



An-Najah National University
Faculty of Graduate Studies

**ASSESSING THE POTENTIAL OF ADOPTING
CIRCULAR ECONOMY AND ITS EFFECT ON
THE SUSTAINABLE PERFORMANCE IN THE
PALESTINIAN CONSTRUCTION INDUSTRY**

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**This Thesis is Submitted in Partial Fulfillment of the Requirements for The Degree
of Master of Engineering Management, Faculty of Graduate Studies, An Najah
National University, Nablus-Palestine.**


2024

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Dedication

إلى فلسطين، بلادي تائهة الملامح..

إلى غزة، جارة الفردوس..

إلى قرطبه، معقل العلم وموطئ العلماء،

إلى صغيرتي التي لا أعرفها..

إلى تلك الطفلة التي ترتدي قبعة عسكرية،

وتُهدي المساء شيئاً من عطرها الخافت

إلى تلك العرافة الخائفة من بقايا فنجاني الترابي البارد،

إلى أولئك الذين قسّموا أرواحهم في جسوننا،

وتركوا آثاراً لا تدلّ عليهم.. أنما تدلّ على غيرهم،

إلى جلّ الوجوه التي تبقى تقاسيمها نصب العين والوجدان،

إلى كلّ المجازات الرّاحلة..

إلى من بنى بجبين العزّ لآمالي جسراً.. والدي العطوف،

إلى من أسقت بدمع العين لي حُلماً.. أمي العظيمة،

إلى جارة القلب ومسند الروح.. عائلتي الصغيرة،

إلى منارات الطريق وقلاعنا الشامخة.. أسانذتنا الأعزاء.

إليكم جميعاً.. أهدي هذا العمل.

Acknowledgement

Above all, I enlarge my sincere thanks to the Almighty God who granted me this strength, staying power and braveness to efficaciously complete this thesis. Special thanks to our honorable supervisors, Dr. Mutasim Baba and Dr. Abdel Halim Khader for their steady guidance, continuous assist, and invaluable comments and pointers contributed significantly to the achievement of this thesis.

I enlarge my sincere thanks to the internal and external examiners for their efforts in reviewing the thesis and providing amendments to enhance it.

I also thank my pricey own family and friends for their unwavering motivation and never-ending assistance.

Finally, I expand my sincere thanks to everybody who positively contributed to my thesis writing and editing, immediately or indirectly. Your support has been helpful and appreciated.

Declaration

I, the undersigned, declare that I submitted the thesis entitled:

ASSESSING THE POTENTIAL OF ADOPTING CIRCULAR ECONOMY AND ITS EFFECT ON THE SUSTAINABLE PERFORMANCE IN THE PALESTINIAN CONSTRUCTION INDUSTRY

Unless otherwise referenced, I declare that the work provided in this thesis is the researcher's work and has not been submitted elsewhere for any other degree or qualification.

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Date: 25/7/2024.

List of Contents

Dedication	iii
Acknowledgement	iv
Declaration.....	v
List of Contents.....	vi
List of Tables.....	ix
List of Figures	x
List of Appendixes	xi
Abstract.....	xii
Chapter One: Introduction and Literature Review.....	1
1.1 Chapter overview	1
1.2 General Background	1
1.3 Study Area.....	3
1.4 Problem Statement.....	5
1.5 Research Significance.....	7
1.6 Research Questions	7
1.7 Research Objectives.....	8
1.8 Research Hypotheses	8
1.9 The Proposed Conceptual Model.....	9
1.10 The Structure of the Thesis	10
1.11 Literature Review.....	11
1.12 Current State of the Palestinian Construction Industry	12
1.13 Circular Economy in the Construction Industry	13
1.14 Construction Waste Industry	14
1.14.1 Construction Waste Quantity Worldwide.....	15
1.14.2 Construction Waste Industry in Palestine	17
1.15 Construction Waste Materials	18
1.15.1 Concrete	18
1.15.2 Asphalt	19
1.15.3 Wood and Metal.....	20
1.15.4 Non-Ferrous metal	21

1.15.5 Steel	21
1.15.6 Glass.....	22
1.15.7 Bricks	23
1.16 Construction Waste Management	24
1.17 Environmental Impact of Construction Waste	25
1.18 Previous studies on adoption of CE in CI.....	26
1.18.1 Awareness of the principles of the CE	26
1.18.2 Current Practices in the Construction Industry	27
1.18.3 Barriers and challenges in construction industry	28
1.18.4 Opportunities and incentives in construction industry	29
Chapter Two: Methodology	32
2.1 Chapter Overview	32
2.2 Methodology Flow Chart.....	32
2.3 Research Design	32
2.4 Sampling Strategy and Sample Size Determination	33
2.5 Data Collection Methods	34
2.6 Data Analysis Techniques	35
2.6.1 Convergent Validity	36
2.6.2 Effect Size (f^2).....	36
2.6.3 Goodness of Fit (GOF)	36
2.6.4 Model Fit Analysis.....	37
2.6.5 Coefficient of Determination (R^2)	37
Chapter Three: Analysis and Results	38
3.1 Response Rates	38
3.2 Demographic Profiles of the Respondents.....	38
3.3 Descriptive Analysis	39
3.4 Assessment of the Measurement Model (Outer Model)	40
3.4.1 Convergent Validity	40
3.4.2 Discriminant Validity	41
3.5 Assessment of the Structural Model (Inner Model).....	43
3.5.1 The Coefficient of Determination (R^2)	43
3.5.2 Predictive Relevance (Q^2).....	43

3.5.3 The Effect Size (F^2).....	44
3.5.4 Goodness of Fit index (GoF)	45
3.5.5 The Significance of the Path Coefficients - Hypotheses Testing.....	45
Chapter Four: Discussion, Conclusions and Recommendations	52
4.1 Chapter Overview	52
4.2 Discussion of Results.....	52
4.2.1 Dissection of awareness of the principles of CE in the Palestinian construction industry	53
4.2.2 Dissection of current practices in construction projects	54
4.2.3 Dissection of Barriers and Challenges to implementing CE	55
4.2.4 Dissection of opportunities and incentives in construction industry	55
4.2.5 Dissection of social, economic, and environmental impacts of implementing circular economy in Palestine	56
4.2.6 Dissection of Collaboration and Partnerships within the construction sector	57
4.2.7 Dissection of Future Outlook for the construction sector.....	58
4.2.8 Dissection of implementing CE concepts in the construction sector.....	58
4.3 Hypothesis Testing Discussion	59
4.4 Theoretical Implications	60
4.5 Practical Implication	60
4.6 Conclusions.....	61
4.7 Recommendations.....	62
4.8 Research Limitations	62
4.9 Future Research Directions.....	63
List of Abbreviations	64
References.....	66
Appendices.....	75
الملخص.....	ب

List of Tables

Table 1.1: Amount of waste produced annually in Thailand	16
Table 1.2: Total construction waste amounts by material (in 103 tons) 2002–2005	16
Table 1.3: Gross average of C&D waste component in West Bank as of 2021	17
Table 3.1: The mean, standard deviation and implementation level for constructs.....	39
Table 3.2: Construct Reliability and Validity.....	41
Table 3.3: Fornell- Larcker criterion.....	42
Table 3.4: Heterotrait -monotrait ratio (HTMT).....	43
Table 3.5: Quality Criteria - R ² and Q ²	43
Table 3.6: Effect Size (F ²).....	44
Table 3.7: Path Coefficient, STDEV, T values, and P-Values.....	46

List of Figures

Figure 1.1: Location map of Palestine	4
Figure 1.2: Map of the built up areas in the West Bank (WB).....	4
Figure 1.3: The Proposed Conceptual Model	9
Figure 1.4: Estimated annual C&D waste generation amount (ton/year) over West Bank	18
Figure 3.1: Model Framework - P-values	50
Figure 3.2: Model Framework - T-Statistics	51

List of Appendixes

Appendix A: Tables	75
Table A.1: Sample size recommendation in PLS-SEM for a statistical power of 80%	75
Table A.2: Respondents profile summary	76
Table A.3: Descriptive Analysis of All Aspects Of The Questionnaire	77
Table A. 4: Factor Loadings	78
Table A.5: Cross loadings	79
Table A.6: Operationalization Of Model constructs	80
Appendix B: Research Questionnaire in English.....	81
Appendix C: Research Questionnaire in Arabic	92

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Abstract

In recent years, the global community has acknowledged the critical importance of sustainable development approaches in addressing acute environmental concerns while also ensuring long-term social and economic success. In this environment, the Circular Economy (CE) has emerged as a viable paradigm for encouraging sustainability in a variety of industries, including construction. In Palestine, the construction industry is crucial to economic growth.

This thesis aims to assess the potential of adopting the principles of CE in the Palestinian construction industry and to investigate its effects on sustainable development. It also aims at studying how the application of CE in the Palestinian construction industry can help in using resources, and exploring the potential social and environmental impacts of applying the principles of CE in Palestinian construction industry.

To this end, a research model was developed where data was collected using questionnaire and semi-structured interviews. Data were collected from a random sample of 80 participants including engineers, contractors and suppliers. The respondents scored CE in a medium level 2.480. Aspects observed in current practice reveal only occasional fulfilment of goals set regarding recycled content, although some obstacles are related to the limited availability of recycled materials, the lack of official rules concerning their use, insufficient financial incentives, and the lack of appropriate training. But the opportunity to extend CE is the possibility to decrease its negative impact, governmental programs, and financial stimuli, all of which stimulate activity. The partial least squares- structural equation modeling (PLS-SEM) using Smart PLS software was used to analyze the data collected by the questionnaire and test the model hypotheses. The results obtained showed that the level of implementation of adopting principles of CE is of medium level.

Keywords: Circular economy (CE); Construction industry (CI); Partial least squares structural equation modeling (PLS-SEM); Sustainable development (SD).

Chapter One

Introduction and Literature Review

1.1 Chapter overview

A general description is given in this chapter of the topic of study. The elements that are divided under this part include the general background, study area, problem statement, problem significance, research questions, research objectives and hypotheses development.

1.2 General Background

In Palestine, the construction industry is a major economic driver, contributing to a large amount of the country's Gross Domestic Product (GDP). However, the construction industry in Palestine faces specific challenges due to the geopolitical conditions that the region is going through. Despite the many obstacles it faces, this sector remains crucial to the Palestinian economy because it creates job opportunities and contributes to the development of the construction sector (El-namrouty, 2012). The construction sector in Palestine is affected by various environmental, economic and social issues resulting from its location within a context characterized by political, social and economic challenges.

The construction industry holds significant potential as a platform for implementing Circular Economy (CE) methods. Through the application of CE concepts, Palestinian construction firms can reduce resource consumption and the negative environmental impact while simultaneously improve their economic performance and contribute to the achievement of broader sustainable development goals.

The construction sector is in need of sustainability practices because of their importance in raising awareness of social and environmental responsibility. Through sustainability, we can reduce waste, achieve economic feasibility in addition to resource efficiency. In addition, sustainable construction aims for the well-being of the community affected by construction projects. And working to enhance social inclusion and provide safe working conditions. Sustainability is of great importance as it works to mitigate the environmental impact and contributes to the well-being of society (Kibert, 2016).

CE is an economic model that aims to maximize resource effectiveness via eliminating waste, keeping long-term value, lowering the main resources, and creating closed loops for goods, components, and material while maintaining environmental and socioeconomic benefits. The CE is a system in which no resources are wasted and nature is renewed. Maintenance, reuse, refurbishment, remanufacturing, recycling, and composting are all actions that contribute to the CE. It is one of the most current approaches to tackling environmental sustainability (Ghisellini, Cialani, & Ulgiati, 2016).

The importance of the CE lies in finding new solutions that reduce the environmental impact, by balancing consumption and reuse. The CE also seeks to reduce energy and waste of natural resources and work to reduce the emission of gases that lead to increased environmental and climate impacts. In the last few years, the worldwide move to the CE has gradually piqued the interest of all relevant societal actors, including businesses, consumers and their associations, research centers/universities, and organizations (Bressanelli, Perona, & Saccani, 2017).

Furthermore, the CE is seen as a relatively recent sustainable model characterized by "a regenerative system in which resource inputs, wastes, emission levels, and energy leakage are reduced by slowing down, closing, and narrowing matter and energy loops." In addition to long-term design, repair, upkeep, reuse, remanufacture, improvement, and recycling (Geissdoerfer & Martin, 2020), and CE has emerged as one of the most essential and current ways to tackling sustainability (Hobson, 2021).

According to Gherman & -Simina Lakatos (2023) the recent CE agenda and its potential adoption in the construction industry has prompted the construction supply chain to reconsider how they are able to minimize and recycle waste materials, where healing construction materials for further recycling and/or direct reuse is critical for effective inclusion.

Applying CE principles in Construction Industry (CI) will cut industrial costs, lessen negative environmental consequences, make cities more livable, effective, and comfortable, and assist in dealing with process difficulties. Although the CE concept has gained support in academia, industry, and government, its general use remains restricted (Ghisellini, Cialani, & Ulgiati, 2016).

According to Jayakodi , Senaratne, & Perera (2024) ,the broader implications of implementing the CE principle in the CI are as follows: (i) to encourage materials productivity by recycling and reusing construction materials; (ii) to prevent unneeded waste generation and waste disposal to landfill and (iii) enhancing the use of sustainable materials by obtaining sustainable materials through incorporating the collaborative advantages of the different parties. CE transition is widely acknowledged to be a multi-faceted problem combining environmental, economic, technological, cultural, political, and behavioral variables.

This thesis aims to evaluate and adopt the principles of the CE in the Palestinian construction sector, in addition to study and examine their impact on sustainable performance.

1.3 Study Area

The construction process is considered as one of the sector that greatly aids the economic stability in the Palestinian economy. Along with this it is also a source of negative environmental pollution and a major canner of natural resources.

Given the absence of culture awareness and increasing population in the territories, the construction industry continues to look for a harmonious balance between social and economic development. In the context of this thesis, we consider such issues as a sustainable use of natural resources, minimizing the amount of waste, collections of wastes for reusing and the use of materials. It tries to investigate the hindrances and obstacles in CE application of construction industry and also the limiting and additional effects of the sustainable operation on circular economy concepts.

To address effectively construction's waste, the first step would be setting guidelines and design rules to reduce building and construction waste, which can be up to 17-81% kg/m² (Al-Sari, A Al-Khatib, & Avraamides, 2011) , actually it is estimated as approximately 548 tons day-1 (Hammad, 2011). A figure 1.1 shows location map of Palestine and figure 1.2 shows Map of the built up areas in the West Bank (WB).

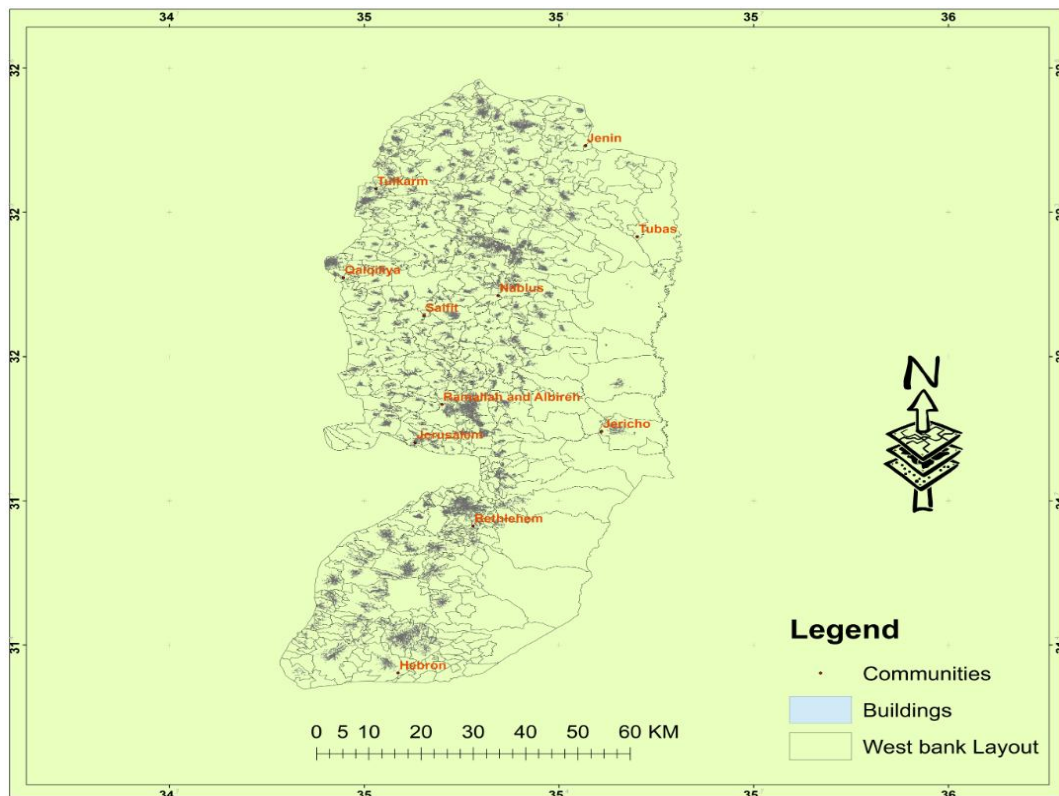
Figure 1.1

Location map of Palestine



Figure 1.2

Map of the built up areas in the West Bank (WB)



1.4 Problem Statement

The Palestinian CE faces serious problems including but not limited to its low capacity, overloading with waste materials and environmental issues. Then, in order to involve CE principles in construction industry, we need to be mindful of rational approaches for its embrace. A mix of these activities presents aid effectiveness boost whereas by the agro industry becomes more competitive over a period of time. While these challenges do exist; yet knowing the distinct social, political, and economic circumstances of Palestine which enable the emergence of challenges that have to be addressed effectively before developing community engagement practices is a basic step (Usama, Narmeen, & Mohammed Khurram S, 2020) .

From an environmental perspective, many industrial sectors, like the Palestinian construction industry, confront a variety of environmental difficulties that lead to environmental deterioration and can result in increasing costs owing to resource depletion caused by environmental degradation. Furthermore, poor use of these resources compounds exacerbates the environmental effect of waste. The Palestinian construction sector is vulnerable to the impacts of climate change, as it can significantly affect buildings and infrastructure projects through weather events and changing climatic conditions. This implies that they will require adaptable and flexible building approaches to deal with shifting climatic patterns (Haas, Krausmann, & Dominik Wiedenhofer and Markus Heinz, 2016). Carbon emissions occur as a result of the manufacturing and movement of these commodities. Pollutants such as Volatile Organic Compounds (VOCs), particulates, and other pollutants are emitted throughout construction processes, resulting in air pollution.

In order to solve these ecological issues, the Palestinian construction industry must be ready to adopt sustainable and eco-friendly approaches, for instance by making an effort towards the development of green building standards and better solid waste management. The implementation of environmental issues about building sector concerns in Palestine is likely to initiate a sustainable pathway to Palestine's green future.

Form and economic perspective, during the CE initiatives in Palestine, the economy gets a lot of benefits; however, the topics as the scarcity of resources, ecology degradation, and the waste generation still remain the problems. Construction wastes in

general have got great effects on the economy, society, environment, communities well-being and urban sustainable responsibility (Kataguiru & Eugenia Boscov, 2019) . The economy of the building sector could be affected because of the adoption of CE principles which could have a substantial impact on the interests and purposes of the key players. The CI may be a source of jobs and economic opportunities and, eventually, it'll become a basis for other enterprises (Reddy Battula & Kumar Namburu, 2020) . Although efforts are made to reduce waste, the fact that it still exists poses the problem that it highly affects costs in construction projects. Gaining more wastes means having to bear higher disposal costs, and as well, more price fixtures which comprise those like inefficient resource utilization, lost productivity and fines for non-adherence to environmental regulations (Navone & Moffitt, 2019).

