	68.6	30
Inappropriate resting place for labors	68.54	31
Inappropriate supply chain	68.48	32
Communication issues with foreign workers	68.36	33
Lack of enough attention to the labor personal issues	68.24	34
Labor Low Education Level	68.18	35
Lack of transportation facility to the site location	68.18	36
Quality of lighting at the construction site	67.52	37
Volatile economic and political environments	67.52	38
Labor absenteeism	67.22	39
Impact of other workforce members on the productivity of other labors	66.81	40
Adverse weather conditions	66.51	41
Repeated rework due to the contractors, consultants, or client's fault	66.51	42
Poor ventilation at the construction site	66.45	43
Labor strike	66.15	44
Working within a confined space	65.61	45
Lack of creating competition among labors	64	46

4.5 Ranking Groups Negatively Affecting Labor Productivity

Table 9 demonstrates positioning of 7 groups that has an influence on labor productivity. It is shown that the Labor related factors group was ranked first of the 7 (Importance index value = 72.75), any project can be easily affected when the labor is physically fatigued because rest is essential for effective productivity.

Furthermore, project related factors have moderate impact when compared with Management related factors with importance index value of 72.41. In contrast, the external related factors group was graded last with importance index = 66.92.

Table 4.16 Ranking Factors Negatively Affecting Productivity Among Groups

Factors	Importance Index	Rank
Labor related factors	72.75	1
Management related factors	72.41	2
Technology/Construction/Material related factors	72.02	3
Project related factors	69.93	4
Motivational related factors	69.85	5
Site related factors	67.94	6
External related factors	66.92	7

Chapter 5

CONCLUSIONS AND RECOMMENDATIONS

5.1 Conclusion

The issues addressed in this thesis were discovered through a thorough examination of existing literature and an investigation into the present estimating practices within the industry. To gain insight into the genuine concerns of industry professionals regarding labor productivity, questionnaires were distributed, enabling the creation of a reliable database for productivity analysis. This chapter provides a summary of the study's findings and conclusions. It also offers recommendations for enhancing labor productivity on construction sites and suggests potential areas for future research. The study had three primary objectives: i) To determine, examine and analyze the factors that affect labor productivity on construction projects. ii) To investigate whether there were strong relationships between these factors and productivity. iii) To rank the mentioned factors according to their severity.

The construction industry in today’s modern world, holds a significant position as a key sector contributing to the development and achievement of societal goals. The examination and understanding of construction productivity are of utmost importance as it can result in losses for governing agencies as well as impact the economic dynamics of the construction sector. Having prior knowledge about labor productivity in construction beforehand can contribute to saving time and cost. Given the high investments in these projects and the complexity of construction processes,

various factors have the potential to significantly influence overall productivity, leading to potential delays and increased costs for project completion.

5.2 Summary of the Study

The primary objective was to determine, examine and analyze the factors influencing labor productivity on construction projects. This goal was accomplished through the implementation of an extensive literature review and ranking the factors based on input from contractors:

- The study revealed three major factors: Physical fatigue of the labor, Unclear instructions to the labors, and Lack of labor discipline. By Addressing these factors in a prioritized manner, based on their relative impacts, and closely monitoring work throughout the implementation process, we can effectively enhance labor productivity and ultimately improve the total effectiveness within the construction sector.

The second goal, to investigate whether there were strong relationships between these factors and productivity.

- This goal was accomplished through a survey (questionnaire) that outlined the 7 related factors that affect labor productivity. The findings from this evaluation could serve as valuable historical data to enhance labor productivity in building projects, considering that estimating labor productivity is part of the most formidable challenges of bidding preparation and cost control.

Lastly, the third objective aimed to rank the mentioned factors according to their severity on construction sites. The results strongly indicated through a table of 46 factors ranked which affect labor productivity, that rest is very essential for the labor

to get the required and desired results, supervising projects while it is being carried out also as a critical managerial approach for enhancing labor productivity. Other established strategies included giving clear and accurate instructions to the labors, accurate supervision and systematic training. The study highlighted the importance of well- devised, scheduled, and executed training to address specified requirements. Training should be delivered by knowledgeable trainers, and its impact should be carefully evaluated.

5.3 Recommendations

Construction tasks often come with significant expenses and can lead to disputes and claims, which in turn affect the progress of construction projects. To ensure successful project completion, the construction organization's environment must be conducive for implementation. Identifying and addressing the weaknesses in specific tasks are essential to overcoming challenges in the construction industry. The following recommendations were found to be crucial factors in improving labor productivity:

i. When recruiting managers and project managers, it is essential to select candidates who are suitable for their specific tasks. Maintaining friendly relations with laborers and making them aware of their significance to the organization can also foster better labor productivity.

ii. Avoiding complex designs and incomplete drawings is crucial to prevent confusion among different construction agencies. Ensure that everyone on the job site is using the same terms for the same things. Also, encourage open communication between workers and supervisors just to be sure they are on the same page

iii. To enhance productivity, implementing a financial incentive, such as recognizing the best employee of the year, can create healthy competition among employees.

iv. Efforts should be made to minimize change orders and design errors, as they can be costly and time-consuming, affecting work sequences.

