EFFECT OF STAKEHOLDER'S PERCEPTION IN THE ADOPTION OF GREEN BUILDING PRACTICES IN THE CONSTRUCTION INDUSTRY

By

JIBRAN KHAN

(NUST2017MSCE&M00000204815)

Master of Science

In

Construction Engineering & Management

Department of Construction Engineering & Management

School of Civil & Environmental Engineering (SCEE)

National University of Sciences & Technology (NUST),

Islamabad, Pakistan

(2021)

This is to certify that the

thesis titled

EFFECT OF STAKEHOLDER'S PERCEPTION IN THE ADOPTION OF GREEN BUILDING PRACTICES IN THE CONSTRUCTION INDUSTRY

Submitted by

JIBRAN KHAN

(NUST2017MSCE&M00000204815)

has been accepted towards the partial fulfillment of the requirements for the degree of

Master of Science in Construction Engineering and Management

____

Dr. Khurram Iqbal Ahmad Khan
Supervisor/Assistant Professor
Department of Construction Engineering and Management,
School of Civil and Environmental Engineering (SCEE)
National University of Sciences and Technology (NUST)

THESIS ACCEPTANCE CERTIFICATE

Certified that final copy of MS thesis written by Mr. Jibran Khan, Registration No. NUST2017MSCE&M00000204815, of PG Wing-SCEE has been vetted by undersigned, found complete in all respects as per NUST Statutes / Regulations, is free of plagiarism, errors, and mistakes and is accepted as partial fulfillment for award of MS/MPhil degree. It is further certified that necessary amendments as pointed out by GEC members of the scholar have also been incorporated in the said thesis.

Signature: ______________________________

Supervisor**: Dr. Khurram Iqbal Ahmad Khan**

Date: __________________________________

Signature (HOD): _______________________

Date: __________________________________

Signature (Dean/Principal): _______________

Date: _________________________________

ACKNOWLEDGEMENTS

In the name of Almighty Allah, the most Merciful, the Beneficent. All praise is only for Allah who created us and always planned the best for us. I am grateful to the Almighty Allah for His countless blessings and mercy bestowed upon me through the difficulties of life and I seek His guidance and pray to Him for blessings and ease throughout this life and the life to come.

I am in debt of gratitude to my research supervisor Dr. Khurram Iqbal for his guidance, motivation, and constant encouragement throughout this journey. I appreciate the valuable time and personal support accorded by him.

I am incredibly grateful to all the respondents for their valuable contribution to this research. And at the end, I would like to pay my earnest and honest gratitude to my family, especially my parents for their unconditional support, encouragement, and patience.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

ABSTRACT

From the last three decades, the world is continuously moving towards the sustainable development in every walk of a life to mitigate the deteriorating effects on the environment. This has also forced construction industry to adapt to this change as it is the major contributor in exhausting natural resources and adding to unsustainable development. However, this adoption is not smooth around the world. The purpose of this research is to quantify the effect of stakeholder's perception in the acceptance of green building, practices (GBP). To achieve the objective, Ordinal Regression analysis is used. Questionnaire has been developed containing the factors needed to implement on of green building practices and circulated among the main stockholders i.e., Consumer, Advisor and Worker. Key factors in each of the stakeholder opinion is highlighted and quantified. The results show that Client and contractor are more inclined towards the adoption of GBP while consultant is reluctant to this change. This research adds up to current knowledge and can assist policy makers in the implementation of green building practices.

Chapter 1

INTRODUCTION

1.1 STUDY BACKGROUND

Buildings have been conventionally seen as a comparatively important sector of the economy, but the technology or resource consumption patterns experience relatively little change in the building construction industry (Ahmad et al., 2020). According to Kats (2003), buildings consume 70% of the nation's electricity and utilize a large number of materials, produce a considerable amount of waste, at the cost of the generated economy (Ibaseta et al., 2021). The demand to create more energy-efficient and environmentally friendly buildings techniques developed an understanding of the green building movement (Zhao et al., 2019). The modern green building concept was initiated as a result of escalated oil prices in the 1970s and the environmental movement of the 1960s for developing energy-efficient and renewable energy resources (USA EPA, 2016). Many researchers have defined the green building terminology. For example, Kibert (2016) described green building as "healthy facilities designed and built in a resource-efficient manner, using ecologically-based principles".