From a social perspective, the career path that is created in the Palestinian construction sector has an immense influence on the social welfare status of both individuals and communities in such industry. These shortcomings are displayed in the form of subordinate community participation and poor working conditions. Existing efforts within the Palestinian construction sector are directed towards alleviating the social challenges and bringing about necessary change amongst these communities.

CE transition also can be regarded as a gain from the point out of view of the society. Alongside the jobs-related conditions the industry is faced with like wage levels workers' occupational health to the inclusion of others (Rakotonarivo, 2021). Moreover, the noise or life disturbances, dust etc. can make social tensions enough to strain and break the relations between community (Perkumienė & Vienažindienė, 2019). By dealing with these social issues, the community improves the quality of life among its members as well as has the impact of the mitigation of these problems. This objective is made possible by the introduction of CE principles in the construction industry, which ideally should be approached in collaboration with the local communities to foster a high level of social and economic development in the area. Implication of CE provisions gives rise to new job opportunities, training for workforce and improving the workers' knowledge in the field of engineering according to the changes in this area. Moreover, it promotes better work environment through a reduction in on-site construction period length and exposures to possible safety hazards (Murray, Skene, & Haynes, 2015) .

1.5 Research Significance

The value of this thesis study lies in that it investigates the applicability of CE within construction sector in Palestine, as well as consideration of their implications on the Sustainable Development Goals (SDGs).

To assess the practical effects of investing Corporates Social Responsibility (CSR) on the operational efficiency levels over a long-term perspective of the Palestinian construction industry is the fundamental objective of this dissertation. The insights found in this analysis can be applied to the growth of the industries allowing them to be centered using the environmental and social objectives while also stimulating the economic growth.

In the light of the present situation and companies' awareness of the fact that sustainability is key to the survival of any business, this thesis calls for the adoption of CE as a method applicable for organizations in their quest for the survival of any business. The results illustrated in this thesis actually might make the managers of the construction sector change their views on CEs in such a way that they would recognize them as not only environmentally-friendly but also economically-useful, and probably encourage general transition to more sustainable patterns of work.

1.6 Research Questions

Based on the research problem, this study seeks to address the following questions:

- What are the advantages and challenges faced by the Palestinian construction industry regarding resource availability and sustainability issues?
- What are the potential social and environmental consequences of integrating CE principles into the Palestinian construction industry, and how can these effects be evaluated and quantified?
- What are the potential economic, environmental, and social benefits of implementing CE principles in the Palestinian construction industry?
- How can the adoption of CE principles in the Palestinian construction industry contribute to more efficient resource utilization and reduced waste generation?

1.7 Research Objectives

1. To assess the advantages and challenges faced by the Palestinian construction industry in terms of resource availability and sustainability.
2. To evaluate the potential social and environmental consequences of integrating CE principles into the Palestinian construction industry and identify methodologies to evaluate and quantify these effects.
3. To investigate the potential economic, environmental, and social benefits of implementing CE principles in the Palestinian construction industry.
4. To develop a framework for adopting CE principles in the Palestinian construction industry to contribute to more efficient resource utilization and reduced waste generation.

1.8 Research Hypotheses

To address the research questions and tackle the research problem, the following primary hypotheses have been formulated:

- H1: Increasing awareness of the principles of CE among workers in the construction sector will significantly facilitate its adoption in the Palestinian construction industry.
- H2: Integrating current sustainable practices into construction projects promotes the adoption of CE concepts, resulting in enhanced resource efficiency, minimized waste generation, and improved environmental sustainability within the Palestinian construction industry.
- H3: The presence of barriers and challenges to implementing CE concepts has negative impacts on the successful adoption and implementation of CE practices in Palestinian construction industry.
- H4: Provision of financial, legal, and incentive support fosters the adoption of CE in the Palestinian construction industry contributing to long-term success.
- H5: The adoption of environmentally-friendly approaches in Palestinian construction projects correlates positively with enhanced environmental and economic performance.
- H6: Enhanced cooperation and partnerships within the Palestinian construction industry contribute to better project performance, sustainable practices, and stakeholder satisfaction.

H7: The future outlook for the Palestinian construction industry presents significant development opportunities and necessitates the adoption of business practices.

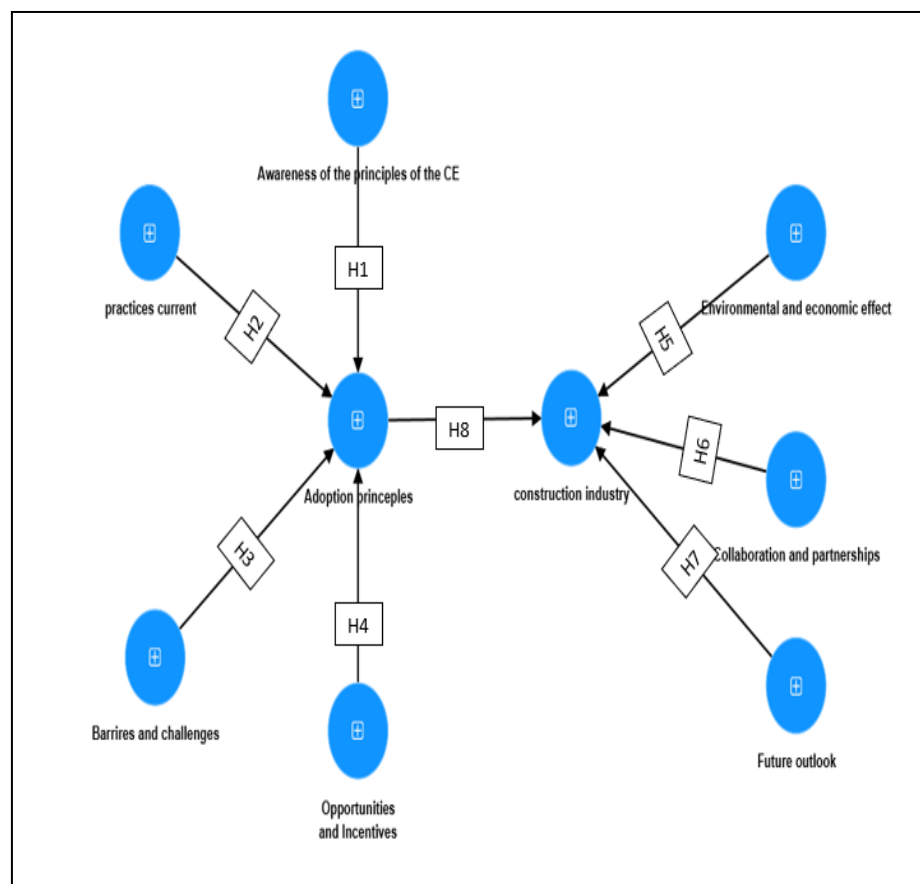
H8: Utilizing CE models in the Palestinian construction project planning and management leads to better project outcomes, increased stakeholder satisfaction, and the generation of social value, aligning with sustainable development goals and industry best practices.

1.9 The Proposed Conceptual Model

To address the research questions, a conceptual model depicted in Figure 1.3 was developed, drawing upon insights from previous studies and the description of the issues at hand.

Figure 1.3

The Proposed Conceptual Model



CI is the Dependent Variable (DV) and adopting the principles of CE be as a DV, DV with Awareness of the principles of the CE among workers in the construction sector, Current practices in the CI, Challenges of adopting CE principles, Opportunities and

Incentives, Environmental and economic impact, Collaboration and partnerships and Future expectations in the CI.

Awareness of the principles of the CE among workers in the construction sector, Current practices in the construction industry, Challenges of adopting CE principles, Opportunities and Incentives, Environmental and economic impact, Collaboration and partnerships and Future expectations in the construction industry Independent Variable (IDV).

1.10 The Structure of the Thesis

The thesis comprises four chapters. The first chapter provides an overview and general background of the study, including the statement of the research problem, the field of study, significance of the research, research questions, research hypotheses, research question, research hypotheses, research objectives, and the proposed conceptual model.

The second part of this chapter presents a comprehensive literature review related to the CE, CE in CI, construction waste industry, current state of the Palestinian CI, construction waste materials, construction waste management, and the environmental impact of construction waste.

The second chapter outlines the methodology employed in the research, including the research design, sampling strategy, determination of sample size, data collection methods, and data analysis techniques.

The third chapter presents data analysis and descriptive statistics, including an evaluation of the proposed model. The study's hypothesis and findings are tested.

Finally, Chapter four delves into the discussion of the results, highlighting their implications. It also includes a conclusion, recommendations, limitations, and suggestions for possible future research directions.

1.11 Literature Review

Circular Economy

In response to the developing reputation of environmental degradation, resource depletion, and monetary inequality, the idea of the round CE has emerged as a promising paradigm shift in the direction of sustainability and resilience. The CE targets to decouple financial growth from resource depletion by way of selling the continuous move of substances and resources inside the machine. At its core, the CE seeks to reduce waste, maximize useful resource performance, and sell sustainable practices in any respect stages of a product's life cycle, from design and production to intake and disposal. Central to the CE idea is the concept of “ultimate the loop” by designing merchandise which can be long lasting, recyclable and dismantled, in addition to selling the sharing and leasing of goods to get the maximum out of them. By transferring from an emphasis on possession to get entry to and overall performance-based totally models, the CE ambitions to decouple economic increase from useful resource intake, at the same time as concurrently creating new jobs and improving societal properly-being (Korhonen, Honkasalo, & Seppälä, 2017).

Products and substances are stored in use as long as feasible in a CE by means of using strategies which include recycling, reuse, and restore. The CE seeks to lessen the extraction of raw materials, the production of waste, and pollutants through prolonging the lifestyles of products and promoting material reuse. Furthermore, keeping goods and substances in use, encouraging cooperation and innovation, and designing for the reduction of waste and pollution are a number of the fundamental tenets of the CE (Velenturf & Purnell, 2021) .These ideas are based totally on the concept of useful resource "cyclicity," which holds that assets are constantly cycled via the economy rather than being discarded after usage. By adopting CE principles, businesses, governments and communities can open new opportunities for innovation, job creation and economic growth, while simultaneously reducing environmental impacts and enhancing societal well-being (Velenturf & Purnell, 2021).

According to Femi Kofoworola & H. Gheewala (2008) the CE provides a path to SD by promoting resource management, environmental protection, and economic prosperity. It extracts limited resources by keeping products and materials in use for longer periods, reduces cost by extending the life of products, reduces waste, and improves resource

use. Additionally, it stimulates job creation and fosters innovation, both critical elements for enhancing economic resilience.

1.12 Current State of the Palestinian Construction Industry

The Palestinian CI plays a crucial role in the economy of the Palestinian territories, including the West Bank and Gaza Strip. However, it operates within a complex social and political environment that greatly influences its growth and development. The CI is one of the largest sectors in the Palestinian economy, contributing significantly to the gross domestic product and employment opportunities. According to data from the Palestinian Central Bureau of Statistics (PCBS), building and construction activity constituted a large portion of gross domestic product, typically ranging between 7% and 9% in recent years. The growth of the Palestinian CI is closely linked to the political and economic situation in the region. The example that illustrates this is policies on movement (tourism regulations), availability of sources (environmental) and political instability and how they can notably affect the growth of the economy. Palestine suffers both the political curtailment of the natural sources, for example they may not be able to use land or water, and the geographical restrictions, as when the only water source dries, they are forced to live without water. The mining and construction industry meet difficulties in ecological resources management that is caused by application of these resources. One of the environmental challenges it confronts is the inadequate waste management practices within the construction sector, leading to environmental degradation. Construction waste, comprising debris and hazardous materials, frequently ends up in landfills or informal waste disposal sites, posing risks to ecosystems and public health (Hammad, 2011) .

Despite these challenges, the construction sector has demonstrated resilience and experienced periods of growth, especially during times of increased international aid and investment. Infrastructure development projects, including housing, commercial buildings, and public infrastructure, are vital drivers of growth in the CI. Addressing the environmental, social and financial challenges requires coordinated efforts from government institutions, private sector, civil society organizations, Non-Governmental Organizations (NGO's) and the international community.

1.13 Circular Economy in the Construction Industry

CE principles are gaining significant interest in the CI due to the sector's significant resource consumption, waste generation and environmental impact. Implementing circular practices in construction can lead to resource efficiency, waste reduction, and sustainable development. Incorporating recycled materials into construction projects reduces the demand for virgin resources. For example, various building materials can be recycled, including concrete, asphalt, metals, glass, plastic, and wood. Recycled aggregate, which is derived from crushed concrete and construction debris, serves as a substitute for natural aggregate in concrete production. Likewise, reclaimed wooden from dilapidated buildings can be reused in new construction, presenting a sustainable opportunity to freshly felled wood. Advances in recycling technologies have accelerated the variety of substances that may be successfully recycled inside the CI. Innovative approaches together with superior sorting techniques, mechanical and chemical recycling strategies, and additive manufacturing strategies allow treasured assets to be recovered from production and demolition waste streams (Jahan, Zhang, & Bhuiyan, 2022) .

Using recycled substances normally calls for less energy and water than generating new materials from raw assets. Moreover, integrating recycled content into construction projects can contribute to green building certifications and sustainability objectives. Nevertheless, challenges such as quality control, contamination, and limited availability of recycled materials may hinder widespread adoption. Addressing these challenges necessitates collaboration amongst stakeholders, investment in recycling infrastructure, and regulatory support to enhance market demand for recycled materials (Sepasgozar & Kin Peng Hui, 2021) .

Also, the recovery of assets such as materials, components, fixtures, and finishes through building deconstruction is an available option besides demolition. Such materials can be massaged and can be used in other construction works or sold to recycling on-companies and interior architectural companies. Teardown also ensures that there is no damage to the environment with concerns involving waste products like dust, noise, and air pollution. Remanufacturing means returning additives like quality back to the factory condition. At the same prevention time, it focuses on improving appearance as well as functionality to bring existing systems and building stock back up

to the new level. While in the long run, these methods increase the lifetime of the base elements and decrease the request for new raw materials that will have to be generally mined or obtained from natural resources (El-namrouty, 2014).

Of the many organic and monetary advantages to building is extreme dismantling and reuse, there are likewise some significant challenges and causes that must be resolved to grow practiced by all and sundry. The challenges involved depend on whether they are related to the deconstruction procedure, e.g. logistics such as site accessibility, workforce requirements, and accidents. Additionally, policy regulations, demand of the market for salvaged materials, and economic incentives may influence the implement ability of utilizing dismantled structures (Sepasgozar & Kin Peng Hui, 2021) .An efficient carrying out and a good cooperation between the stakeholders are the two fundamental pillars for making CE momentum to be significant in the construction sector. A study of opinion and trade barriers along with suggestions for overcoming these, integrating these participants, policy makers, academia and civil society has revealed (Letelier, Tarela, & Osses, 2017) .

1.14 Construction Waste Industry

Currently, account for a high percentage of all waste that is generated around the world, which is illustrated in a serious ecological status. Waste production which has been escalating though out the world as population growth has been curbed in a recent study by the World Bank which anticipated a 0. Worldwide waste will grow by additional 40 billion tons per year which will be observed by 2050 (Heshmati, 2017). Therefore, this indigenous rate of accumulation is a source of problems of health, atmosphere, and economy. To solve these problems, some countries promoting recycling process which considers the waste stream as resources by creating technological innovation and techniques. The process of building new goods from junk could, literally, be described as creating new life from dead products. Thus, recycling aids starting new businesses and growing the economy (Li Ma & Lu Zhang, 2020).

Construction and Demolition Waste (CDW) is the solid waste produced at construction sites and partial or total demolition of building structure and related stuff. Global solid waste generation has surged from less than 0.3 million tons per day in 1900 to over 3.5 million tons per day in 2010, with projections indicating a doubling by 2025 and

quadrupling by 2100 (Heshmati, 2017) . For instance, in the United States alone, 534 million tons of CDW were created in 2014, including 28.9 million tons during building and 505.1 tons during demolition (Assamoi & Lawryshyn, 2011) . CDW quantity and composition vary by location, depending on variables such as growing populations, regulation, regional planning, and the country's building sector. Internal and external variables impact both the quantity and quality of CDW (Duan, Wang, & Huang, 2014) .

The European Union generates more than 700 million tons of building and demolition debris each year. Countries with large populations, such as France and Germany, account for more than half of total waste created within the European Union (Haas & Maximilian, 2021) .

1.14.1 Construction Waste Quantity Worldwide

Data available for various European nations show that the quantity of building and construction waste differs by country, depending on how it is classified. In 2018, the UK CI generated 62% of solid waste, which included construction, demolition, and excavation debris. Managing and monitoring the quantity of waste produced during construction projects is critical. According to the EPA, the total waste created by construction-related projects in that year was comparable to municipal waste from households and businesses. It is anticipated that worldwide building waste would reach 2.2 billion tons by 2025.

In Canada, building waste accounts for 35% of landfill space. Similarly, investigations of Australian landfills have found that building activity accounts for 20-30% of total dumped garbage (Craven Research Assistant & Director, 2019) . Construction waste is widely regarded as an important aspect of municipal solid waste in Thailand. Thailand's municipal solid trash output grew from 11.2 million tons in 1993 to 14.3 million tons in 2002. The average per capita generation rate also rose, from 0.53 kg/capita/day in 1993 to 0.62 kg/capita/day in 2002. Table 1 in shows the amount of waste in Thailand, and Table 2 shows distribution of the quantities of waste resulting from demolition and construction according to the type of material.

Table 1.1*Amount of waste produced annually in Thailand*

Information	2002	2003	2004	2005
Total number of construction permits 1	174,909	245,448	284,026	268,293
Total area construction (10 ⁶ m ²) 1	37.48	54.64	66.96	62.01
Total construction waste generated (10 ⁶ tons) 2	0.77	1.13	1.38	1.28
Total population of Thailand (10 ⁶ persons)3	63.4	63.9	64.5	65.0
Estimated construction waste generation (kg/cap)	12.2	17.7	21.5	19.7

Source: 1: National Statistics Organization of Thailand, 2007. Population and Labor Statistics. Available from: <http://wwwweb.nso.go.th/eng/stat/stat.htm>

2: HQ Air Force Center for Environmental Excellence, 2006. Construction and Demolition Waste Management Pocket Guide. Prepared by 3D/International. Available from: <https://www.denix.osd.mil/denix/Public/Library/Sustain/BDC/>

3: Association of South East Asian Nations (ASEAN), 2005. Statistical Yearbook, Estimates of Population by Year Chapter I: Population and Demography. Available from: <http://www.aseansec.org/SYB2005/Chapter-1.pdf>

Table 1.2*Total construction waste amounts by material (in 10³ tons) 2002–2005*

No	Material	10 ³ tons				Average (%)
		2002	2003	2004	2005	
1	Asbestos	0	0	0	0	0
2	Hazardous waste	1.8	2.6	3.2	2.9	0
3	Concrete/bricks	354.8	517.2	634.1	586.7	460
4	Gypsum	48.4	70.6	86.5	80.1	6
5	Glass	3.6	5.3	6.5	6	0
6	Metal	10.2	14.9	18.3	16.9	1
7	Wood	105.9	154.4	189.2	175.1	14
8	Unknown composition	200.6	292.4	358.4	331.6	26

Source: (Kofoworola & Gheewala, Estimation of construction waste generation and management in Thailand, 2009b)

In 2003, Thailand generated around 40,165 tons of municipal solid waste per day. In 1996, the amounts of building and construction waste in Austria, Denmark, Germany, and the Netherlands were around 300, more than 500, 2600, and 900 kg/capita, accordingly (Brodersen et al, 2002). According to (Kofoworola & Gheewala, 2009a) , building and construction debris accounted for approximately 65% of landfill area in Hong Kong during its peak years of 1994-1995.