vi. When recruiting managers and project managers, it is essential to select candidates who are suitable for their specific tasks. Maintaining friendly relations with laborers and making them aware of their significance to the organization can also foster better labor productivity.

vii. Contractors should provide detailed schedules of material supply for each project, outlining the time required for material delivery and the availability of local markets to meet the demand. Emphasis should be placed on using high-quality construction materials and appropriate tools, as these not only expedite the work but also minimize material wastage, leading to better labor productivity.

viii. the Utilization of BIM (Building Information Modeling) can be beneficial: Employ BIM software to create a digital representation of the project, enabling collaboration, data exchange, and clash detection to improve project accuracy

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APPENDIX

Appendix: Questionnaire

Labor Productivity as regards Construction Management

Dear participant:

The purpose of this study is to examine the contribution of the negative impact of different factors on construction labor productivity (CLP). This study is being conducted by the construction management group of the Civil engineering department at Eastern Mediterranean University (EMU). This questionnaire is comprised of two sections. Through the first section, we kindly request you to share some basic demographical and occupation-related information about yourself. Subsequently, in the second section, we will be gathering your perception regarding the severity of the negative impact of different factors on CLP. The result of this research will be further analyzed and prioritized to identify the severity of the aforementioned parameters and subsequently provide a mitigation approach to enhance CLP. Therefore, we kindly request your participation in this study by filling out and/or answering the questionnaire below.

Notably, you are under no obligation to engage in this research and can decline at any time. You can also leave the study at any time, for any reason at all. In this instance, every one of your answers will be deleted and not included in the study. We guarantee that, should you choose to participate in and finish the study, your personal information will be kept private and used only for data analysis and scientific research. A report summarizing the results of the analysis of the data may be submitted for publication. To indicate that you are participating voluntarily, kindly fill out the consent form below. Thanks in advance for your contribution.

What is your Gender? *

- Female
- Male

What is your age? *

- Below 30
- 30-40
- 40-50
- Above 50

What is your educational status? *

- High or equivalent Degree
- Bachelor Degree
- Master's Degree
- Ph.D. or higher

Which one of the following categories best describes your position in the construction field?

- Construction manager
- Contractor
- Client
- Consultant
- Academic Expert

How many years of experience do you have in the construction field? *

- Less than 1 year
- 1-5 Year
- 6-10 Years
- 11-15 Years
- Over 15 Years

What sector are you cooperating with? *

- Private
- Public

What part of construction did you worked or are you currently working in? (Major focus)

- Building/ Structure
- Road/ Transportation
- Water Management
- Waste Treatment

What was the major focus in the construction part you worked/ currently working in?

_____

What is the country that you are currently working in? *

_____

Section2:

*The following parameters have been identified as part of factors that might be affecting labor productivity in building construction. The below questionnaire has been developed based on a 5-point Likert scale to evaluate the impact of the factor on labor productivity in construction. Please state your perception regarding the **impact** of the following factors on CLP by scoring from 1 to 5 according to the below-provided definition for each scale.*

Definition of scale for impact

1. Negligible impact

2. Minor impact

3. Moderate impact

4. Significant impact

5. Severe impact

Factors Affecting Labor Productivity

SN	Statements	1	2	3	4	5
	Labor related factors					
1	Age of labor					
2	Lack of labor experience/ skills					
3	Labor low education level					
4	Working without days off					
5	Extra overtime working					
6	Physical fatigue of the labor					
7	Lack of labor discipline					
	Technology/Construction /					

	Material related factors					
8	Inexperienced machinery operatives					
9	The inefficiency of equipment used on the construction site					
10	Poor choice of material quality					
11	Inappropriate supply chain					
12	Lack of labor adoption with new technologies					
	Site related factors					
13	Adverse weather conditions					
14	Lack of transportation facility to the site location					
15	Quality of lighting at the					

	construction site					
16	Poor ventilation at the construction site					
17	Working within a confined space					
18	Inappropriate site layout planning					
19	Inappropriate resting place for labors					
20	Inappropriate storage place on the site					
	Project related factors					
21	Repeated rework due to the contractors, consultants, or client's fault					
22	Inaccurate provision of project’s specifications and readable drawing					

23	Project complexity					
	External related factors					
24	Volatile economic and political environments					
25	Labor strike					
26	Labor absenteeism					
27	Impact of other workforce members on the productivity of other labors					
	Management related factors					
28	Lack of labor training sessions					
29	Lack of labor surveillance/ Supervision					

30	Emphasizing following the health and safety precautions					
31	Lack of supervisors experience					
32	Communication issues with foreign workers					
33	Late inspection of Completed sub-projects					
34	Unclear instructions to the labors					
35	Lack of periodic meetings with the labors					
36	Unrealistic scheduling and expectation of labors performance					
37	Inappropriate selection of crew size and composition					

38	Unexpected variation or Change-order during execution					
39	Delay in responding to labor request for information					
40	Difficulties in exchanging information between the site management and the workers					
41	Lack of appropriate labor inspection or supervision					
	Motivational factors					
42	Lack of Promotion opportunities					
43	Lack of creating competition among labors					
44	Lack of enough attention to the labor personal issues					

45	Lack of provision of a satisfactory environment for labors					
46	Lack of incentive and recognition programs					