Similarly,(Robichaud, 2011) pointed four key elements Green building, D. H. Reduce environmental impact, improve residents' health, contractor's return on investment and life cycle assessment during P & D phase (Khoshbakht et al., 2018). Additionally, GB combines a number of different procedures and practices to minimize energy consumption of buildings, it's deteriorating effects on environment, and human health (Nykamp, 2017). According to Nduka et al. (2015), green building techniques used by industry professionals are; The sustainability of the site, the protection of materials and resources, energy conservation, the maintenance and operation of buildings, the strength and care of users, water preservation, reprocessing and waste reduction. In addition, (Zhang et.al, 2011) Nwokoro and Onukwube (2011) and Sharma (2018) also investigated the recent practices and difficulties of sustainable construction.

The trend in the implementation of green building practices is accepted and adopted globally by majority of industry professionals (Nduka et al. 2015). Moreover, various green building practices discussed in the literature possess some degree of similarity. And also, no building can become purely green buildings because it isn't mandatory to have every principle of green buildings (Otegbulu, 2011).

Subsequently, the consensus of stakeholders on the adoption of green building practices plays a significant role (Darko et al., 2017). As the idea seems more attractive from an environmental and health perspective but offers very little justification from the cost benefits point of view (Nduka et al. 2015). However, the identification of factors of stakeholder's perception about the adoption of green building practices can help build this consensus. The majority of the stakeholders see time, cost, and quality as their significant KPI's against which they measure their project's success (Güngör and Gözlü, 2017). . Furthermore, Irfan et al. (2019) are of the view that the complete satisfaction of stakeholders should also be considered in every aspect of the project. But with regard to adoption of GBP is concerned, the stakeholders are reluctant because Zhang et al. (2011) and Chan et al. (2017) extracted from their studies that costs and other barriers such as poor policies pertinent to green building adoption and risks act as obstructions in the implementation of green practices in the building construction industry. These studies concluded that design stage of green buildings may be more expensive due to energy efficient materials and design of green appliances at the design stage which bars stakeholders from developing any consensus. The coverage of published literature about the stakeholder's perspective towards the adoption of green building practices is limited in number and needs more comprehensive and robust studies to bridge this gap.

Therefore, that research purposes to fill this research hole. The reason for conducting that research is to emphasize and quantify the impact of the most important factors from the perspective of each stakeholder to introduce green building practices in the construction industry. To this end, by proposing a regression model, ordinal regression analysis is applied to discover the impact of stakeholder perception. This research contributes to the current literature and knowledge by proposing an ordered regression model that helps senior managers and policy makers to pace up the adoption of GBP in the construction industry.

1.2 RESEARCH OBJECTIVES

The objectives of this study are:

- To identify the key factors for adopting green building practices in the construction industry.
- Analyze the impact of stakeholders' perceptions on the factors behind green building practices in the construction industry.
- To develop descriptive framework and recommend the solutions based on the results.

1.3 RESEARCH SIGNIFICANCE

This research will provide a framework as a source of guidance for to adopt to green building practices and consequently reducing the emphasis on nonrenewable resources. Additionally, it will develop a consensus through which stakeholder's conflicts can be avoided with their timely coordination, cooperation and participation which otherwise pose considerable risks in adopting to green building practices. Following different research significance will be achieved from this study:

1. Identify the key factors related to introduction of green building practices in the construction sector.
2. Identification the perception of different stakeholders related to GBP
3. To coup up with the goals of SDGs
4. Streamlining all the stakeholders by removing the conflicts among them to framework for adoption of GBP
5. Country's economic growth will be enhanced
6. Optimum utilization of resources can be ensured by adoption of GBP