1.14.2 Construction Waste Industry in Palestine

The Ministry of Public Works and Housing in Palestine reported that construction waste is generated at a rate of 0.25 kilogram per person/day (Hammad, 2011) . Additionally, waste produced during construction in the southern West Bank ranged from 17 to 81 kilos per square meter of building floor, as noted by (Al-Sari & Al-Khatib, 2012). According to a joint report issued by the Palestinian Central Bureau of Statistics (PCBS) and the Environmental Quality Authority (EQA), Palestinians generated 4,333 tons of garbage each day in 2019. The survey also predicts a 4% increase in waste generation as a result of population growth and current consumption trends. Road building sites are another major source of construction waste. Statistics from the West Bank regarding road construction projects between 2015 and 2016 indicate that asphalt waste amounted to 1,035 tons per year, with the foundation layer and soil were projected at 3,746 tons per year. It is estimated that around 200,000 tons of building and construction waste are created each year (Hammad, Yoshida, & Mfarreh, 2015) . Table 3 shows the amounts of Construction and Demolition (C&D)waste under the supervision of the Ministry of Local Government and the Japan International Cooperation Agency (JICA). The calculation of the amount of waste was based on the built square meters, by multiplying 85% of the licensed area (m²) by 50 kg/m² (Hammad, ., & Mfarreh, 2013) .

Table 1.3

Gross average of C&D waste component in West Bank as of 2021

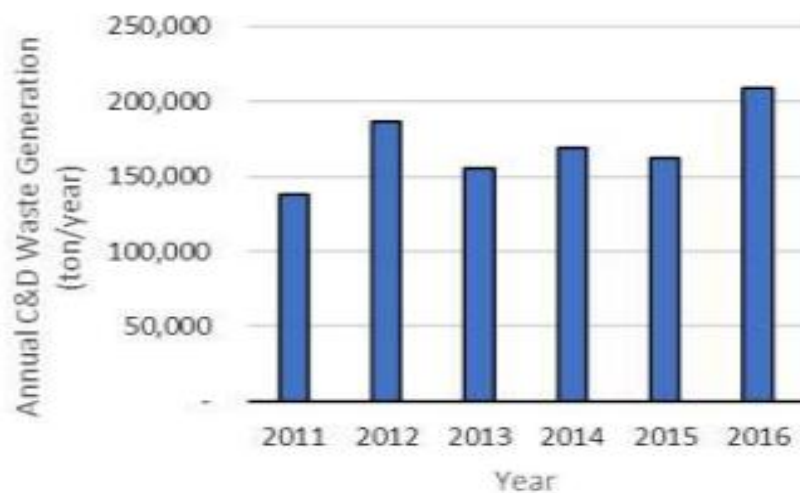
Composition of Waste	Q1 of 2021 (kg/m ²)	Q2 of 2021 (kg/m ²)	Q3 of 2021 (kg/m ²)	Q4 of 2021 (kg/m ²)	Total in 2021 (Kg/m ²)	Share (%)
Concrete	852.9	1125.9	1294.9	1456.9	4730.5	41.4
Bricks	455.3	601	691.2	777.7	2525.2	22.1
Stones	292.5	386.2	444.1	499.7	1622.6	14.2
Metal	72.1	95.2	109.5	123.2	399.9	3.5
Plastic	82.4	108.8	125.1	140.8	457.1	4
Wood	88.6	116.9	134.5	151.3	491.3	4.3
Gypsum	43.3	57.1	65.7	73.9	240	2.1
Asphalt	63.9	84.3	97	109.1	354.2	3.1
Tiles	24.7	32.6	37.5	42.2	137.1	1.2
Paper and Cardboard	53.6	70.7	81.3	91.5	297.1	2.6
Other materials	33	43.5	50	56.3	182.8	1.6
Total	2060.1	2719.5	3127.8	3519.2	11426.4	100

Source: ((Mufferreh et al., 2022)

Palestine lacks a legal framework for managing C&D waste, resulting in waste degradation, disturbance of land usage, increased solid waste, and waste of recyclable resources. To solve this issue, the Ministry of Local Government (MoLG) is developing an adequate waste management system, which will include ordinances, guidelines, and standards. In metropolitan areas, the construction sector creates a substantial amount of C&D trash, which is disposed of without the direction of the public authority, resulting in environmental damage and public concern. In Palestine, there is no published study or active rules governing the disposal of building debris. The ministry intends to minimize this serious issue. As Figure 1.4 show, estimated annual C&D waste generation amount (ton/year) over West Bank.

Figure 1.4

Estimated annual C&D waste generation amount (ton/year) over West Bank



Source: (Suleiman Abu Mufarreh).

1.15 Construction Waste Materials

1.15.1 Concrete

Waste generated from construction and demolition projects comprises various materials, with concrete constituting a significant portion that occupies vast space in landfills. Given that transportation, processing, and quarrying of alternatives entail additional operations and incur associated environmental and economic costs, utilizing recycled materials in roadway applications should not be a subject of contention. In most cases, the energy requirements are significantly lower compared to those needed for conventional concrete manufacturing, making it the optimal choice for achieving carbon

savings in green construction. Construction sites are increasingly becoming the main source of production of the enormous type of demolition waste that is demanding special attention due to its huge environmental detriment. This contributes to large scale production of a variety materials which in the end will be blocks and concrete, wood and metal and different other discharges.

The utilization of concrete made from recycled materials is achieved through on-site crushing, coupled with the creation of a useful sub base for roads and foundations. On-site crushing proves to be both high-yield and cost-effective, providing a method to reclaim concrete from the debris on the construction or demolition site. On-site crushing enables the smooth processing of concrete provided by the demolition activities and is the best way to deal with waste associated with environmental demolition activities. It eliminates the necessity to transport large volumes of waste to off-site facilities, thus lowering transportation costs and emissions improvised. On-site crushing eliminates or significantly reduces the need for transportation, resulting in environmental benefits and cost savings. The utilization of Recycled Concrete Aggregates (RCA) in pavement construction contributes to achieving greater sustainability goals. The layers, provide structural support to the paved surface while also distributing such loads, they do it to avoid settling and improve all stability.

When considering the extraction of aggregates, there are both advantages and disadvantages to consider. This practice not only reduces waste but also conserves natural resources, resulting in less concrete needed and thus a reduction in cement consumption. However, there are concerns regarding the use of recycled concrete, as it may contain impurities that could degrade the quality of the reclaimed materials. Despite these concerns, recycling concrete not only conserves resources but also contributes to the Circular Economy by extending the lifespan of goods.

1.15.2 Asphalt

Demolition activities create a considerable amount of asphalt-containing material. Recycled asphalt is created by a systematic process of collecting, crushing, and processing asphalt components recovered from demolition sites. This technique converts leftover asphalt into a valuable resource called Recycled Asphalt Pavement (RAP), which may be reused in new construction projects. The use of recycled asphalt

is consistent with CE ideas, which emphasize the necessity of material reuse and waste reduction (Burcu Aytekin & Mardani, 2022) .

Reusing reclaimed asphalt in construction projects may have both positive and negative outcomes. Positive outcomes include resource conservation, energy savings, cost-effectiveness, and reduced landfill trash. Recycled asphalt may be swiftly placed, resulting in quicker project completion times. However, it may also have quality fluctuation, contamination problems, durability challenges, application restrictions, regulatory compliance, and a lack of adoption owing to conventional views (Green & Bilyanska, 2023) .

Positive outcomes include preserving resources, energy savings, cost-effectiveness, and reduced landfill trash. Contaminants may have an impact on the quality and durability of recycled asphalt, and applications that require high performance may be limited. Compliance with local standards is critical for safe and efficient operation (Green & Bilyanska, 2023).

Some stakeholders may be hesitant to utilize recycled asphalt due to concerns about performance, durability, or antiquated beliefs. To maximize the benefits while limiting the drawbacks, strict quality control processes, adherence to standards, and consideration of the intended use of recycled asphalt are essential. Advances in recycling processes, as well as increased awareness of the benefits of recycled materials, are encouraging the use of recycled asphalt in construction projects.

1.15.3 Wood and Metal

Construction and Demolition Waste (CDW) administration is critical for the CI long-term viability and environmental responsibility. Wood and metal components recovered from demolished or renovated structures are significant resources that may be saved, recycled, and incorporated into new construction projects. Recycling these products not only diverts large volumes of garbage from landfills, but also helps to conserve natural resources and reduce environmental effect (Burcu Aytekin & Mardani, 2022). Reusing recovered wood and metal from demolition trash can have both good and negative consequences, depending on the quality of the recycled materials, their application, and overall building standards. Positive consequences include resource conservation, energy

savings, waste reduction, cost-effectiveness, carbon footprint reduction, and alignment with CE ideals

However, some disadvantages include quality fluctuation, contamination problems, durability challenges, application constraints, regulatory compliance, and perception and acceptability. To maximize beneficial impacts while mitigating any disadvantages, effective quality control procedures, adherence to applicable standards and regulations, and careful consideration of the intended use of recycled wood and metal in building projects are required. Advances in recycling methods, as well as increasing knowledge of the benefits of recycled materials, are helping to boost the use of reused wood and metal in construction projects (Kabirifar, Mojtahedi, & Wang, 2020). To be recyclable. According to the steel organization, recycled scrap accounts for about 100% of steel reinforcement and 25% of steel sections. Scrap steel is virtually completely recycled and can be recycled many times (Craven Research Assistant & Director, 2019) . In Japan, steel used in construction, including steel form and rebar, is produced or cut to size off-site, and the cutting debris may be recycled completely to avoid waste on the building site.

1.15.4 Non-Ferrous metal

Aluminum, copper, lead, and zinc are common nonferrous metals discovered at C&D facilities (Craven Research Assistant & Director, 2019) . In the UK, aluminum is used up to 95,000 tons, with approximately 70% recycled in 1997; copper is recycled up to 119,000 tons from a national market of 262,000 tons; lead is recycled up to 228,700 tons (approximately 85% of lead used is recyclable); zinc is recycled nearly 60,000 tons in the production of galvanized steel strip and 40,000 tons in the production of protective steel galvanized after fabrication. Only 2,000 tons of zinc sheet are used each year for roofing cladding and, to a lesser extent, flashing. Zinc accounts for roughly 30% of the overall content in manufacturing (Wang & Zhengdao, 2013)

1.15.5 Steel

The C&D business produces a large quantity of garbage, including concrete, wood, plastics, and metals. Steel, a key building material, contributes significantly to this waste. As environmental concerns and sustainability grow more significant, the emphasis on recycling materials from C&D operations has increased. Recycled steel has

enormous potential for contributing to a more sustainable and CE. The recycling process include collecting, processing, and reintegrating steel products back into the production cycle. The procedure usually begins with the demolition or deconstruction of structures, in which steel components are meticulously separated from other materials. Advanced sorting methods serve to speed the extraction of steel, resulting in a high-quality commodity for recycling. The shredded steel is then heated in furnaces to eliminate impurities, resulting in high-quality recycled steel.

Recycling steel from C&D activities provides major environmental advantages by reducing needed for new steel production, saving up to 74% of the energy required to produce steel from virgin ore. Additionally, recycled steel requires significantly less energy than virgin steel, resulting in a significant reduction in greenhouse gas emissions. It also conserves natural resources and decreases the environmental impacts of mining and extracting raw materials. It also contributes to the preservation of iron ore reserves for future generations by minimizing the demand for additional extraction. Furthermore, recycled steel from C&D operations generates jobs in collecting, processing, and manufacture, which benefits local economies (Broadbent, 2016).Furthermore, using recycled steel in manufacturing processes improves product attractiveness, potentially leading to greater sales and market share.

1.15.6 Glass

The C&D business contributes significantly to the worldwide waste stream, creating massive volumes of materials from construction sites and building demolitions. Recognizing the need of sustainable practices, the focus has switched to recycling and reusing these materials, with recycled glass gaining popularity due to its unique qualities. While glass recovery in New Zealand exceeded 68% in 2011 and 66% in 2010 (Gao et al., 2020), recycling and recovery rates in the United States are also low, with approximately 27.7% of glass recovered and 8.37 million tons dumped in landfills in 2012 (Environmental Protection Agency, 2012) .

According to Letelier, Tarela, & Osses (2017) advised a 10% substitution of cement with glass powder with a maximum size of 75 μm and 30% (Nassar & Soroushian, 2013) , on the other hand, found that replacing 20% of the cement with milled waste glass in RAC increased concrete parameters such as flexural strength, compressive strength, workability, and reduced drying shrinkage and Alkali-Silica Reaction (ASR)

expansion. (Rahim & Amat, 2015) found that using 10% waste glass instead of sand resulted in the maximum compressive strength. The study used glass sizes ranging from 150 μm to 4.75 mm and found the cube samples had a strength of above 30 MPa. (Tan & Du, 2013) reported a loss in mechanical characteristics when glass sand was utilized to substitute natural sand in a mortar. While the use of recycled glass in C&D operations has increased, difficulties such as contamination and restricted markets remain. Addressing these issues needs a coordinated effort from the building sector, waste management facilities, and government agencies. Opportunities for innovation and improved awareness can boost demand for recycled glass goods, promoting a more sustainable and CE.

Recycled glass finds use in a variety of sectors, demonstrating its versatility and adaptability. In the CI, it is used as an aggregate in concrete, which improves structural integrity and sustainability. Furthermore, recycled glass is used in the production of glass countertops, tiles, and ornamental components, creating a distinct look while reducing environmental impact.

Glass is recycled to produce glass fiber, which is used in thermal and acoustic insulations and can be blended with strengthened cement, gypsum, or resin products (Craven Research Assistant & Director, 2019) . Japan uses recycled glass as an isolation material, whereas the United Kingdom uses recycled glass as a fine cement alternative known as "ConGlassCrete" (Tam, 2006). And aggregate in roads crushed glass has been created for use as an aggregate in bituminous concrete pavement; widely known as 'glass halt', it has been tried in the United States. The C&D glass trash is utilized to create a certified aggregate for septic systems (Tam, 2006).

1.15.7 Bricks

Recycled bricks are a sustainable alternative to landfill garbage, which reduces the need for fresh resources. The reclamation process includes painstaking sorting, cleaning, and processing to maintain structural integrity and quality for reuse. Recycling brick debris in concrete making is an ecologically beneficial substitute that reduces disposal issues and natural resource usage. Brick is the second most often used building material after concrete, and recycling it can help reduce the consumption of natural resources. Dhaka generates 0.269 MT of brick garbage, accounting for 21% of cost CDW (For't & C'erny, 2020) . Broken bricks can be combined with cement and adhesive to create

blocks appropriate for enclosure, greening, and ground tile manufacture (Zhoa et al, 2010) . Broken bricks should be used as a raw material alternative in the third main recycling process, after road foundations.

Recycled brick debris is commonly utilized as a natural aggregate substitute, notably in road building (Ram et al , 2020) . The processed Waste Brick (WB) is widely utilized because of its simplicity and minimal need for extra material processing and treatment. WB aggregates may be utilized as fine or coarse aggregate, and its high porosity improves moisture conductivity and chloride ion penetration. The WB aggregates have been employed effectively to create lightweight concrete so that weight less than 1800 kg per m³ can be presented (Zhoa et al, 2010) . It has been revealed finely powdered building elements manage to decrease a destructive reaction between silica and alkali that happens if it is not well combined. In general, recycled brick debris and accumulated brick dust might possibly bring into the sector the sustainable building practices and practical environment friendly system for the construction sector.

1.16 Construction Waste Management

Construction waste management is the organized process in which gadgets generated during the said process of building, deconstruction, reconstruction, or demolition are employed. The company conducts all these processes in addition, including sifting, crushing, transporting, and stockpiling waste. Landfill wastes pollute the air, water, and soil by being converted into CO₂ and methane as absorptive decomposition occurs. Waste handling during construction proceeds with two techniques that are set forth:

1. **Technical Solutions:** This approach involves implementing design and construction practices that minimize waste generation. Examples include using prefabricated components, modular construction techniques, and designing for disassembly to facilitate reuse and recycling.
2. **Material Recovery:** This approach focuses on recovering and recycling materials from construction waste. It includes processes such as sorting, separating, and processing waste materials to extract valuable resources for reuse or recycling. Examples include recycling concrete into aggregate for new construction projects or reclaiming wood for use in furniture or landscaping.

Contractors must develop a waste management plan as part of their overall environmental management strategy, as well as establish waste reduction objectives and programs. If garbage is unavoidable on building sites, on-site sorting and safe waste disposal are recommended. In Hong Kong, building waste is frequently divided into inert and non-inert categories, with inert materials dumped in public filling areas for land reclamation and non-inert materials disposed of in landfills as solid trash. Waste management include eliminating waste whenever possible, decreasing waste when practicable, and reusing items that would otherwise be discarded. Solid waste management strategies emphasize waste minimization, recycling, and reuse.

As people become more conscious of the environmental implications of building waste, waste management has emerged as an essential method to construction project management. trash management relies heavily on the 3R ideas, which include trash reduction, reuse, recycling, and landfill disposal. The efficient use of building materials is critical to reducing waste creation.

1.17 Environmental Impact of Construction Waste

The rise of the construction sector has substantial environmental consequences (Ansah, 2015), particularly in terms of environmental change and waste generation. Construction waste, whether accumulated outside or buried in the ground, can seriously pollute surface and ground water bodies, endangering the life of aquatic species, hurting inhabitants' living water, and jeopardizing drinking water quality.

The buildup of dangerous compounds in the soil generates a rise in harmful materials, which impedes plant growth and may cause plant mortality. Plants growing in contaminated soil can absorb dangerous compounds and pass them on to fruits, putting human health at risk through the food chain. Demolition operations have a huge detrimental influence on the natural environment. Landfilled and dumped garbage occupy land, diminish soil fertility (Hongping Yuan, 2013), and pose significant threats to groundwater and surface water owing to hot water leaching (Delay, Lager, & Schulz, 2007). Large building materials are discarded owing to their high residual value yet are not recyclable, increasing energy consumption for transportation and disposal. Dust, gas emissions, and noise pollution may all have a severe influence on the environment when demolition technology is utilized for transportation and disposal.

1.18 Previous studies on adoption of CE in CI

1.18.1 Awareness of the principles of the CE

Knowledge about the CE principles is useful when individuals want to encourage sustainable processes within industries that can incorporate this methodology such as construction business. CE is an approach whereby the business community fosters and supports processes of economic growth that use resources responsibly, going for minimal depletion of these resources, and encouraging stewardship of the environment. Increasing the consciousness level of the stakeholders like the workers, the managers, and the policymakers is equally a central point towards the successful application of the CE practices.

Awareness initiatives may be of different type including awareness, orientations, seminars and awareness campaigns. These efforts' purpose is to equip the stakeholders interested in CE with the information needed to understand what CE stands for or how it integrates elements like resource efficiency, sustainable waste management, recycling, or closed-loop systems. These include the awareness of the benefits and applicability that is actualized in CE which leads to the integration of the practices worthy of implementing in the operations of individuals and organizations (Kirchherr, Reike, & Hekkert, 2017) . For instance, (Kabirifar, Mojtahedi, & Wang, 2020) stress that awareness and understanding are critical success factors for CE in the electronics industry and developing educational programs to provide demand-side information is crucial. The fact that most people had little knowledge of environmental issues shows how helpful these programs are in promoting a sustainability culture. Consequently, (Geissdoerfer & Martin, 2020) argue that awareness campaigns can serve to inform lastly the potential environmental and economic impact of CE, thus encouraging even more companies to engage in CES. Furthermore, the understanding of CE principles will foster more cooperation and review of information between the stakeholder involved in the sector. Such a system also improves the function and effectiveness in practicing CE as well as fostering innovations in sustainable technologies (Bocken, Pauw, & Bakker, 2016) . Therefore, development of awareness is the first among many steps that can be taken to create a future construction industry that is sustainable and resilient.

1.18.2 Current Practices in the Construction Industry

If it is not possible to directly source some of the products from recycled or reclaimed material, then it is recommended to use parts and components at least. The level or degree to which construction or organizations incorporated the use of recycled or reclaimed materials differs drastically. Many have already incorporated these practices into their operations on a large scale due to various reasons such as compliance with rules, corporate social responsibility as well as decrease of expenses. For instance, in the European Union, the legislation has played a crucial role in increasing the likelihood of using recycled materials as construction and demolition waste management recycles more than 70% of C&D waste as per the (Ramos, 2023). Though, in the other regions, the practices have not been adopted to the same extent owing to low pressures from the regulations and low awareness (Ahmed & Majava, 2013) .

The level of concern in scouring and incorporating recycled products is a barometer of the various organizations' fidelity towards the new concept of circular economy. Businesses that are in some way oriented on providing environmentally friendly services usually tend to have special procurement policies that focus on acquiring recycled products. Studies suggest that such preventive measures hold the potential of yielding considerable changes within the environmental domain and leaving a positive impact on costs (Amudjie, 2023) . There are still some challenges in these endeavors; for instance, supply chain challenges and the perceived quality of the recycled material can pose challenges (Ahmed & Majava, 2013).

The frequency of using materials derived from the demolition sites is the other aspect defining the present day practices in construction industry. While some organizations routinely use these materials in their food packaging and transportation, others use it less often because of issues of material quality and safety. To be more specific, it is necessary to mention that proper practical application of material reclamation from the demolished object's area presupposes the applicability of certain firmly entailing mechanisms and the ensuring of pertinently high-quality non-acceptance. The opportunity to build new construction using old materials like bricks and concrete that are collected from demolished buildings has been perfected by other constructors, this has made other constructors to embrace it (Hobbs & Adams, 2017) . Reducing, reusing and recycling construction waste on site is an important strategy that has to be used in

the construction industry in order to adopt sustainability strategies. Businesses that adopt waste management programmes at workplace generally record increased rates for recycling as well as re-use thus cutting down on the overall volume of waste. For instance, construction activities in countries that observe high standards for rules on waste management such as Germany have high recycling rates since the construction sites are required to conduct on-site sorting and recycling (Ramos, 2023) . Though these practices are efficient, they can also fail due to some organizational policies and the availability of proper recycling structures (Ahmed & Majava, 2013).

1.18.3 Barriers and challenges in construction industry

Based on the analysis of the literature, several barriers and challenges exist in the construction industry in addressing CE. Recycling is also an issue when it comes to buying parts and materials for the product since some of them cannot be bought as recycled. These scarcities are often due to poor collection and processing facilities for C&D waste and limit construction projects' abilities to recycle and reuse materials, which is at cross purposes with closing the loop (Ghaffar, 2020). Furthermore, lack of a concrete framework and regular norms and practices for showcasing the CE principles is another challenge limiting the Palestine construction industry. It is hereby important and desirable that policies and procedures are well stated in order to reduce confusion in the application of the CE practices. Their absence creates confusion and ambiguity through failure to provide clear directives on how CE practices can be incorporated and implemented, thus explaining why their lack impacts the ability of construction professionals to embrace and follow CE practices.

It is also agreed that more funding based on financial rewards and, if necessary, subsidies is needed to ensure CE initiatives' sustainability. Here in Palestine such incentives are rare, and their absence presents a massive difficulty. Incentives in the form of subsidies or tax reliefs would go a long way in enhancing the usage or integration of environmental friendly products. A great drawback of CE measures is that their upfront costs may be overwhelming for many construction firms, unless if of course there are appropriate incentives to encourage implementation (torgal & Pacheco, 2013).

Furthermore, the lack of training and skill development schemata aggravates the lack of CE practice among construction industry practitioners. Educational interventions to workplace professionals can greatly facilitate their understanding of CE principles, enabling them to be trained how to implement those principles. That is why it is critical to recognize that in places like Palestine where there are limited implementation of such programs, lack of human capital could act as a barrier towards realization of sustainable practices (Kirchherr, Reike, & Hekkert, 2017) .

Poor stakeholder engagement is a major cause of CE failure as the When identifying CE initiatives, communication between various stakeholders are essential. The construction industry subsystem comprises of many players like contractors, suppliers and regulators, and when they are not in agreement, there will be set back. In Palestine, there is no efficient experience and collaboration procedure add to the challenges of implementing the plans (Bressanelli, Perona, & Saccani, 2017). The absence of clearly defined CE best practices is yet another important factor that would continue to work against the use of such practices in the construction industry among professionals. CE has also benefits of implementing standard procedures as well as standard measure that have been established to guide its practice. Its absence means that the process can be unsystematic, and the efficacy of CE initiatives suffers (Adams & Osmani , 2017) .

This includes the following; Finally, it is crucial to behold that there are certain limitations that come with the application of sustainable practices within the context of construction industry, most importantly, the economic issues are always a major impediment. The costs involved in implementing the change toward CE practices may be quite high especially at the initial stages, and this has been noted as a major barrier that discourages construction firms from adopting the technology change. Such constraints are even more blatant in developing economies given that financial tools are deficient (Berg, Antikainen, & Hartikainen, 2018).

1.18.4 Opportunities and incentives in construction industry

The adoption of round CE ideas within the production industry offers numerous opportunities and is pushed by using diverse incentives. One of the number one benefits is the big reduction in environmental effect. By minimizing waste, reusing substances, and enhancing useful resource performance, construction initiatives can extensively

decrease their ecological footprint. This is more and more recognized as crucial for sustainable development and has been shown to be useful now not only for the surroundings however also for the long-time period viability and cost-effectiveness of creation tasks (Adams & Osmani , 2017). Interest in incentives and aid programs aimed at selling round practices within the creation enterprise is developing. These applications can include monetary incentives, subsidies, tax breaks, and presents that make it economically feasible for companies to transition to greater sustainable practices. Research indicates that such incentives can substantially beautify the adoption charge of CE principles inside the creation zone with the aid of offsetting the preliminary expenses and making sustainable practices more attractive (Gao & Qingliang, 2020) .

Government guidelines and guidelines play a important position in promoting the adoption of CE standards. Effective regulations can set clear requirements and create a regulatory framework that encourages sustainable practices. For example, guidelines that mandate using a positive percentage of recycled substances in creation projects can power the market towards greater sustainability (Datta & Tayeh, 2023). The function of presidency is visible as pivotal in growing an surroundings in which round practices can thrive, offering each the carrot (incentives) and the stick (regulations) to guide industry. Financial incentives are in particular crucial in encouraging stakeholders to take part in collaborative efforts to undertake CE practices. Financial blessings can motivate companies to make investments inside the necessary infrastructure and technology for recycling and reusing materials. Studies have proven that once monetary incentives are aligned with environmental goals, stakeholders are more likely to collaborate and engage in sustainable practices (Kirchherr, Reike, & Hekkert, 2017).

Recognition and awards also play a considerable position in motivating stakeholders. Programs that publicly acknowledge and reward agencies for their sustainability efforts can enhance their reputation and inspire others to observe suit. Such popularity serves as a powerful incentive for businesses to adopt and put in force CE practices, because it no longer handiest offers outside validation however additionally enhances their marketplace competitiveness (Geng et al, 2012) . Overall, the mixture of financial incentives, regulatory guide, and reputation packages creates a sturdy framework that promotes the adoption of CE principles. Organizations are an increasing number of

interested by those incentives as they align financial advantages with environmental sustainability. As the development enterprise continues to evolve, those possibilities and incentives could be important in driving the big adoption of circular economic system practices.

Chapter Two

Methodology

2.1 Chapter Overview

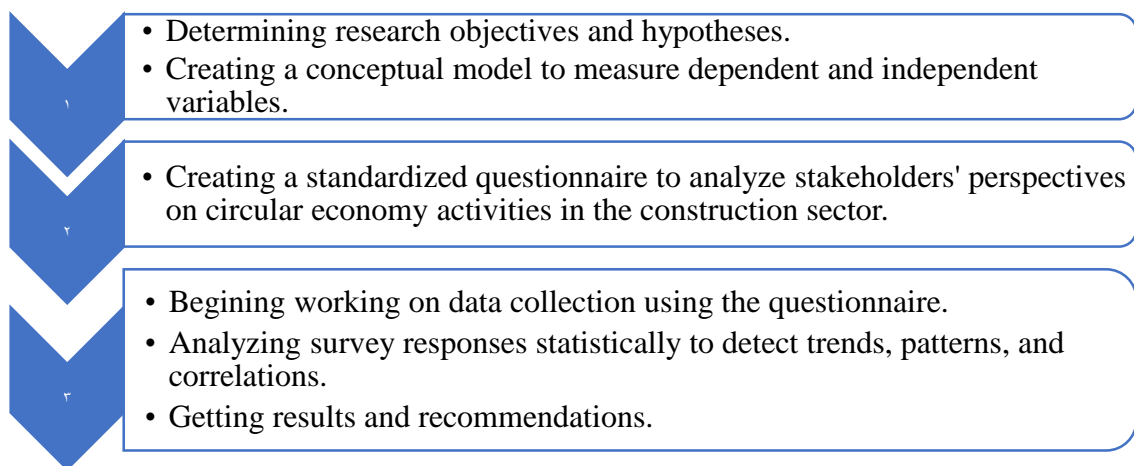
This chapter explains the technique used within the thesis, starting with the studies design, then sampling method and figuring out the sample size, then it records data collection methods, then data evaluation strategies, then designing the survey questionnaire.

2.2 Methodology Flow Chart

The pathway below in Figure 2.1 outlines the methodical stages and techniques used to uncover research insights and answers.

Figure 2.1

Methodology flow chart



2.3 Research Design

In this thesis, quantitative and qualitative approaches were used that help determine the impact of sustainability in the Palestinian building and CI. Both approaches are also helping to increase the extent of CE adoption. The awareness-raising approach is applied by conducting a questionnaire. This questionnaire aims to collect quantitative data on the current practices and positions of stakeholders in the Palestinian CI regarding the principles of sustainability and the CE. This questionnaire was distributed to workers in the construction sector, engineers and other stakeholders. A 5-point Likert scale was used in the thesis.

2.4 Sampling Strategy and Sample Size Determination

The sample size means the amount of observations participants are included in a research study plus the survey. This is a foundational component of research methodology and determine whether or not the results can be considered true or not and whether or not they can be generalized. A greater extent of sample size results in more efficient estimation with a higher statistical power of the investigation which implies that the researcher would tend to detect smaller effects or differences with more confidence. On the one hand, smaller sample sizes may suggest less reliable findings and limited generalizing to the whole population, while on the other hand, on the other hand, the main advantage of small sample sizes is their independence and perception as being closer to everyday life. It would be a matter of settling on the best sample size depending on a lot of attributes which range from the research aim and the study design to the level of precision and the expected statistical significance (Jenkins & Quintana-Ascencio, 2020) .

The target group for the message is engineers, especially supervisory engineers, contractors registered with the Palestinian Contractors Union, real estate investors, and professional workers such as builders, carpenters, and others.

The sample was selected based on the following table according to (Hair et al, 2011) as the sample size of this study according to the attached Table is 80 samples, and the maximum number of constructs from the survey for this study is 7 constructs and the significance level is 5%.The minimum R^2 is 0.25, so the required sample size is 80, and the sample size derived from the gathering of data period is 80 responses. The percentage is distributed among the required category as follows (35% contractors, 25% project and site managers, 40% engineers). In addition, Steven Thompson's Formula was used to calculate the sample size. The population size that would result in a sample size of 80, given a 95% confidence level, 5% margin of error, and maximum variability ($p = 0.5$), is approximately 101.

Cohen 1992 provided sample size recommendations in PLS-SEM for a statistical power of 80% as shown in the TableA.1 in Appendix A. With the maximum number of arrows indicating a construct equal to seven in this study, the sample size reaches a significance level of 5% and the minimum R^2 is 0.25 which is acceptable.

2.5 Data Collection Methods

Quantitative data was collected by a questionnaire. The questionnaire is divided into two parts, The first part is for collecting basic personal data for the research participants. The first part helps understand how is the target sample is distributed based on such indicators as gender, age, education, period of experience in a specific industry, construction, geographic location, function/role in the industry. All this makes it possible to understand the characteristics of the sample and better interpret the collected data. And the second part of the questionnaire consists of 7 sections: (Awareness of the principles of the CE, Current Practices in construction projects, Barriers and Challenges, Opportunities and Incentives, Environmental and economic impact, Collaboration and Partnerships and Future Outlook).

On the other hand, the first section in part two, Awareness of the principles of the CE, are designed to measure the amount of participant's knowledge regarding the concept of CE principles within the construction sector. This section consists of six questions which are provided to assess the knowledge of the participant regarding the definition of a recycling process, utilization of recycled products, and reuse of products applied in the construction industry, as well as the role and effectiveness of Palestinian industrial associations and organizations in increasing their awareness in Palestine.

The second section of the questionnaire is intended to assess general practices in construction projects regarding recycled and recycled materials and reuse, as well as construction waste management and recycling. It consists of a four of questions trying to reveal whether various organizations have developed a sufficient level of circular economy implementation in construction projects. Finally, it should give an insight into the willingness of companies and organizations to enhance those practices. The third section is about discovering the leading barriers to implement the circular economy and suggest the possible solutions to them or the areas for improvement to stimulate the implementation of the circular economy in the construction sector. The fourth section was Opportunities and Incentives, it concerns evaluating the role of money incentives and support in the encouragement of circular economy practices in the construction industry and measuring the significance of government's policies and legislation in the adoption of circular economy principles. Moreover, the section focuses on finding out whether participants are willing to profit from the money incentives and support in

circular practices and predicts how much the incentives influence the various parties to participate in pulling together to adopt circular economy principles in the construction industry. The segment five approximately Environmental and economic impact, this segment objectives to understand greater deeply the ability environmental and economic influences of adopting circular financial system ideas in creation projects, In addition to measuring the beneficial impact of circular economy activities on employment creation in the local community. Section six is ready Collaboration and Partnerships, this segment ambitions to recognize the role that partnerships and collaboration can play in promoting CE system concepts within the production industry, and to determine the quantity to which groups and institutions are willing to take part in those efforts. On the last part of the section which is devoted to studying the views of the participants about whether or not they are the optimistic sufficient of the paradigms of the CE the construction industry in Palestine is likely to be applied. Such a survey helps to set up the indicator of degree of confidence in the process of the construction industry moving toward sustainable development as well as defines the actions that should be taken in the future to promote the adoption of the pattern of the circular economy. Moreover, the questionnaire was put to the on-site engineers (engineers in charge particular), contractors, professionals, and the industry experts to solve the problem of what the main factors affecting CE principles.

2.6 Data Analysis Techniques

This thesis includes analyzing quantitative and qualitative data to adopt the principles of economics in the CI and determine the sustainable impact.

The Smart PLS program was used to conduct statistical analysis and identify trends and patterns, in addition to a Structural Equation Modeling (SEM) using Smart PLS to verify the validity of the proposed model through relationships.

As for descriptive statistics, their importance lies in that they help and give an overview of the distribution of data and identify trends and patterns, where the standard deviation, median, and average were used. SEM was evaluated by: Goodness of Fit (GoF), Effect Size (F^2), Coefficient of Determination (R^2), Convergent Validity, and Model Fit Analysis.

2.6.1 Convergent Validity

Hair et al., (2014) define convergent validity as the correlation between indicators used to measure the same construct. The Average Variance Extracted (AVE) approach is commonly used to assess the convergent validity of reflective measurement models. The recommended minimum considerable outside loading is 0.6. The AVE represents the grand mean of a construct's squared indicator loadings. To be considered noteworthy, a construct's AVE must be at least 0.50 (Hair, Sarstedt, & Hopkins, 2014) .

2.6.2 Effect Size (f²)

Effect Size (f²) is a tool commonly utilized in studies to gauge the intensity of a connection or the scale of an impact. It offers perspectives on the real world relevance of discoveries, beyond their statistical significance. A significant effect size signifies that the independent variable greatly influences the variable whereas a minor effect size implies a subtle impact. The f² values are calculated with the Smart PLS program. A construct is termed small if its f² value is between 0.02 and 0.15, medium if it is between 0.15 and 0.35, and big if it is larger than 0.35 (Leguina, 2015). According to (Essentials of Business Research Methods, 2013.), a construct with f² value <0.02 indicates no influence on the endogenous construct.

2.6.3 Goodness of Fit (GOF)

GoF is a statistical measure that determines how well observed data fit a particular model or distribution. It is often used in fields such as statistics to determine how well a statistical model explains or represents observed data. It is an essential aspect of speculation checking out and version assessment, because it helps researchers decide whether or not the consequences of their evaluation are dependable and valid. GoF is the geometric suggest of the common values of AVE and R² for the endogenous variables. The GoF index can be determined using Eq. 1, which is as follows:

$$\text{GoF} = \sqrt{R^2} * \sqrt{AVE} \dots\dots\dots \text{Eq (1)}$$

Where,

R²: Coefficient of Determination

AVE: Average Variance Extracted

2.6.4 Model Fit Analysis

Analyzing version healthy is a step, in figuring out how nicely a statistical version represents the information. It involves assessing the alignment among the model and the real facts points. Researchers use measures just like the Coefficient of Determination (R^2) to gauge how well the model captures underlying facts patterns and perceive areas, for enhancement. Evaluating model fit is crucial to ensure that the selected model accurately depicts relationships and can provide predictions, and enhance the validity and reliability of their findings.

2.6.5 Coefficient of Determination (R^2)

The R^2 value, also known as the Coefficient of Determination is a metric utilized in research to gauge the intensity of a connection or the impacts size. It is determined by squaring the correlation coefficient (r), between the independent variables. R varies from 0 to 1 where 0 signifies no link between the variables and 1 signifies a flawless relationship. A greater R value indicates an association, between the variables while a lower R value indicates a weaker connection.

Chapter Three

Analysis and Results

3.1 Response Rates

After analyzing the questionnaire results, 80 of them were identified. The results of 80 individuals were analyzed, so the response rate was 100%. Table A.2 in Appendix A shows summarizing the results of the analysis.

The questionnaire was issued to the target population, together with interviews with contractors, in order to investigate the types of trash created at each step of the building process, whether or not it is sorted, and the sorting method, as well as the volume of garbage produced.

3.2 Demographic Profiles of the Respondents

The demographic profile of survey participants gives useful insights into the stakeholder mix of Palestine's building sector. A wide range of specialists were involved, including architects, engineers, contractors, project managers, and other major figures involved in various phases of construction. Respondents' ages ranged widely, indicating that they were at various stages of their careers in the sector. The majority of participants were between the ages of 25 and 34, demonstrating a fair representation of age groups. Furthermore, the gender distribution included both male and female respondents, with a greater proportion of men replying. In addition to the highest academic degree, which was a bachelor's, and the years of professional experience of building and construction, which constituted 42.5 %, ranging between (0-5) years, and the geographical location, which constituted about 47.5 % of the city, and the most common profession among respondents was civil engineer/construction, which represented 33.8 %, as shown in the Table7 in the appendix.

This broad demographic profile highlights the breadth of opinions and experiences provided in evaluating the possible adoption of circular economy concepts and their influence on sustainable performance in Palestine's building sector.

3.3 Descriptive Analysis

Descriptive analysis was conducted to determine the extent to which it is possible to evaluate the possibility of adopting the CE and its impact on sustainable performance in the CI in Palestine. The 80 participants were selected to participate in this study, and the sample was randomly selected from a list of companies operating in the CI, such as contracting companies and engineers in Palestine. Survey data were distributed online, with data links successfully distributed via email and social media. Moreover, all items The questionnaire was measured on a five-point Likert scale (from 1 = strongly disagree ,5 = strongly agree).in order to interpret the results, the length of the period was calculated, where a value between 3.67 and 5 was considered high, from 2.34-3.66 was considered medium, and between 1-2.33 was considered low. These classifications were arrived at using the formula: length of period = (highest weight - lowest weight) / (three ranges) = (5-1) / (3) = 1.33.