Chapter 2

LITERATURE REVIEW

2.1 INTRODUCTION

Construction industry plays an important role in the environment, economy, and social lifestyle (Geng at al., 2012) and yields an unsustainable development (Israngkura, 2011). Facilities, mainly buildings exhaust more than one third of global greenhouse gas (GHG) emissions (World GBC, 2017) and consume a large part of the total global resources (OECD, 2003). Buildings consume over 40% of the world's energy, 25% of water, and 40% of natural resources; they also generate more than 45% of the world's waste (Baharetha et. al, 2012; UNEP., 2009). These catastrophic effects have made the public aware of must be for maintainable building practices (Son et al., 2011). (Umar & Khamidi, 2012) stated that many global events have been organized to raise awareness of environmental and sustainability goals, such as the Rio Earth Summit in 1992, the Maastricht Treaty in 1992, and the Global Warming Treaty. Kyoto Agreement der Earth Summit in Johannesburg 1997 and Earth Observation Summit in Washington 2003. The 2003 Washington Earth Observation Summit, the 2010 African Green Building Rating System (GBRS) Promotion and Promotion Conference of UN-Habitat, the 2012 African Development Forum, the 2013 Swiss Asian Environment Forum and the 2014 Brussels Green Week Conference to promote sustainable built environments Global activities.

The outcome from these global events delivered some brilliant plans and ideas which inspired several countries to inculcate and enforce sustainability principles in their construction industry. Green Building is a part of these sustainability principles. All these factors and events pace up the “green building (GB) movement”. Therefore, implementation of sustainability elements to improve the sustainability of buildings became mandatory all over the globe. The U.S. Environmental Protection Agency (US EPA, 2004) defines GB as “green or sustainable buildings involve the creation and use of healthier and more resource-efficient construction, renovation, operation, maintenance, and demolition models”. The purpose of GB is to mollify the catastrophic impacts of built industry on health, environment, and resource depletion (Qian, 2010). Due to this GB has been now considered as a key for achieving sustainable development in the world (Butera, 2010), and is believed in both 1st& 3rd world countries (Geng at.al., 2012). (Kats, 2003) defined green buildings as those that are more efficient than the buildings built through conventional ways and methods in terms of key elements like materials, land, and water. Furthermore, safeguard of the ecosystem, accentuating human health, and monetary benefits are the advantages of green buildings that move the industry towards the adoption of it (USGBC), 2005). The above-mentioned discussion suggests that GB act as a binding force for construction industry to accomplish socio-economic and environmental sustainability (Edwards, 2005; Lam, 2009). Therefore, it turned out as a new technique that amalgamates completely the design and GB objectives to safeguard the environment and health of humans. This method seems to be effective to mitigate the world's current challenges related to the environment and energy making it more adaptable and making it the latest trend in human development. (Li et. al, 2014). However, there are multiple challenges in the adoption of GB which is making it difficult for a smooth adoption. Although with the benefits attached to it, barriers are also widespread.

2.2 GREEN BUILDING AND GREEN BUILDING PRACTICES

Green building was first defined by (Kibert, 1994) as "Resource efficiency, healthy building development and effective management based on environmental principles". Then (Kibert, 2012) designed it as a building and built it to conserve resources. It is the practice of designing environmentally friendly structures and building by consuming resources efficiently, using nature-based principles. Green building combines a huge range of methods and techniques to minimize the construction effects on energy utilization, environment, and wellbeing of humans. Worldwide, the attitude towards green building practices is positive and it has been accepted by incorporating green building principles in the building construction industry. Different researchers use various terminologies for green building to elaborate its concept. GB includes the methods and techniques that minimize the environmental effect of the construction industry which inculcates green building, sustainable building, efficient building, and environmental development. (Fischer, 2010) defined GB as amalgamated building techniques and practices that sharply mitigate the carbon footprint of structures comparative to current practices. Similarly, (Wang, 2013) coined green building as environmentally friendly structures which are designed and constructed inefficient resource management, utilizing nature-based principles. (Chatterjee, 2009) termed GBP as a method of Construct buildings and infrastructure in a way that reduces resource consumption and mitigates negative impacts on the environment and develops an improved environment for humans.