The results show that the overall level of execution of both Awareness of the Principles of the CE (AW), Current Practices in Construction Projects (PC), Barriers and Challenges (BC) Opportunities and Incentives (OI), Environmental and Economic Effect (EEF), Collaboration and Partnerships (CP), Future Outlook (FO), Total adopting the principles of CE, Total Construction industry was high level. Table 2 in Appendix A presents the results of descriptive analysis for all items used in the study, table 3.1 shows Gross average of C&D waste component in West Bank, and the Table 3.2 shows Implementation level for constructs.

Table 3.1

The mean, standard deviation and implementation level for constructs

Item	Mean	Standard deviation	Implementation level
Awareness of the principles of the CE (AW)		0.852	High
Current Practices in construction projects (PC)	3.667	0.797	High
Barriers and Challenges (BC)	3.885	0.819	High
Opportunities and Incentives (OI)	3.747	0.794	High
Environmental and economic effect (EEF)	3.766	0.804	High
Collaboration and Partnerships (CP)	3.809	0.765	High
Future Outlook (FO)	3.778	0.71	High
Total adopting the principles of CE	3.708	0.715	High
Total Construction industry	3.969	0.863	High

3.4 Assessment of the Measurement Model (Outer Model)

The reflecting measurement model must be analyzed in order to determine the constructs' reliability and validity. Reliability refers to the consistency and precision with which the concept is measured across diverse settings. To decide on convergent validity, we compare indicator reliability, composite reliability, and average variance. The Extracted (AVE), Cross loadings, the Fornell-Larcker standards, and the Heterotrait-Monotrait ratio (HTMT) are utilized to evaluate discriminant validity.

The measurement model includes indicators and paths for measuring Awareness of the principles of the CE, Current Practices in construction projects, Barriers and Challenges, Opportunities and Incentives, Environmental and economic effect, Collaboration and Partnerships, Future Outlook, Adopting the principles of CE, Construction industry.

3.4.1 Convergent Validity

Convergent validity is an important part of establishing construct validity in research, and it is one of the primary factors considered when evaluating a measurement model in Structural Equation Modeling (SEM) studies. Furthermore, convergent validity is one of the primary methods for determining construct validity, since it analyzes the degree of convergence of several indicators for the same concept, The notion or link between these indicators ("Handbook of Partial Least Squares," 2010). Convergent validity can be determined using tests such as indicator loading, AVE, and construct Composite Reliability (CR). A high factor load on the building indicates connectivity. There are several commonalities among the indicators, which are assessed through construct and need external loadings, since in preliminary research they are allowed to be higher than 0.60 (Hair et al., 2014.). If the value is greater than 0.60 it is considered strong, indicating that the indicator is a good measure of its basic structure. Based on the results Factor Loadings in the Table A.4 in Appendix A, it is clear that all values are greater than 0.60, indicating that they are all relatively strong indicators. For them. Constructs are well-measured by the indicators that are examined. This is a favorable sign of the validity and reliability of our PLS-SEM study.

The AVE, described because the grand mean value of the squared loadings of the signs related to the assemble (i.e., the overall of the squared loadings divided through the

quantity of signs), have to be extra than 0.5 (Henseler et al, 2016) . In our take a look at, as shown Construct Reliability and Validity in the Table five, all constructs within the research model have AVE values extra than 0.5, suggesting that they may be properly assessed, which is a great signal of the model's validity.

Table 3.2

Construct Reliability and Validity

Construct	Cronbach's alpha	Composite reliability	(AVE)
AW	0.840	0.913	0.543
BC	0.869	0.886	0.565
CP	0.725	0.728	0.644
EEF	0.823	0.833	0.587
FO	0.737	0.765	0.658
OI	0.901	0.905	0.630
PC	0.776	0.801	0.600

Cronbach’s alpha is a measure used to quantify the reliability of a set of scales, or of the items in a test. It provides a measure of as to how integrated the items on the scale are. The Cronbach’s alpha score indicates that the items in the scale are equally interrelated and closely related since a high score shows the most internal consistency. Hair et al., (2014), on the other hand, explains that a Cronbach’s alpha of 0. 70 or higher as corresponding dependability of internal consistency to the criterion. Secondly, CR is an internal measure, which has a value between (0-1) to determine the consistency of the indicator, the variability of error rate variance index was used. A CR value greater than 0.7 was taken into consideration as higher CR values indicate higher levels of reliability (Hair, oseph, & Tomas, 2021) .

3.4.2 Discriminant Validity

Discriminant validity assesses the extent to which constructs differ from each other, ensuring that each latent variable measures a unique concept. In SEM, discriminant validity is typically assessed by comparing the square root of the AVE for each construct with the correlations between the constructs. AVE values must be higher than the correlations between constructs to demonstrate discriminant validity (Leguina, 2015).

There are numerous approaches for assessing discriminant validity. The first technique is called the Fornell-Larcker criteria. Fornell and Larcker (1981) created this criteria, which compares the square root of the Average Variance Extracted (AVE) for each construct to their correlations. The square root of each build (AVE) must exceed the highest. Correlation with other constructions (square root of AVE for each) requires a structure to be greater than the maximum connection with other structures in the same row and column, as shown the Table 3.3.

Table 3.3

Fornell- Larcker criterion

	Awareness	BC	CP	EEF	FO	OI	PC
AW	0.737						
BC	0.250	0.850					
CP	0.271	0.78	0.805				
EEF	0.212	0.752	0.766	0.803			
FO	0.203	0.766	0.718	0.741	0.811		
OI	0.149	0.811	0.694	0.743	0.615	0.913	
PC	0.179	0.794	0.663	0.74	0.579	0.775	0.811

The cross-loading approach is one way to assess discriminant validity. It helps evaluate whether each indicator is primarily assessing its target construct or capturing variation from other constructs. It evaluates how much each indication depends on the targeted latent variable in comparison to the other latent variables in the model. The results shown cross loadings in the tableA.5 in Appendix A, show the indicators placed in it relationship with model constructs. The table shows, for example, the values of (AWA1, AWA2, AWA3, AWA4, AWA5, AWA6(is (0.683, 0.807, 0.773, 0.617, 0.754, 0.769), Which belongs to Awareness which represents the highest values in each row and therefore, it Discriminant validation.

The third type of testing is Heterotrait-Monotrait (HTMT), which is used to assess discriminant validity in (SEM). Where an HTMT score of less than 1 implies high discriminant validity and good reliability, and a number larger than 1 suggests possible discriminant validity issues, all HTMT values are provided in the Table 3.4. It is evident that all values are smaller than one, which indicates discriminant validity.

Table 3.4*Heterotrait -monotrait ratio (HTMT)*

Construct	Awareness	BC	CP	EEF	FO	OI
AW						
BC	0.267					
CP	0.312	0.96				
EEF	0.232	0.99	0.999			
FO	0.235	0.945	0.971	0.941		
OI	0.156	0.908	0.85	0.859	0.745	
PC	0.202	0.969	0.861	0.915	0.733	0.998

3.5 Assessment of the Structural Model (Inner Model)

3.5.1 The Coefficient of Determination (R^2)

The R^2 measures how much the IDV contribute to the observed variation in the DV. It is crucial in determining the model's success in predicting outcomes. (Ringle & Sarstedt, 2018). R^2 is the percentage of variation explained by the model in the DV, with values ranging from 0 to 1. Table 8 shows the values of R^2 , and we note that the values lie between 0 and 1, indicating high model agreements and demonstrating that the IDV the model explains a significant amount of variance in the dependent factor.

3.5.2 Predictive Relevance (Q^2)

The Q-square (Q^2) statistic evaluates a model's prediction performance. Understanding and reporting Q^2 results is crucial for evaluating a model's predictive accuracy. A number larger than zero reflects the model's predictive relevance. Since the values of Q^2 in our study for all combinations are larger from scratch and the model therefore has sufficient predictive quality as shown in Table 3.5.

Table 3.5*Quality Criteria - R^2 and Q^2*

Construct	R-square	Q^2 predict
Adoption principles in CI	0.978	0.565
construction industry in the Palestine	0.985	0.56

3.5.3 The Effect Size (F²)

In a regression study, effect size is a statistical metric used to quantify the magnitude of predictors' effects on the DV. It denotes the percentage of variance in the DV that can be explained by the IDV ,and can be calculated as observe in equation:

$$F^2 = \frac{R^2_{included} - R^2_{exclude}}{1 - R^2_{included}} \dots\dots\dots \text{Eq (2)}$$

Cohen's recommendations suggest that F² has a small effect size of around 0.02, a medium effect size of around 0.15, and a high effect size of around 0.35. Table 3.6 below shows the effect size values for the constructs of this study. The F² values shown in the table indicate the adoption of the principles of the CE, the obstacles and challenges facing the adoption of the principles of the CE, cooperation and partnerships, the environmental and economic impact, future expectations, opportunities and incentives (0.59, 4.035, 2.879, 0.427, 2. 938, 1.246) The values are higher than 0.35, which means that it has a high impact on the adoption of CE principles and the construction industry.

The F² values indicate that the variable of awareness of the principles of the CE (0.182) is higher than 0.15, which means that the effect of awareness on the adoption of the principles of the CE is moderate, while the variable of current training (0.037) has a small effect on the principles of the CE.

Table 3.6

Effect Size (F²)

Construct	F ²	Effect size
Adoption principles → CI	0.59	High
AW → Adoption principles	0.182	medium
BC → Adoption principles	4.035	High
CP → CI	2.879	High
EEF → CI	0.427	High
FO → CI	2.938	High
OI → Adoption principles	1.246	High
PC → Adoption principles	0.037	Small

3.5.4 Goodness of Fit index (GoF)

GoF is an important statistic in (SEM) that assesses how well a proposed model fits the data. It is an important part of statistical analysis since it describes the difference between actual and anticipated values for a specific model. A excessive GoF shows that the version as it should be reflects the determined information, while a low GoF shows that the model may additionally need to be altered to better fit the facts. According to (Gasparri & Arasteh, 2011), To assure the validity and reliability of the SEM version, GoF evaluation is important. It can be computed the use of this smooth equation:

$$GOF = \sqrt{avg. AVE * avg. R^2} \dots\dots\dots Eq (3)$$

$$avg. AVE = \frac{0.543+0.565+0.644+0.587+0.658+0.630+0.60}{7} = 0.604\dots\dots\dots Eq (4)$$

$$avg. R^2 = \frac{0.978+0.985}{2} = 0.982\dots\dots\dots Eq (5)$$

And by applying equation:

$$GoF Index = \sqrt{0.604 * 0.982} = 0.77\dots\dots\dots Eq (6)$$

According to Wetzels & Schröder and Claudia van Oppen (2009) , the values 0.1, 0.25, and 0.36 suggest a modest, medium, and high GoF.

The extent of the model was evaluated in this research using the equation (1). GoF was determined for the suitability value 0.77, which indicates that the model represents about 77 % of the variance in the data, which indicates the GoF of the model high enough.

3.5.5 The Significance of the Path Coefficients - Hypotheses Testing

SEM was used to evaluate construction project performance by estimating structural model relationships (path coefficients) based on statistical significance and strength. The path factors' values vary from -1 to +1, indicating that the connection is regarded negative

Table 3.7*Path Coefficient, STDEV, T values, and P-Values*

Path	Original sample	Standard deviation	T statistics	P values	Results
Adoption principles → CI	0.206	0.037	5.518	0	Supported
AW → Adoption principles	0.065	0.032	1.988	0.047	Supported
BC → Adoption principles	0.535	0.037	14.602	0	Supported
CP → CI	0.383	0.025	15.304	0	Supported
EEF → CI	0.167	0.03	5.522	0	Supported
FO → CI	0.331	0.022	15.232	0	Supported
OI → Adoption principles	0.418	0.04	10.413	0	Supported
PC → Adoption principles	0.072	0.047	1.525	0.127	Not Supported

As the value approaches -1. However, if it approaches +1, the link is regarded positive; the closer the calculated coefficients are to 0, the weaker it is. Table 3.7 shows the values of the path coefficient standard deviation, T values, and P values for direct relationships.

First Hypothesis (Adoption principles → CI): Increasing awareness of the principles of CE among workers in the construction sector will significantly facilitate its adoption in the Palestinian construction industry. As shown in Table 10, it is clear that there is a positive relationship between awareness → adoption of CE principles, as the results of the analysis of the proposed hypothesis H1 are (path cof. = 0.065, t = 1.988, P value = 0.047) where the p - value Higher than 0.05 and t value greater than 1.96, the relationship can be evaluated as “significant”. A statistic “if the value of t is equal to or greater from 1.96 at a significance level of 5% and p greater than 0.05, therefore the hypothesis was supported.

Accepting the first hypothesis means that raising awareness of circular economy concepts among construction workers helps enhance the application of these concepts in Palestinian construction. This suggests that workers who have knowledge are more likely to perform actions based on it. Because the growing interest in circular economic concepts can enhance cooperation and partnerships between many stakeholders, which contributes to achieving sustainable improvement in the organization and enhancing economic and environmental sustainability, in addition to improving the environmental

and economic situation through resource management, reducing waste, and increasing resource productivity. He points out that raising awareness of the principles of the circular economy is a crucial step towards achieving sustainable growth and sustainability in the construction area in Palestine, in addition to strengthening future attempts to put these principles into practice.

Second Hypothesis (PC → adoption of CE principles): Integrating current sustainable practices into building projects promotes the adoption of CE concepts, resulting in enhanced resource efficiency, minimized waste generation, and improved environmental sustainability within the construction sector. It is clear that the relationship between PC → adoption of CE principles, since the results of the analysis of the proposed hypothesis H2 are (path coef. = 0.072, $t = 1.525$, P value = ((0.127)), the relationship can be evaluated as “significant”. Statistical “ If the value of t is equal to or greater 1.96 at a significance level of 5% and p is greater than 0.05, and the P-value for this hypothesis is less than 0.05, as well as the t -value is less than 1.96, and therefore the hypothesis was rejected. Rejection of the hypothesis shows that the direct incorporation of current sustainable practices into construction projects did not show a substantial impact at the adoption of round economic system standards within the creation industry within the Palestinian context.

Third Hypothesis (Barriers and challenges → adoption of CE principles): The presence of barriers and challenges to implementing CE concepts has a negatively impacts the successful adoption and implementation of Circular Economy practices in businesses and organizations. It is evident that there is a favorable correlation between barriers and challenges → adoption of CE principles, as the results of the analysis of the proposed hypothesis H3 are (coef. path = 0.535, $t = 14.602$, P value = 0.00) where p - if the value is higher than 0.05 and the t value is greater of 1.96, then the relationship can be rated as “significant”. A statistic “if the value of t is equal to or greater of 1.96 at a significance level of 5% and p greater than 0.05, and thus the hypothesis was supported.

Accepting the third hypothesis underscores the significance of overcoming obstacles and challenges in the adoption and implementation of circular economy concepts within companies and organizations. This highlights the crucial nature of addressing these barriers, suggesting that doing so is essential for the successful implementation of

circular economy practices. Embracing circular economy concepts and practices can enable organizations to enhance performance and achieve greater sustainability.

Four Hypothesis (OI→ adopting CE principles): Provision of financial, legal, and incentive support fosters the adoption of CE concept in the construction sector contributing to long-term success. It is evident that there is a favorable correlation between opportunities and incentives →adopting CE principles, as the results of the analysis of the proposed hypothesis H4 are (cof. path = 0.418, t = 10.413, P value = 0.00) where the p-value is higher than 0.05 and the t-value is greater than 1.96, thus the hypothesis was supported.

Accepting the hypothesis emphasizes the importance of providing financial and legal support, as well as incentives, to implement circular economy concepts in businesses and organizations, which increases the chances of these concepts' success and can contribute to improving growth and performance in the construction sector, thereby enhancing industry sustainability and prosperity. Furthermore, recognizing the concept increases investment in circular building projects and encourages industry innovation by allowing firms and organizations to take use of existing incentives and possibilities.

Five Hypothesis (EEF→ CI):The adoption of environmentally friendly approaches in Palestinian building projects correlates positively with enhanced environmental and economic performance. The relationship between environmental and economic performance →CI is a positive relationship, as the results of the analysis of the proposed hypothesis H5 are (cof. path = 0.167, t = 5.522, P value = 0.00) where the p value is higher than 0.05 and the t value is greater than 1.96 Thus, it supported the hypothesis.

Accepting the fifth hypothesis means that using an environmentally friendly method in Palestinian construction work is definitely linked to enhancing environmental and economic performance, and thus focusing on sustainable environmental practices in construction, which contributes to enhancing environmental and economic performance and increasing resource efficiency. Accepting this concept will greatly assist the long-term selection process in construction projects, enhance the commitment of enterprises and companies to environmentally responsible strategies and improve economic performance. Moreover, adopting the idea encourages the use of environmental

standards in establishing projects, which may help in sustaining and increasing Palestinian infrastructure. By developing overall environmental and economic performance at the same time.

Six Hypothesis (CP → CI): Enhanced cooperation and partnerships within the construction sector contribute to better project performance, sustainable practices, and stakeholder satisfaction.

The relationship between cooperation and partnerships → CI is a positive relationship, as the results of the analysis of the proposed hypothesis H6 are (coef. path = 0.383, t = 15.304, P value = 0.00) where the p value is higher than 0.05 and the t value is greater than 1.96 Thus, it supported the hypothesis.

Based on results of the sixth hypothesis, this suggests that close cooperation and partnership among employees of the construction industry increase the project performance quality as well as contribute to the improved environmental practices. Hence, cooperation between companies, companies being different in the sector, and the relevant parties in that sector can help to yield better results, implement sustainable practices, and thus can attain higher satisfaction by the stakeholders including owners, workers, and consumers. An indication is supporters of the need to come up with strong partnerships within the construction industry because these relationships endorse project performance advancement and sustainability in practices.

Seventh Hypothesis (Future outlook → CI): The future outlook for the construction sector presents significant development opportunities and necessitates the adoption of business practices.

The relationship between future outlook → CI is a positive relationship, as the results of the analysis of the proposed hypothesis H7 are (coef. path = 0.331, t = 15.232, P value = 0.00) where the p value is higher than 0.05 and the t value is greater than 1.96 Thus, it supported the hypothesis.

Considering the seventh hypothesis indicates that the expectation factor gets higher while project performs well, as the concerned party's expectature of the future improves the project performance and it leads to achieving sustainable goals.

Eight Hypothesis (Adoption of CE principles → CI): Utilizing CE models in construction project planning and management leads to better project outcomes, increased stakeholder satisfaction, and the generation of social value, aligning with sustainable development goals and industry best practices

The relationship between adoption of CE principles → CI is a positive relationship, as the results of the analysis of the proposed hypothesis H8 are (cof. path = 0.206, t = 5.518, P value = 0.00) where the p value is higher than 0.05 and the t value is greater than 1.96 Thus, it supported the hypothesis.

The findings suggest that implementing CE concepts in the construction sector may improve overall project performance, increase stakeholder satisfaction, and help to achieve sustainable development goals. Furthermore, Figure 3.1 and Figure 3.2 shows the P-Values and T – Statistics between the indicators and their underlining construct.