Likewise, (Kamana, 2011) termed GB because of a design that centers around expanding efficient utilization of resources such as water, energy, and materials and decreasing structure effects on people wellbeing and climate throughout the structure's lifecycle through improved orientation, plan, execution, support, and dismantling. Moreover, (Yang et.al, 2011) opined that GB is a result of a concept which concentrates on expanding the productivity of resource utilization. Hence, concluded from the above explanations, that GB is type of practice(s) in which structures are modelled and constructed without yielding ecological debasement during the whole lifecycle of building displaying high environmental, socio-economic performance. Notwithstanding, the capacity for improving the environment in the construction industry lies in green building dur to its sustainable principles and practices. The meaning of these green buildings corresponds to the use of green buildings in this study.

2.3 WHY GREEN BUILDINGS

It is well established that there is a numerous benefit linked with green buildings. In environmental point of view, green buildings aid in safeguarding the ecosystem and enhance urban biodiversity by efficient land use (Henry A, 2012). Waste reduction from construction and demolition is a key factor of green building (Akadiri, 2012). The waste recycling rate must be greater than 90% so that the obvious environmental effects due to construction and demolition are eradicated (Coelho, 2012). In comparison with traditional buildings, GB in general yields better performance depicted from energy and water efficiency, and reduction in carbon footprint. Jo et al. suggested that CO_2 emission can be drastically cut if whole construction works in Seoul adopt the LEED rating system (Jo JH, 2009). The improved efficiency of building majorly in terms of life cycle point of view can help in cost reductions or savings. This yields optimization of the operational cost of the building. GB can help in energy saving by 30% in comparison with traditional buildings as reported by the economist.

Thermal comfort is the most significant factor in occupants satisfaction which is complex dynamic of temperature and humidity (Zhang, 2011). This has aroused great interest of researchers, who simulated and measured the thermal comfort of GB correlated with conventional buildings. Therefore, the desired comfortable temperature range can be recommended (Sicurella F, Evola G, 2012). Psychological, physical, cultural, and behavioral factors attributed to adaptive thermal comfort may also play a role (Akadiri, 2012).

2.4 HISTORY OF THE ADOPTION OF GREEN BUILDING PRACTICES

Umar & Khamidi, (2012) reported that several global events were organized to raise awareness of environmental and sustainability goals, for instance the Maastricht Treaty in 1992, the Rio Earth Summit in 1992, and the 1997 The Kyoto Conference on Global Warming in 2015, the Johannesburg Earth Summit in 2002, and the Washington Earth Observation Summit in 2003. In addition, the 2003 Washington Earth Observation Summit, the 2010 UN-HABITAT Africa Green Building Rating System (GBRS) Advocacy and Promotion Conference, the 2012 African Development Forum, the 2013 Swiss Asian Environment Forum and the 2014 Green Week Conference are all global promotion of ecological sustainability of activities. The review and planning of these global activities has prompted many countries to implement and merge maintenance standards in their construction industries. A subset of this standard is GB. However, the concept of green building is that the construction sector can actively contribute to environmental protection.

The climate change globally has attained the attention of the world and due sensitivity of it, the world is moving towards sustainable solutions for development Berardi (2014). This has also forced construction towards the adoption of green buildings practices. Therefore, green building emerged as a new lifestyle in a construction industry which integrates design, construction with the sustainability principles and objectives to protect the environment and human health from the adverse effects and mitigate its contribution in climate change.(Li et. al, 2014). The potential in green buildings is making governments and GB advocates to work on devising procedures and policies to enhance the wider adoption of GB. For instance, Singapore has set target to convert 3/4th of the country's building into green construction by year 2030(BCA 2009). To make it possible a numerous step has been taken How to allocate approximately US$100 million to owners to convert them into green renovations, and allocate US$20 million to help customers, contractors, and other stakeholders use green building practices and technologies to design sustainable buildings for implementation (BCA, 2009) (Schwalbe, 2015) (Low et al., 2014). Similarly, USA, UK, and Canada have developed policies (such as mortgages and discount loans) to encourage and encourage taking over green building practices and technologies (Qian and Chan, 2010).