Figure 3.1

Model Framework - P-values

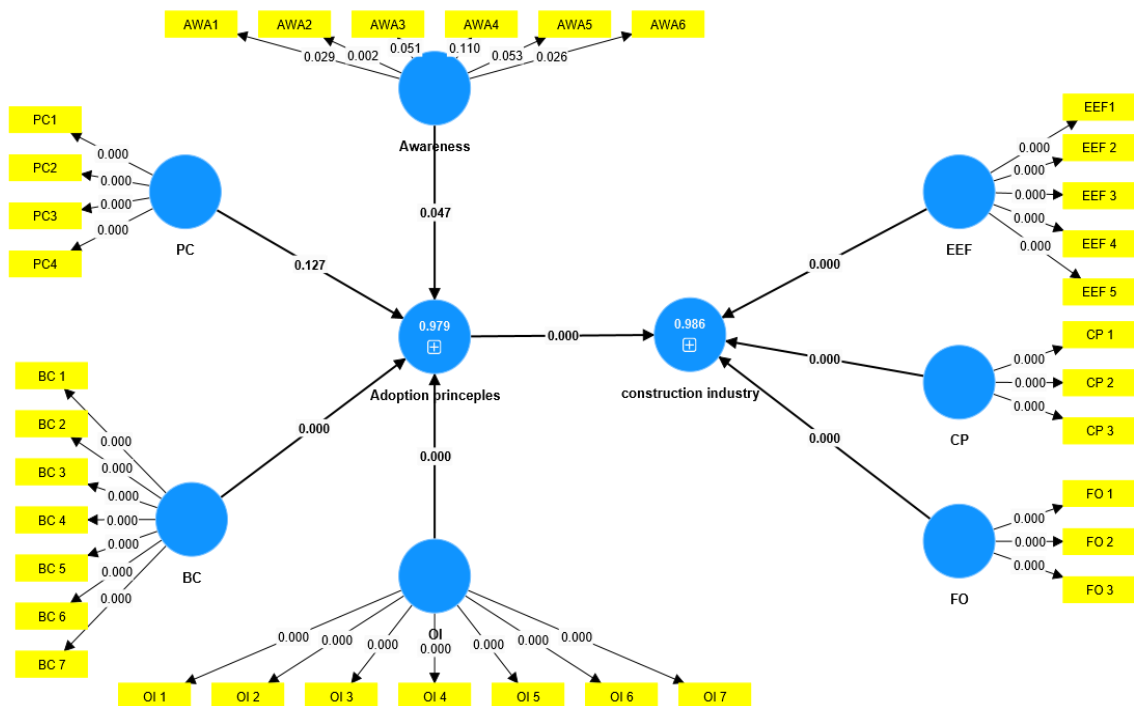
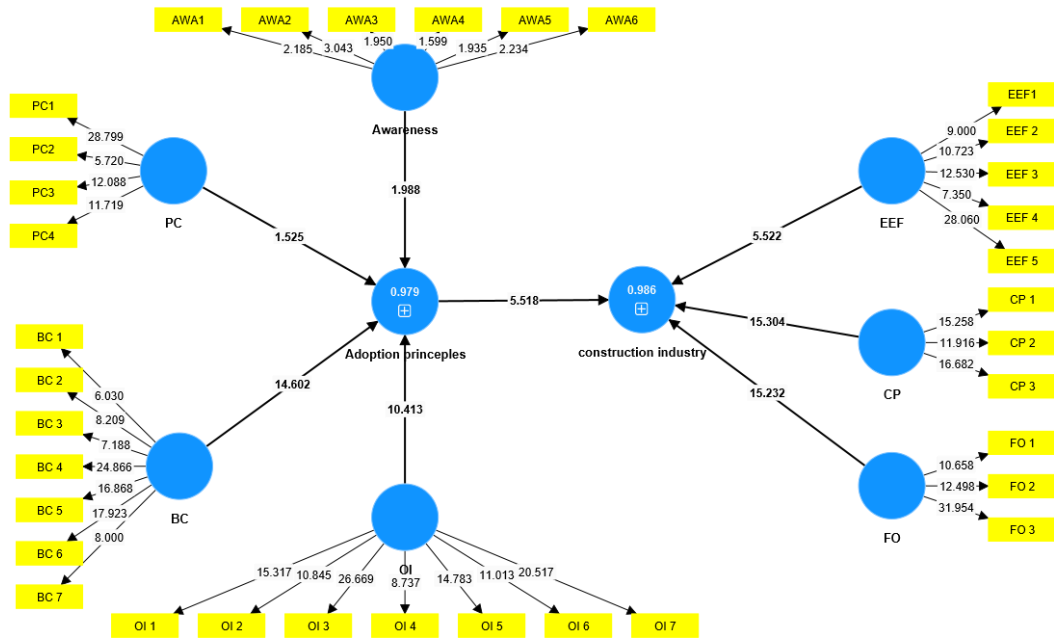


Figure 3.2

Model Framework - T-Statistics



Chapter Four

Discussion, Conclusions and Recommendations

4.1 Chapter Overview

In this chapter, the results of questionnaire analysis are presented, based on the preceding chapter was description and discussion. Additionally, the impact of theoretical framework and developed indicators are thoroughly examined. It includes a comprehensive discussion of the findings, including the environmental, economic, and social impacts of implementing CE concepts in Palestine. Hypothesis testing is conducted, along exploring the theoretical and practical implications emerging from the research results.

At the end, we discuss the implications, findings, suggestions, limits that will assist future research directions.

4.2 Discussion of Results

The study aims to examine the impact of adopting CE principles on the construction industry. The proposed model includes four mechanisms: awareness of CE principles among workers, current practices in construction projects, challenges of CE principles, and opportunities for incentives. Furthermore, the CI includes (environmental and economic impacts, collaboration and partnerships, future outlook).

In Palestine, where natural resources are limited and environmental difficulties abound, implementing environmental education concepts has the potential of promoting sustainable development in a variety of sectors, including the building industry. However, there are several obstacles that prevent the broad implementation of community education for such concepts in Palestine.

After examining the findings of the questionnaire, it was discovered that the average adoption of circular economy concepts was moderate. It was 2.76 on a 5-point Likert scale, suggesting that participants had a favorable contact with the ideals of circular economy. However, there were some obstacles in applying it, according to the respondents' opinions during the interviews, such that certain institutions may experience challenges in integrating technology and digital platforms to conduct CE

programs: Lack of funds and financial resources for implementing CE programs. Participants may struggle to cover the price of training courses, academic courses, or other educational activities.

The building sector significantly contributes to environmental deterioration, influencing many parts of the ecosystem. Waste creation is a major environmental issue in the building sector. The interviews revealed that building projects generate massive amounts of garbage, such as debris, unneeded materials, iron, wood, and so on, since the waste is not adequately divided throughout the development phases and is simply removed from the site. Furthermore, the questionnaire and interview data show that environmental and regulatory disruptions have economic consequences, such as increased costs and delays in construction projects. Companies in the construction sector must be aware of these problems and ensure that their projects meet environmental requirements and applicable legislation.

4.2.1 Dissection of awareness of the principles of CE in the Palestinian construction industry

The CE is a fundamental technology for sustainable development that aims to stabilize economic growth, environmental regeneration and social sustainability. The tremendous results from the first hypothesis showed that increasing awareness of CE concepts among workers within the construction sector has a fundamental and positive impact on adopting these concepts in the Palestinian construction industry. In principle, improved understanding of CE concepts should result in a shift in construction sector behavior and procedures. When individuals have firsthand knowledge of the benefits of a CE, they are more inclined to embrace new behaviors that preserve resources and minimize waste. This accreditation is expected to enhance the environmental and economic performance of this industry. The implications also suggest that awareness of CE principles may also stimulate cooperation and knowledge trade between groups and institutions in the sector, enhancing the interaction between events and contributing to more desirable innovation and exchange of sustainable practices.

It is possible to work to develop awareness of CE standards among employees within the construction sector by providing training programs, which is one of the effective ways to increase awareness of CE concepts. These programs can address CE concepts

and provide an explanation of how they can be applied in the CI. Working on awareness campaigns to communicate the concepts of the CE in a simple and recognizable way to workers in the CI and explaining how to apply them in daily signs. In addition to aiding innovation in construction, it can serve to inspire companies to develop new solutions that use circular principles in product design and strategy. By encouraging innovation, revolutionary solutions can be completed that help achieve sustainability within the construction area.

However, the usefulness of these strategies can also face some obstacles, which include: Resistance from a small number of people or groups operating within the area, as they will not forget that the change is unnecessary or expensive. Companies can also have trouble reshaping the transformation of theoretical concepts of the CE into practical practices applicable to projects. Construction, due to the complexities of daily paintings and associated additional fees.

4.2.2 Dissection of current practices in construction projects

Regarding current practices in construction projects. Moreover, this is important because it gives an indication of whether the industry is oriented towards waste minimization and efficient use of resources. In fact, the more activities that can be classified as such, the more prepared the industry will be to move from the traditional economic model towards a more sustainable economic model. However, this data can be significantly improved by implementing extensive awareness and training programs for construction workers which will provide an understanding of the essence of the circular economy. Second, similar comprehensive programs should also focus on explaining the benefits and application perspectives for specific projects.

Finally, but no less important, it is also necessary to work on encouraging innovation, research and development in the construction sector to create new technologies and products that work on the principles of the circular economy. Moreover, cooperation between the government, the private sector and civil society can be strengthened to exchange knowledge and experiences and develop joint projects that adopt circular economy concepts. However, applying these methods may not be easy. It may face obstacles as follows: lack of financial support and state support for using sustainable practices in the construction sector, and lack of technology that can be applied to adopt

sustainable practices in the construction sector. This may make an effort for companies to adopt them. The dearth of prior research on the effectiveness of sustainable technology in Palestine's building industry makes it difficult to make well-informed decisions.

4.2.3 Dissection of Barriers and Challenges to implementing CE

Limitations and confounds of implementing circular economy precepts with the use of circular economy strategies are what hinder the smooth circularity integration of these concepts in companies and organizations. Conventional economy practices are the major impediment to the introduction of a circular economy plan in the market, as businesses have gone through a long journey of applying production processes which generate huge volumes of waste. It might be difficult for them to change from their usual way of doing things and then start doing sustainable things. Moreover, businesses can all encounter issues as constrained resources of financial and legal support, poor technology and infrastructure, and opportunities for co-operations and partnerships are not in abundance. Thus, it is of the essence to develop tools in order to cope with these threats and barriers comprising such activities as education and training provision, funding and legal support, technology and infrastructure promotion, collaboration and partnership fostering, and making policies and laws better. By working together, real advancements can be achieved in implementing circular economy principles and finding success in this area.

4.2.4 Dissection of opportunities and incentives in construction industry

Financial and legal ameliorations and concessions are one of essential things that emission reduction master plan and the circular economy concept require in the construction industry. Undoubtedly, these institutions convey effective information for entities to practice circular economy system in the right environment; notwithstanding, this may enhance the succeed of maximum organizations in the long run. As a conclusion towards the hypothesis acceptance, there should be discussed the appropriate policies and programs which can be framed to advance the concepts of the circular economy in the construction as well. Additionally, the policies, legal and legislative can be there to stimulus recyclable materials use and sustainable practices promotion on construction projects.

Cultural resistance is one of the prime reasons for the waning of the transition and transformation processes happening in numerous countries and sectors, including building industry. This resistance finds its roots in social, organizational, and cultural factors that fail to support the use of the circular economy principles. Besides that, legislation and regulation may well be a predominant asset in realizing this goal. The governments will create and enforce environmental regulations that will help in the mitigation of environmental issues emanating from the construction industry and enhance the adoption of eco-friendly techniques. Through legislature pertaining to structure, there are footings for sustainable green infrastructure development as well as creating an agenda for improvement of the environment. Such as choosing environmentally friendly materials in growing buildings or designing buildings in a way in which they can save energy and reduce waste.

4.2.5 Dissection of social, economic, and environmental impacts of implementing circular economy in Palestine

The use of CE principles within the community in Palestinian construction sector will have the potential of producing a great wide range of positive social and ecological outcomes. On a sociological plane, advocating for CE can then lead to community stability and inclusive society.

The way in which education should be brought closer to the local material sources and promotions of the coordinated partnerships with stakeholders in a way that offers economic development and job opportunities, particularly in the disadvantaged regions or areas. In addition to this, the principles of SD aim at social justice as they suggest safe working conditions, fair labor standards and community participation throughout building phase with the ultimate objective, that the benefits will be allocated among all the stakeholders in a fair way (Korhonen & Honkasalo, 2017).

To that end, the process of energy efficiency certification should also aim at reducing the negative environmental impact and giving preference to the environmental SD. Examples of CE practices include material reuse, recycling and energy efficiency all of which mostly are undertaken to help preserve exhaustible resources and at the same time reduce greenhouse gas emissions and waste to a minimum.

Fusing circular economy approaches to the Palestinian building industry can set apt grounds for the development of innovative ideas and dissemination of information. CE is meant to test and enhance remodeling of both products and process where unnecessary wastes are eliminated and that the resources are enhanced for efficiency. It promotes innovation on materials, building techniques and creative technologies.

4.2.6 Dissection of Collaboration and Partnerships within the construction sector

The increased creative collaboration and partnership within the construction industry helps in project performance accomplishment thereby rising the sustainability practices and satisfying the stakeholders. A strong proverbial behavioral approach in the construction sector can be useful for projects by constructing institutional interaction among company and strike coalitions. Participatory sessions comprising of joint workshops and seminars can be arranged to discuss and share knowledge and practices on green building technologies and project management. Another idea is to call to concerted action across the business community, where the joint projects can be promoted to set up pilot projects or research that are aimed at achieving specific targets including the application of circular economy. Along with it, experiences may be shared, actions undertaken which surely benefit from utilizing environmentally safe marching orders. In this category stainable practices could be, using sustainable building material like recycled materials and green concrete, this also could be through adopting building technologies that are based on renewable energy and improved resource utilization.

Collaborations and partnerships may fail legal or regulatory related blocks like zoning, green building laws and other building legislations among others. In considerations of the permits and licenses which are ordinarily complex and require even a lot of time and effort. Other barriers include the lack of a built-up teamwork culture in the community and the issue of whether the new migrants will like the community or not. When groups of different cultures come together to work on the same issue, allowing them to show different perspectives can lead to challenge of accepting and dealing with cultural differences.

4.2.7 Dissection of Future Outlook for the construction sector

The construction sector is the path to success as the future holds immense opportunities for development and growth which thus require high level of inventiveness and consistency of work systems. This is likely one of the key factors leading to the implementation of the adaptation approach, which is deemed as the fastest and the most coordinated response which the building industry needs to account for the ever-changing economic and technological environment.

A business can get to the new level of maturity, enhance efficiency, increase competitiveness, making sustainability aspects, and opening new horizons for innovations and development of competitive engineering solutions. Therefore, this sector is described as dynamic and unstable, and almost every time companies have to be ready for unexpected opportunities and changes in corporate operations, and even whose purpose is to eliminate the gap between consumers' concepts and achievements in sustainable business. Consequently, applying this thesis would be significant in that investors would be encouraged to put more money on the construction sector. As they spot many ways the construction sector could be developed and bring them a stability of returns.

4.2.8 Dissection of implementing CE concepts in the construction sector

Utilizing CE models in project planning and management can greatly enhance outcomes. Using these models, engineers and managers can anticipate potential challenges and implement creative solutions to address them, thereby minimizing delays and extra expenses. Furthermore, employing these models can improve communication and interaction among all stakeholders, ultimately boosting their satisfaction and confidence. By focusing projects on meeting social and environmental objectives, tangible social value can also be created. In the end, this method helps to achieve sustainability goals and implement best practices in construction, improving the sustainability and efficiency of construction projects.

The prospects for construction business will rely on a range of forces that include urbanization tendencies, ecological necessities, adoption of the technology, and the regulatory frameworks. Implementing this hypothesis means that construction companies have to move their practices with arrays of changes in business practices to

keep abreast of the competition and the dynamics of the environment. The effect of this plan of adaptation may be the necessity of strategies and the vision that construction company owners give their projects. Organizations need to be constantly alert and open to the challenges of the future and be innovative by proactively seeking trends, anticipating market changes, and capitalizing on any emerging opportunities. This can be achieved by funding the R&D activities, encouraging creativity, as well as establishing an environment, which promotes constant innovation.

4.3 Hypothesis Testing Discussion

Based on the hypotheses of this research; (H1, H2, H3, H4, H5, H6, H7, H8), the were studied. The relationship between the hypotheses was positive and the hypothesis was proven. Except hypothesis H2 was rejected. The relationship between awareness of the principles of continuing education and adopting the principles of continuing education is important and positive, and is consistent with the hypothesis of adopting the principles of continuing education with the previous study (Aslam & Huang, 2020) . Therefore, hypothesis H1 was supported.

The relationship between current sustainable practices and the adoption of CE principles does not match the adoption of CE principles with the study (Lu, Bao, & Zetkolic, 2019).

Therefore, hypothesis H2 was rejected, and this result can be attributed to a number of issues that led to the rejection of this hypothesis: Palestine faces major economic challenges, including lack of funding and high unemployment rates, which makes companies and institutions focus on survival. And to survive in the market instead of investing time and effort in applying sustainable practices and CE concepts, in addition to the lack of infrastructure necessary to apply CE concepts, such as recycling centers, which makes it difficult to fully implement these practices.

The relationship between the challenges of applying continuing education concepts and adopting the principles of continuing education is positive and compatible with study (Hossain et al., 2020).Therefore, hypothesis H3 was supported, and the relationship between encouraging incentive support and adopting CE principles is positive, and matches the hypothesis taken from the study (Gamage & Senaratne, 2024), Therefore, hypothesis H4 was supported.

As for the hypotheses related to the building and construction industry (H5, H6, H7), which are environmental and economic performance, cooperation, and partnerships in the building and construction sector, the results indicated that they are positive and important relationships. The future expectations of the building and construction sector were matched with the study (Alhawari et al, 2021), Therefore, the hypotheses were supported.

4.4 Theoretical Implications

The study contributed to a better understanding of the issue of implementing CE concepts in the context of Palestine's building sector, as well as the influence on sustainable performance. By investigating the factors influencing the adoption of CE principles, This study complements earlier research that looked at of evaluating the possibility of adopting the CE and its impact on sustainable performance in the Palestinian CI as it is the first study to fully address this topic in Palestine.

4.5 Practical Implication

This study has several practical consequences for the different players in the Palestinian and international building industries. First, by identifying the important drivers influencing the adoption of CE concepts, this study provides significant insights for policymakers, industry practitioners, and sustainability advocates looking to promote sustainable practices in the construction sector. Furthermore, the report provides actionable information for Palestine's industry players, policymakers, and decision makers to better grasp the benefits of adopting circular methods. This report provides practical recommendations for incorporating CE ideas into building projects, such as promoting material reuse and recycling. These practical consequences can assist industry experts improve their sustainability practices, decrease environmental impact, and boost overall project performance.

Construction enterprises that use CE concepts may open up new frontiers for value generation, innovation, and market differentiation in an increasingly sustainability-conscious corporate environment. This research helps stakeholders embrace CE ideas, improve their sustainable performance, and contribute to the larger move toward a more sustainable built environment.

4.6 Conclusions

The principles of CE can revolutionize the CI in Palestine and help increase economic, environmental and social sustainability. The conclusion of this study presents significant opportunities and challenges of applying the principles of the CE and their effect on sustainable development performance in Palestine, as using the CE model in construction can allow reducing the consumption of resources, waste generation, and improving the efficiency of resources used throughout the life cycle of construction. Moreover, the adaptation of the circular practices can stimulate innovative projects, create new jobs and help to develop a robust and competitive CI in Palestine.

The general information is summarized in the objectives of this research, mainly to investigate the impact of adopting CE principles on the CI and how much it has been implemented. The obtained results, which show that the implementation level of adopting CE principles was an average of 2.480 of 5 based on a Likert scale, were followed by a number of obstacles. These challenges will only be addressed in Palestine by active collaboration between policymakers and construction industry stakeholders, as well as academic and civic organizations. The necessary outcome is the development of a favorable framework for the transformation toward recycling's comprehensive integration.

Based on the analysis and interviews conducted, the successful implementation of CE principles in the Palestinian CI is dependent on collaborative work, exchange of knowledge and capacity building, and the implementation of enabling policies and incentives. Circular makes it possible for the Palestinian construction sector to improve its sustainable performance, but also fulfil the bigger picture for economic growth, environmental preservation, and social prosperity in the region. This study marks the first research on whether CE can be adopted and the effect it has on sustainability performance in the CI in Palestine.

4.7 Recommendations

Steps and recommendations that will help assessing the potential of adoption CE and its effect on the sustainable performance in the Palestine CI:

1. Improve the current practices in construction projects through effective training to be defined in detail. Of the identified schemes, these offer a detailed understanding of the principles of the circular economy and the potential benefits, tools applied within the framework of certain cases. Furthermore, ensures the development of innovations and research focused on the constructive improvement of research and development in the construction area, which generates technologies and products that complies with the features of the circular economy.
2. Overcoming the barriers and preventing factors for implementing the principles of the circular economy to provide business and legal recourse to build necessary and in the construction industry set up recycling stations and other requirements to implement the circular economy principles without barriers.
3. Encourage the pilot implementation of circular design rules at the beginning of the product cycle to stimulate material reutilization, recycling, and resource management. By taking these suggestions, the sector and the construction business in Palestine may swiftly establish a CE, enhance its green nature, and ramp up its involvement to a more tough and environmentally conscious construction.
4. Organizing events and workshops that bring together stakeholders to exchange knowledge and enhance cooperation in the field of the circular economy.

4.8 Research Limitations

All these limitations are critical to guarantee unequivocal trustworthiness and meaningfulness of research results and, ultimately, to direct the subsequent research generation to address these and other identified gaps to expand the current knowledge about CE adoption by the Palestinian CI. Some of such limitations include:

- Response bias: Participants may respond in a way socially desirable or may withhold sensitive aspects of the topic, which will undermine the quality of the collected data.
- Limitations of the geographical scope: The geographical scope of this study is appropriate. It has been limited to the West Bank only, without any additional places. Taking advantage of the border situation, such as the situation in the Gaza Strip, which is also part of the Palestinian territories, but because of the Israeli occupation, we were not able to reach the Gaza Strip.

4.9 Future Research Directions

This study provided a solid foundation for subsequent research aimed at improving the findings by repeating the research in additional developing nations to corroborate the findings. In addition to conducting longitudinal studies to track the progress and development in adopting the CE and its impact on sustainable performance in the Palestinian CI over time. This would provide insight into trends, patterns and long-term outcomes of CE initiatives.

It is also evaluating the success of capacity building programs and training activities targeted at raising awareness, knowledge, and skills about CE principles among construction professionals, workers, and students. Identify gaps in education and training needs, create targeted interventions, and undertake economic analyses to assess the cost-benefit of implementing the CE in the Palestinian construction sector. Evaluate the financial viability, ROI, and social and economic benefits of adopting circular business models and processes.

Pursuing these prospective study topics will allow scholars and practitioners to get a better knowledge of CE concepts in the context of the Palestinian construction sector, as well as contribute to the promotion of regional sustainable development goals.

List of Abbreviations

Abbreviation	Meaning
AWA	Awareness
AVE	Average Variance Extracted
ASR	Alkali – Silica reaction
ASEAN	Association of South East Asian Nations
BIM	Building Information Modeling
BC	Barriers and Challenges
EEF	Environmental and Economic Effect
R²	Coefficient of Determination
CE	Circular Economy
CI	Construction Industry
CR	Composite Reliability
C&D	Construction @ Demolition
CDW	Construction @ Demolition waste
CP	Collaboration and Partnerships
CSR	Corporates Social Responsibility
DV	Dependent Variables
EPA	Environmental Protection Agency
EQA	Environmental Quality Agency
F²	Effect Size
FO	Future Outlook
GoF	Goodness of Fit
GDP	Gross Domestic Product
HTMT	Heterotrait – Monotrait
IDV	Independent Variables
JICA	Japan International Cooperation Agency
MoLG	Ministry of Local Government
NGO's	Non-governmental organizations
OI	Opportunities and Incentives

Abbreviation	Meaning
PLS-SEM	Partial Least Square Modeling of Structural Equations
PCBS	Palestinian Central Bureau of Statistic
PC	Current Practices in construction projects
Q^2	Predictive Relevance
RAP	Recycled Asphalt Aggregates
RCA	Recycled Concrete Aggregates
SD	Sustainable Development
SDGs	Sustainable Development Goals
SEM	Structural equation modeling
VOCs	Volatile Organic Compounds
WB	Waste Bricks

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Appendices

Appendix A

Tables

Table A.1

Sample size recommendation in PLS-SEM for a statistical power of 80%

Maximum Number of arrows Pointing at a Construct	Significance Level											
	1%				5%				10%			
	Minimum R ²				Minimum R ²				Minimum R ²			
	0.10	0.25	0.50	0.75	0.10	0.25	0.50	0.75	0.10	0.25	0.50	0.75
2	158	75	47	38	110	52	33	26	88	41	26	21
3	176	84	53	42	124	59	38	30	100	48	30	25
4	191	91	58	46	137	65	42	33	111	53	34	27
5	205	98	62	50	147	70	45	36	120	58	37	30
6	217	103	66	53	157	75	48	39	128	62	40	32
7	228	109	69	56	166	80	51	41	136	66	42	35
8	238	114	73	59	174	84	54	44	143	69	45	37
9	274	119	76	62	181	88	57	46	150	73	47	39
10	256	123	79	64	189	91	59	48	156	76	49	41

Source: (Hair et al., 2011)

Table A.2*Respondents profile summary*

Number	Item	Choice	Frequency	Percentage
1	Gender	Male	50	62.5%
		Female	30	37.5%
		Total	80	100%
2	Age	18-24	16	20%
		25-34	32	40%
		35-44	18	22.5%
		45-54	8	10%
		55 or older	6	7.5%
		Total	80	100%
3	Education degree	Some college	7	8.8%
		Bachelor degree	46	57.5%
		Master's Degree	19	23.8%
		Doctorate or professional degree	8	10%
		Total	80	100%
4	Years of Experience in the Construction Industry	0-5 Years	34	42.5%
		6-10 Years	15	18.8%
		11-15 Years	18	22.5%
		More than 15 years	13	16.3%
		Total	80	100%
5	Geographic Location	City	38	47.5%
		Village	33	366.7%
		Refugee camp	9	11.3%
		Total	80	100%
6	Occupation in the Construction Industry	Construction Manager	11	13.8%
		Site Engineer	13	16.3%
		Project Manager	21	26.3%
		Civil / Structural Engineer	27	33.8%
		Contractor	8	10%
		Total	80	100%

Table A.3*Descriptive Analysis of All Aspects Of The Questionnaire*

Indicator	Items	Mean	Standard deviation
AW1	current level of awareness about circular economy principles	2.587	0.984
AW2	respondents' perceptions regarding the effectiveness	2.7	0.927
AW3	Training or Education on Circular Economy Principles	2.85	1.097
AW4	Assessment of the Effectiveness of Encouraging Material	2.725	1
AW5	offering training to construction workers	2.8	0.927
AW6	Acceptance of Purchasing Recycled Products	2.9	1.261
PC1	Active Seeking and Use of Reclaimed Materials	2.237	0.912
PC2	Materials Reclaimed from Demolition Sites	2.638	0.925
PC3	On-Site Management of Construction Waste through Recycling and Reuse	2.663	0.851
PC4	Integration of Waste Management Plans.	2.612	0.798
BC1	Lack of Standardized Guidelines and Best Practices	2.013	0.955
BC2	Lack of Financial Incentives	2.05	0.973
BC3	Lack of Training and Skill Development Programs	2.5	0.866
BC4	Ineffective Collaboration and Communication	2.612	0.829
BC5	lack of training and skill development programs hinders	2.612	0.829
BC6	Lack of Uniform Guidelines	2.55	0.805
BC7	Economic Constraints	2.8	0.914
OI 1	Environmental Impact Reduction	2.125	0.9
OI 2	Interest in Incentives and Support Programs	2.087	0.938
OI 3	Importance of Government Policies and Regulations	2.237	0.912
OI 4	Role of Financial Incentives	2.087	0.951
OI 5	Influence of Recognition and Awards	2.288	0.99
OI 6	Interest in Financial Incentives	2.225	1.024
EEF 1	Role of C&D Waste Management	2.55	0.805
EEF 2	Impact of Circular Practices on Job Creation	2.612	0.873
EEF 3	Cost Savings from Adopting Circular Practices	2.462	0.908
EEF 4	Attraction of Investors or Financial Support	2.263	0.848
EEF 5	Regulatory and Economic Barriers to Sustainable Waste Management	2.962	1.269
CP 1	Impact of Collaboration on Circular Economy Adoption	2.212	0.876
CP 2	Importance of Sharing Best Practices and Knowledge	2.15	0.95
CP 3	Openness to Collaborating with Other Stakeholders	2.15	0.937
FO 1	Optimism about Future Adoption	2.513	0.975
FO 2	Importance of International Collaborations	2.013	0.955
FO 3	Impact of Circular Economy Practices on Construction Costs	2.05	0.973

Table A. 4*Factor Loadings*

Constrict	AW	PC	BC	OI	EEF	CP	FO
AW1	0.683						
AW2	0.807						
AW3	0.773						
AW4	0.617						
AW5	0.754						
AW6	0.769						
PC1		0.848					
PC2		0.645					
PC3		0.804					
PC4		0.789					
BC1			0.670				
BC2			0.721				
BC3			0.648				
BC4			0.863				
BC5			0.817				
BC6			0.845				
BC7			0.665				
OI 1				0.813			
OI 2				0.748			
OI 3				0.869			
OI 4				0.743			
OI 5				0.793			
OI 6				0.738			
OI 7				0.840			
EEF 1					0.723		
EEF 2					0.758		
EEF 3					0.778		
EEF 4					0.710		
EEF 5					0.853		
CP 1						0.815	
CP 2						0.783	
CP 3						0.809	
FO 1							0.706
FO 2							0.831
FO 3							0.885

Table A.5*Cross loadings*

Construct	Awareness	BC	CP	EEF	FO	OI	PC
AWA1	0.683	0.126	0.17	0.078	0.055	0.073	0.116
AWA2	0.807	0.271	0.295	0.26	0.215	0.252	0.268
AWA3	0.773	0.138	0.171	0.116	0.149	0.043	0.089
AWA4	0.617	0.104	0.064	0.072	0.067	0.033	0.029
AWA5	0.754	0.153	0.104	0.08	0.164	0.055	0.075
AWA6	0.769	0.208	0.257	0.199	0.152	0.087	0.076
BC 1	0.186	0.831	0.522	0.595	0.670	0.509	0.468
BC 2	0.179	0.885	0.68	0.713	0.721	0.582	0.602
BC 3	0.074	0.648	0.471	0.502	0.467	0.444	0.402
BC 4	0.36	0.863	0.729	0.765	0.592	0.721	0.73
BC 5	0.228	0.817	0.662	0.665	0.544	0.721	0.739
BC 6	0.223	0.845	0.613	0.723	0.47	0.688	0.682
BC 7	0.032	0.665	0.345	0.448	0.235	0.541	0.57
CP 1	0.193	0.722	0.815	0.718	0.617	0.625	0.606
CP 2	0.26	0.563	0.783	0.567	0.492	0.457	0.447
CP 3	0.206	0.582	0.809	0.643	0.609	0.576	0.531
EEF1	0.223	0.723	0.613	0.845	0.47	0.688	0.682
EEF 2	0.129	0.587	0.518	0.758	0.638	0.485	0.498
EEF 3	0.214	0.615	0.614	0.778	0.567	0.549	0.51
EEF 4	0.075	0.46	0.565	0.710	0.542	0.464	0.46
EEF 5	0.166	0.727	0.75	0.853	0.619	0.644	0.664
FO 1	0.124	0.441	0.532	0.467	0.706	0.384	0.299
FO 2	0.186	0.67	0.522	0.595	0.831	0.509	0.468
FO 3	0.179	0.721	0.68	0.713	0.885	0.582	0.602
OI 1	0.14	0.637	0.544	0.541	0.543	0.813	0.674
OI 2	0.039	0.653	0.47	0.562	0.461	0.748	0.686
OI 3	0.198	0.676	0.673	0.686	0.542	0.869	0.848
OI 4	0.106	0.566	0.611	0.576	0.526	0.743	0.641
OI 5	0.113	0.629	0.548	0.586	0.429	0.793	0.689
OI 6	0.096	0.654	0.449	0.551	0.391	0.738	0.719
OI 7	0.12	0.69	0.545	0.616	0.515	0.840	0.796
PC1	0.198	0.676	0.673	0.686	0.542	0.848	0.869
PC2	0.083	0.478	0.384	0.496	0.272	0.571	0.645
PC3	0.215	0.68	0.472	0.547	0.461	0.681	0.804
PC4	0.036	0.66	0.483	0.546	0.478	0.67	0.789

Table A.6*Operationalization Of Model constructs*

Variable and indicators	Question	Reference
Awareness of the principles of the CE	current level of awareness about circular economy principles	(Aslam et al., 2020)
	training or education on the principles of the circular economy	(Reichel et al., 2016)
Current Practices in construction projects	The number of times recycled materials are used in construction	(Lu et al., n.d.)
	waste management plans integrated into the early stages of construction project planning	(Wang et al., 2014)
Barriers and Challenges	limited availability of recycled materials	(Hossain et al., 2020)
	effective collaboration and communication among stakeholders	(Katagiri et al., 2019)
Opportunities and Incentives	environmental impact is beneficial in adopting circular economy principles in construction projects	(Gamage et al., 2024)
	support programs aimed at promoting circular practices in construction industry	(Heshmati, 2015)
Environmental and economic effect	the role of construction and demolition (C&D) waste management in contributing to environmental sustainability?	(Tam & Tam, 2008)
	circular practices in construction can positively impact job creation in the local community	(Alhawari et al., 2021)
	adopting circular practices in construction can lead to cost savings	(Gasparri et al., 2023)
Collaboration and Partnerships	collaboration and partnerships between stakeholders can impact the adoption of circular economy practices in the Palestine construction industry	(El-Namrouty, 2012a)
Future Outlook	the future adoption of circular economy practices in the Palestine construction industry	(Datta et al., 2023)
	international collaborations and partnerships will be in shaping the future landscape of circular economy practices in the Palestine construction industry	(El-Namrouty, 2012b)
	the adoption of circular economy practices impact the overall costs of construction projects in Palestine	(Pomponi & Moncaster, n.d.)

Appendix B

Research Questionnaire in English



An-Najah National University

Faculty of Graduate Studies

Engineering Management Program

Questionnaire about assessing the potential of adoption circular economy and its effect on the sustainable performance in the Palestine construction industry.

Dear Participant,

Thank you for taking the time to participate in this survey. Your input is valuable for understanding the current landscape and opportunities for promoting circular economy principles in the construction industry.

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Master of Engineering Management

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Mob No.: +972598072845.

Part one: General information

Please answer the following questions by adding (X) in the answer that suits you.

1. Gender:

() Male () Female

2. Your age:

() 18-24 () 25-34 () 35-44

() 45-54 () 55 or older

3. Your education degree:

() Some college or vocational training () Bachelor degree

() Master's Degree () Doctorate or professional degree

4. Years of Experience in the Construction Industry:

() 0-5 Years () 6-10 Years

() 11-15 Years () More than 15 years

5. Geographic Location:

() City () Village

() Refugee camp

6. Your Occupation/Role in the Construction Industry:

() Construction Manager () Site Engineer

() Project Manager () Civil / Structural Engineer

() contractor

Part two: (section 1: Awareness of the principles of the CE)

This section includes awareness of the principles of the CEa set of questions related to the level of awareness of the principles of the circular economy in the construction industry, in addition to how to apply the concepts of the circular economy to building materials.

A circular economy (CE) is an economic model that aims to maximize resource effectiveness via eliminating waste, keeping long-term value, lowering the main resources, and creating closed loops for goods, components, and material while maintaining environmental and socioeconomic benefits. And, the CE is a system in which no resources are wasted and nature is renewed.

Awareness of the principles of the CE

Q1 How would you rate your current level of awareness about circular economy principles within the context of the construction industry?

- Very high awareness
- High awareness
- Moderate awareness
- Low awareness
- No awareness at all

Q2 How effective do you think industry associations and organizations in Palestine are in promoting awareness and education about circular economy practices among construction professionals?

- Very effective
- Effective
- Moderately Effective
- Ineffective
- Very ineffective

Q3 Have you received any training or education on the principles of the circular economy?

- Extensively trained
- Received substantial training
- Received moderate training
- Received minimal training
- Not at all received training

Q2 To what extent does your organization actively seek out and use reclaimed materials in construction projects?

- Regularly Occasionally
 Rarely Not considered Not applicable

Q3 How often do you use materials reclaimed from demolition sites for construction materials for your projects?

- always repeatedly
 sometimes Scarcely never

Q4 How often does your organization manage construction waste on site through recycling and reuse?

- always repeatedly
 sometimes Scarcely never

Part two: (section3: Barriers and Challenges)

This section includes barriers and challenges in construction industry set of questions related to identified barriers to implementing circular economy practices in construction.

Barriers and Challenges

Q1 Does the limited availability of recycled materials pose an obstacle to implementing circular economy practices in the construction industry?

- Always Frequently
 Occasionally Rarely Never

Q2 To what extent do you think the lack of standardized guidelines and best practices for implementing circular economy principles is a barrier in the Palestine construction industry?

- Extremely significant barrier Significant barrier
 Neutral Limited barrier
 Not a barrier at all

Q3 how does the lack of financial incentives or support for circular economy initiatives impact their adoption in the Palestine construction industry?

- Significantly hinders adoption Hinders adoption to some extent
 Neutral Has minimal impact on adoption
 Does not hinder adoption at all

Q4 To what extent do you believe that a lack of training and skill development programs hinders the adoption of circular economy practices among construction industry professionals?

- It hinders very much Significantly hinders
 Moderately hinders Slightly hinders
 Does not hinder at all

Q5 To what extent is the lack of effective collaboration and communication among stakeholders hindering the adoption of circular economy initiatives in the construction industry?

- It hinders very much Significantly hinders
 Moderately hinders Slightly hinders
 Does not hinder at all

Q6 To what extent do you think the lack of uniform guidelines for circular economy practices hinders the adoption of circular economy practices among construction industry professionals?

- It hinders a lot It hinders a lot
 It hinders to a moderate degree It hinders a little
 It does not hinder at all

Q7 To what extent do you think the economic constraints to adopting sustainable practices are hindering the adoption of circular economy practices among construction industry professionals?

- It hinders a lot It hinders a lot
 It hinders to a moderate degree It hinders a little
 It does not hinder at all

Part two: (section 4: Opportunities and Incentives)

This section includes opportunities and incentives in construction industry set of questions related to the perceived benefits of adopting circular economy principles in construction, in addition to interest in incentives or support programs to promote circular practices.

Opportunities and Incentives

Q1 To what extent do you think that reducing environmental impact is beneficial in adopting circular economy principles in construction projects?

- Very high potential benefits High potential benefits
 Moderate potential benefits Low potential benefits
 No potential benefits

Q2 How interested are you in incentives or support programs aimed at promoting circular practices in construction industry?

- Extremely interested Very interested
 Moderately interested Slightly interested
 Not interested

Q3 In your view, how important is the role of government policies and regulations in promoting the adoption of circular economy principles in the construction industry?

- Very important Important
 Neutral Somewhat important
 Not important at all

Q4 Please indicate the extent to which you believe that financial incentives will encourage stakeholders to actively participate in collaborative efforts to adopt circular economy practices in the construction industry?

- Strongly disagree Disagree
 Neutral Agree
 Strongly agree

Q5 Do you believe that recognition and awards will encourage stakeholders to actively participate in collaborative efforts to adopt circular economy practices in the construction industry?

- Always repeatedly
 sometimes Scarcely
 Never

Q6 Do you think that having financial incentives could stimulate greater sustainability and resource efficiency in the construction industry?

- I totally agree I agree
 Neutral I do not agree
 I don't agree at all

Q7 Please rate your organization's interest in financial incentives or support programs to promote circular practices in construction?

- Very high interest High interest
 Moderate interest Low interest
 No interest

Part two: (section 5: Environmental and Social Impact)

This section includes environmental and social impact in construction industry set of questions related to environmental benefits of circular practices in construction and consideration of social aspects such as job creation or community engagement in circular projects.

Environmental and economic effect

Q1 How do you perceive the role of construction and demolition (C&D) waste management in contributing to environmental sustainability?

- Strongly contributes Contributes
 Neutral Does not contribute
 Strongly does not contribute

Q2 How do you think circular practices in construction can positively impact job creation in the local community?

- Very significant impact Significant impact
 Moderate impact Minimal impact
 No impact

Q3 How much do you believe that adopting circular practices in construction can lead to cost savings?

- Extremely Significantly
 Moderately Slightly
 Not at all

Q4 To what extent do you think circular practices in construction can attract investors or financial support?

- To a very large extent To a large extent
 To a moderate extent To a small extent
 Not at all

Q5 To what extent do regulatory or economic barriers hinder sustainable management of building and construction waste in your region?

- Very high barriers High barriers
 Moderate barriers Low barriers
 There are no barriers

Part two: (section 6: Collaboration and Partnerships)

This section includes collaboration and partnerships impact in construction industry set of questions related to collaborate with other stakeholders to improve circularity in the construction industry.

Collaboration and Partnerships

Q1 To what extent do you believe collaboration and partnerships between stakeholders can impact the adoption of circular economy practices in the Palestine construction industry?

Q3 Please express your vision for the future of circular economy practices in the construction industry?

() Very optimistic

() Optimistic

() Neutral

() Pessimistic

() Very pessimistic

Notes:

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.....
.....

Thank you for contributing.

Appendix C

Research Questionnaire in Arabic



جامعة النجاح الوطنية

كلية الدراسات العليا

برنامج ماجستير الادارة الإدارة الهندسية

استبيان حول تقييم إمكانية تبني الاقتصاد الدائري وأثره على الأداء المستدام في صناعة البناء والتشييد في فلسطين.

عزيزي المشارك،

نشكرك على الوقت الذي أمضيته للمشاركة في هذا الاستطلاع. تعتبر مدخلاتك ذات قيمة لفهم المشهد الحالي والفرص المتاحة لتعزيز مبادئ الاقتصاد الدائري في صناعة البناء والتشييد.

الباحث : شيماء زين الدين ماجستير الإدارة الهندسية

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رقم الجوال : +972598072845

الجزء الأول: معلومات عامة

يرجى الإجابة على الأسئلة التالية بإضافة (X) في الإجابة التي تناسبك

1. جنس

() الذكور () الإناث

2. عمرك

() 18-24 سنة () 25-34 سنة

() 35-44 سنة () 45-54 سنة

() 55 سنة فأكثر

3. الدرجة العلمية

() بعض الكليات أو التدريب المهني () درجة البكالوريوس

() درجة الماجستير () درجة الدكتوراه أو الدرجة المهنية

4. سنوات الخبرة في مجال البناء والتشييد:

() 0-5 سنوات () 6-10 سنوات

() 11-15 سنوات () أكثر من 15 سنة

5. الموقع الجغرافي:

() مدينة () قرية () مخيم لاجئين

6. مهنتك / دورك في صناعة البناء والتشييد:

() مدير البناء () مهندس الموقع

() مدير المشروع () مهندس مدني / إنشائي

() عامل بناء () المقاول

الجزء الثاني : القسم الاول: الوعي بمبادئ الاقتصاد الدائري

يتضمن هذا القسم الوعي بمبادئ الاقتصاد الدائري مجموعة من الأسئلة المتعلقة بمستوى الوعي بمبادئ الاقتصاد الدائري في صناعة البناء والتشييد، بالإضافة إلى كيفية تطبيق مفاهيم الاقتصاد الدائري على مواد البناء .

حيث يمكن تعريف الاقتصاد الدائري على انه :

هو نموذج اقتصادي يهدف إلى تعظيم فعالية الموارد من خلال القضاء على النفايات، والحفاظ على القيمة طويلة الأجل، وخفض الموارد الرئيسية، وإنشاء حلقات مغلقة للسلع والمكونات والمواد مع الحفاظ على الفوائد البيئية والاجتماعية والاقتصادية . والاقتصاد الدائري هو نظام لا يتم فيه اهدار الموارد ويتم فيه تجديد الطبيعة .

الوعي بمبادئ الاقتصاد الدائري

س1: كيف تقيم مستوى وعيك الحالي حول مبادئ الاقتصاد الدائري في سياق صناعة البناء والتشييد؟

() وعي مرتفع جداً () وعي مرتفع () وعي متوسط

() وعي منخفض () لا يوجد وعي على الإطلاق

س2: ما مدى فعالية الجمعيات والمنظمات الصناعية في فلسطين في تعزيز الوعي والتعليم حول ممارسات

الاقتصاد الدائري بين العاملين في مجال البناء؟

() فعال جداً () فعال () فعال إلى حد ما

() غير فعال () غير فعال جداً

س3: هل تلقيت أي تدريب أو تعليم حول مبادئ الاقتصاد الدائري؟

() لم يتلق التدريب على الإطلاق () تلقى تدريباً بسيطاً

() تلقى تدريباً متوسطاً () تلقى تدريباً كبيراً

() تم تدريبه على نطاق واسع

س4: ما مدى تقييم فعالية تشجيع إعادة استخدام المواد لتعزيز الاقتصاد الدائري في صناعة البناء والحد من النفايات؟

- () غير فعالة على الإطلاق () غير فعالة () واسطة ()
() فعال () مؤثر جدا

س5: إلى أي مدى تعتقد أن توفير التدريب لعمال البناء على ممارسات إعادة تدوير نفايات البناء والتشييد أمر ضروري؟

- () ضروري للغاية () ضروري إلى حد ما () محايد ()
() غير ضروري جداً () غير ضروري على الإطلاق

س6: إلى أي مدى تقبلون شراء المنتجات المعاد تدويرها لاستخدامها في أعمال البناء؟

- () أرفض بشدة شراء المنتجات المعاد تدويرها لأعمال البناء
() رفض شراء المنتجات المعاد تدويرها لأعمال البناء
() محايد أو غير مبال تجاه شراء المنتجات المعاد تدويرها لأعمال البناء
() قبول شراء المنتجات المعاد تدويرها لأعمال البناء
() أقبل بشدة شراء المنتجات المعاد تدويرها لأعمال البناء

القسم الثاني : الممارسات الحالية في صناعة البناء والتشييد

يتضمن هذا القسم الممارسات الحالية في صناعة البناء والتشييد مجموعة من الأسئلة المتعلقة بممارسات إدارة النفايات في مواقع البناء واستخدام المواد المعاد تدويرها أو المستصلحة في مشاريع البناء .

الممارسات الحالية في مشاريع البناء

س1: كم مرة تستخدم مؤسستك المواد المعاد تدويرها أو المستصلحة في مشاريع البناء؟

- () أبداً () نادراً () أحياناً ()
() بشكل متكرر () دائماً

س2: إلى أي مدى تسعى مؤسستك بنشاط إلى استخدام المواد المستصلحة في مشاريع البناء؟

- () بانتظام () أحياناً () نادراً
() لا يعتبر () لا ينطبق

س3: ما هو معدل استخدامك للمواد المستصلحة من مواقع الهدم كمواد بناء لمشاريعك؟

- () أبداً () نادراً () أحياناً
() مراراً وتكراراً () دائماً

س4: كم مرة تقوم مؤسستك بإدارة مخلفات البناء في الموقع من خلال إعادة التدوير وإعادة الاستخدام؟

- () أبداً () نادراً () أحياناً
() مراراً وتكراراً () دائماً

القسم الثالث: المعوقات والتحديات

يشتمل هذا القسم على العوائق والتحديات في صناعة البناء والتشييد ومجموعة من الأسئلة المتعلقة بالعوائق المحددة التي تحول دون تنفيذ ممارسات الاقتصاد الدائري في البناء .

العوائق والتحديات

س1: هل يشكل التوفر المحدود للمواد المعاد تدويرها عائقاً أمام تنفيذ ممارسات الاقتصاد الدائري في صناعة البناء والتشييد؟

- () أبداً () نادراً () أحياناً
() مراراً وتكراراً () دائماً

س2: إلى أي مدى تعتقد أن عدم وجود مبادئ توجيهية موحدة وأفضل الممارسات لتنفيذ مبادئ الاقتصاد الدائري يشكل عائقاً أمام صناعة البناء في فلسطين؟

- () حاجز كبير للغاية () حاجز كبير () محايد
() حاجز محدود () ليس عائقاً على الإطلاق

س3: كيف يؤثر نقص الحوافز المالية أو الدعم لمبادرات الاقتصاد الدائري على اعتمادها في قطاع البناء في فلسطين؟

() يعيق التنبؤ بشكل كبير () يعيق التنبؤ إلى حد ما () محايد
() له تأثير ضئيل على التنبؤ () لا يعيق التنبؤ على الإطلاق

س4: إلى أي مدى تعتقد أن نقص برامج التدريب وتنمية المهارات يعيق اعتماد ممارسات الاقتصاد الدائري بين المتخصصين في صناعة البناء والتشييد؟

() يعيق كثيراً () يعيق بشكل كبير () يعيق إلى حد ما
() يعيق قليلاً () لا يعيق على الإطلاق

س5: إلى أي مدى يعيق الافتقار إلى التعاون والتواصل الفعال بين أصحاب المصلحة اعتماد مبادرات الاقتصاد الدائري في صناعة البناء والتشييد؟

() يعيق كثيراً () يعيق بشكل كبير () يعيق إلى حد ما
() يعيق قليلاً () لا يعيق على الإطلاق

س6: إلى أي مدى تعتقد أن عدم وجود مبادئ توجيهية موحدة لممارسات الاقتصاد الدائري يعيق اعتماد ممارسات الاقتصاد الدائري بين المتخصصين في صناعة البناء والتشييد؟

() يعيق كثيراً () يعيق بشكل كبير () يعيق إلى حد ما
() يعيق قليلاً () لا يعيق على الإطلاق

س7: إلى أي مدى تعتقد أن القيود الاقتصادية التي تحول دون تبني الممارسات المستدامة تعيق اعتماد ممارسات الاقتصاد الدائري بين المتخصصين في صناعة البناء والتشييد؟

() يعيق كثيراً () يعيق بشكل كبير () يعيق إلى حد ما
() يعيق قليلاً () لا يعيق على الإطلاق

القسم الرابع: الفرص والحوافز

يتضمن هذا القسم الفرص والحوافز في صناعة البناء والتشييد مجموعة من الأسئلة المتعلقة بالفوائد المتصورة لاعتماد مبادئ الاقتصاد الدائري في البناء، بالإضافة إلى الاهتمام بالحوافز أو برامج الدعم لتعزيز الممارسات الدائرية .

الفرص والحوافز

س1: إلى أي مدى تعتقد أن الحد من الأثر البيئي مفيد في اعتماد مبادئ الاقتصاد الدائري في مشاريع البناء؟

() لا توجد فوائد محتملة () فوائد محتملة منخفضة

() فوائد محتملة معتدلة () فوائد محتملة عالية

() فوائد محتملة عالية جدًا

س2: ما مدى اهتمامك بالحوافز أو برامج الدعم التي تهدف إلى تعزيز الممارسات الدائرية في صناعة البناء والتشييد؟

() مهتم للغاية () مهتم جدًا () مهتم إلى حد ما

() مهتم قليلاً () غير مهتم

س3: من وجهة نظرك، ما مدى أهمية دور السياسات واللوائح الحكومية في تعزيز اعتماد مبادئ الاقتصاد الدائري في صناعة البناء والتشييد؟

() غير مهم على الإطلاق () مهم إلى حد ما () محايد

() مهم () مهم جدًا

س4: يرجى الإشارة إلى مدى اعتقادك بأن الحوافز المالية ستشجع أصحاب المصلحة على المشاركة بنشاط في الجهود التعاونية لتبني ممارسات الاقتصاد الدائري في صناعة البناء والتشييد؟

() لا أوافق بشدة () لا أوافق () محايد

() أوافق () أوافق بشدة

س5: يرجى تقييم اهتمام مؤسستك بالحوافز المالية أو برامج الدعم لتعزيز الممارسات الدائرية في البناء؟

- () بدون فائدة () فائدة منخفضة () فائدة متوسطة
() فائدة مرتفعة () فائدة عالية جداً

القسم الخامس : الأثر البيئي والاجتماعي

يتضمن هذا القسم التأثير البيئي والاجتماعي في صناعة البناء مجموعة من الأسئلة المتعلقة بالفوائد البيئية للممارسات الدائرية في البناء ومراعاة الجوانب الاجتماعية مثل خلق فرص العمل أو مشاركة المجتمع في المشاريع الدائرية.

التأثير البيئي والاقتصادي

س1: كيف ترى دور إدارة مخلفات البناء والهدم في المساهمة في الاستدامة البيئية؟

- () يساهم بقوة () يساهم () محايد
() لا يساهم () لا يساهم بقوة

س2: كيف تعتقد أن الممارسات الدائرية في البناء يمكن أن تؤثر بشكل إيجابي على خلق فرص العمل في المجتمع المحلي؟

- () لا تأثير () الحد الأدنى من التأثير () تأثير معتدل
() تأثير كبير () تأثير كبير جداً

س3: إلى أي مدى تعتقد أن اعتماد الممارسات الدائرية في البناء يمكن أن يؤدي إلى توفير التكاليف؟

- () لا على الإطلاق () قليلاً () إلى حد ما
() إلى حد كبير () إلى أقصى حد

س4: إلى أي مدى تعتقد أن الممارسات الدائرية في البناء يمكن أن تجذب المستثمرين أو الدعم المالي؟

- () إطلاقاً () إلى حد صغير () إلى حد متوسط
() إلى حد كبير () إلى حد كبير جداً

س5: إلى أي مدى تعيق العوائق التنظيمية أو الاقتصادية الإدارة المستدامة لمخلفات البناء والتشييد في منطقتك؟

() لا توجد حواجز () حواجز منخفضة

() حواجز متوسطة () حواجز عالية

() حواجز عالية جدًا

القسم السادس: التعاون والشراكات

يتضمن هذا القسم تأثير التعاون والشراكات في صناعة البناء والتشييد على مجموعة من الأسئلة المتعلقة بالتعاون مع أصحاب المصلحة الآخرين لتحسين التدوير في صناعة البناء والتشييد .

التعاون والشراكات

س1: إلى أي مدى تعتقد أن التعاون والشراكات بين أصحاب المصلحة يمكن أن يؤثر على اعتماد ممارسات الاقتصاد الدائري في صناعة البناء والتشييد في فلسطين؟

() ضروري جداً () ضروري () هام

() غير مهم () ليس ضروريا

س2: ما مدى أهمية مشاركة أصحاب المصلحة في صناعة البناء والتشييد أفضل الممارسات والمعرفة المتعلقة بمبادرات الاقتصاد الدائري؟

() مهم للغاية () مهم () محايد

() غير مهم جداً () غير مهم على الإطلاق

س3: يرجى الإشارة إلى مدى انفتاح مؤسستك للتعاون مع أصحاب المصلحة الآخرين (مثل الموردين والوكالات الحكومية والمنظمات غير الحكومية) لتعزيز التدوير في مشاريع البناء؟

() غير منفتح على الإطلاق للتعاون () منفتح قليلاً للتعاون

() منفتح للتعاون إلى حد ما () منفتح جداً للتعاون

() منفتح للغاية للتعاون

القسم السابع : النظرة المستقبلية

يتضمن هذا القسم النظرة المستقبلية في صناعة البناء والتشييد مجموعة من الأسئلة المتعلقة بالتوقعات لمستقبل ممارسات الاقتصاد الدائري في صناعة البناء والتنبؤات للاتجاهات والتطورات في جهود الدائرية .

نظرة مستقبلية

س1: ما مدى تفاؤلك بشأن تبني ممارسات الاقتصاد الدائري في المستقبل في صناعة البناء والتشييد في فلسطين؟

- () متفائل جداً () متفائل () محايد () متشائم جداً () متشائم

س2: ما مدى أهمية التعاون والشراكات الدولية في تشكيل المشهد المستقبلي لممارسات الاقتصاد الدائري في صناعة البناء والتشييد الفلسطينية؟

- () حاسم للغاية () حاسم () محايد () ليس حاسماً جداً () غير حاسم على الإطلاق

س3: يرجى التعبير عن رؤيتك لمستقبل ممارسات الاقتصاد الدائري في صناعة البناء والتشييد؟

- () متشائم جداً () متشائم () محايد () متفائل () متفائل جداً"

ملاحظات:

.....

.....

.....

شكراً لتعاونك



جامعة النجاح الوطنية
كلية الدراسات العليا

تقييم إمكانية اعتماد الاقتصاد الدائري وتأثيره على الأداء المستدام
في صناعة البناء الفلسطينية

إعداد

شيماء عقاب زين الدين

إشراف

د. معتصم بعباع

د. عبد الحليم خضر

قدمت هذه الرسالة استكمالاً لمتطلبات الحصول على درجة الماجستير في الإدارة الهندسية،
من كلية الدراسات العليا، في جامعة النجاح الوطنية، نابلس - فلسطين.

2024

تقييم إمكانية اعتماد الاقتصاد الدائري وتأثيره على الأداء المستدام في صناعة البناء الفلسطينية

إعداد

شيماء عقاب زين الدين

إشراف

د. معتصم بعباع

د. عبد الحليم خضر

الملخص

في السنوات الأخيرة، أقر المجتمع العالمي بالأهمية الحاسمة لنهج التنمية المستدامة في معالجة الشواغل البيئية الحادة مع ضمان النجاح الاجتماعي والاقتصادي على المدى الطويل أيضاً. في هذه البيئة، برز الاقتصاد الدائري (CE) كنموذج قابل للتطبيق لتشجيع الاستدامة في مجموعة متنوعة من الصناعات، بما في ذلك البناء. في فلسطين، تعد صناعة البناء أمراً بالغ الأهمية للنمو الاقتصادي.

تهدف هذه الأطروحة إلى تقييم إمكانية تبني مبادئ التعليم المستمر في صناعة البناء والتشييد الفلسطينية ودراسة آثارها على التنمية المستدامة. ويهدف أيضاً إلى دراسة كيف يمكن لتطبيق مبادئ CE في صناعة البناء والتشييد الفلسطينية أن يساعد في استخدام الموارد، واستكشاف الآثار الاجتماعية والبيئية المحتملة لتطبيق مبادئ CE في صناعة البناء والتشييد الفلسطينية.

ولتحقيق هذه الغاية، تم تطوير نموذج بحث حيث تم جمع البيانات باستخدام الاستبيانات والمقابلات شبه المنظمة. تم جمع البيانات من عينة عشوائية مكونة من 80 مشاركاً من المهندسين والمقاولين والموردين. وحصل أفراد العينة على درجة CE بدرجة متوسطة 2.480. تكشف الجوانب التي تمت ملاحظتها في الممارسة الحالية فقط عن تحقيق عرضي للأهداف المحددة فيما يتعلق بالمحتوى المعاد تدويره، على الرغم من أن بعض العقبات تتعلق بمحدودية توافر المواد المعاد تدويرها، وعدم وجود قواعد رسمية بشأن استخدامها، وعدم كفاية الحوافز المالية، ونقص التدريب المناسب. لكن فرصة توسيع التعليم المستمر هي إمكانية تقليل تأثيره السلبي، والبرامج

الحكومية، والمحفزات المالية، وكلها عوامل تحفز النشاط. تم استخدام نمذجة المعادلات الهيكلية للمربعات الصغرى الجزئية (PLS-SEM) باستخدام برنامج Smart PLS لتحليل البيانات التي تم جمعها بواسطة الاستبيان واختبار فرضيات النموذج. وأظهرت النتائج التي تم الحصول عليها أن مستوى تنفيذ تبني مبادئ CE هو مستوى متوسط.

الكلمات المفتاحية: الاقتصاد الدائري (CE)، صناعة البناء (CI)، التنمية المستدامة (SD) نمذجة المعادلات

الهيكلية بالمربعات الصغرى الجزئية. (PLS-SEM)