Green building requires amalgamation among GB technologies and other building parts to accomplish its objectives (Hoffman and Henn, 2008). It is obvious that SD can be achieved through the utilization of green technologies. For example, In California, the implementation of high-efficiency systems for water heating, heating, ventilation, air conditioning, and cooling, the passage of sunlight, the correct location and configuration of buildings, and the use of energy passive solar systems helped designers reduce the energy consumption of buildings by 60 % (USGBC, 2003). (IEA, 2015) believes that the progress of green technology can change the development of the global energy market, because the world represents a key turning point in achieving environmental goals. The UNEP (UNEP, 2009) found that advocating green technologies mitigate the energy utilization of plants by 30-80%.(Chen at. al, 2015) reported that building can become energy efficient and increase level of comfort by adopting suitable green building technologies.

Although keeping in view all the advantages of GB practices, the latest tools, technologies, and strong government support yet what are the factors which are obstacle in the thorough adoption of GBP in the industry? The research has been carrying out to explore the solutions by investigating advantages and barriers.

So far, studies have been conducted on specific countries for example (Williams and Shahid, 2016);(Winston, 2010) Delays, Codes, Awareness Raising, and Knowledge Availability. International surveys designed to collect and compare data from the views of British experts from different countries on a series of driving factors, obstacles, and strategies to encourage the adoption of British technology. This article reports the results of the obstacles. The findings of this article are designed to help practitioners and industry stakeholders, especially policymaking Develop appropriate strategies to overcome the identified obstacles. This article may also be useful for researchers to design further empirical studies.

2.5 FACTORS DETERMINING ADOPTABILITY OF GREEN BUILDING PRINCIPLES IN CONSTRUCTION

Former researches by Augenbroe and Pearce (2009); Zhang et al. (2011); Nwokoro and Onukwube (2011) highlighted important factors for the adoption of GB. Augenbroe and Pearce (2009) reported fifteen factors of GB which include: energy preservation measures, laws for an effective Land use and urban planning policies, measures to reduce waste, internal quality, resource protection strategies, environmentally friendly energy technologies, review of modeling process, positive role of the industry materials, improved measurement and accounting of costs, implementation of incentive programs, new types of partnership projects, Commercial building as a training and recognition of productivity benefits. Zhang et al. (2011) also identified GB variables including energy productivity, water proficiency, material conservation, indoor environmental improvement, and operational and maintenance optimization. Moreover, this research divided GB variables into two groups: Architecture (passive) and mechanical (active). Passive methods refer to building modeling that does not require mechanical tools for heating or cooling and relies on elements of the building envelope (breathability, exterior walls, doors, windows, and roofs). and the orientation of building to get maximum natural light and reduce energy consumption and total life cycle cost. Likewise, it also uses recycled materials to have low carbon footprint. Conversely, active building design is related to the use of electric or mechanical equipment for heating, cooling, or lightening a place by air conditioner, heaters, artificial lighting, lifts, siphons.

Research by Otegbulu (2011) also highlights eleven elements of green design which are: energy and water efficient utilization, reducing waste, operation of the building, built, maintenance, resident health, occupant productivity, water management, climate, and environmental integration. However, various researchers have identified similar types of elements. No building can be a green building as it can’t inculcate all the above-stated features in it (Otegbulu, 2011). So, research adopt energy and Water efficiency; Conservation of the environment and resources; Recycling and waste reduction; Sustainability of the location; Environmental quality of indoor air, maintenance, and optimization of buildings in their research. The data obtained represent the perspectives of interest groups for the adoption of green building principles in buildings projects in Nigeria (Ogunsanmi, 2015). Egbu (2008) mentioned the most powerful motivators for going green were government restrictions and laws. This means that the Indian construction industry is currently in a state of flux.

Hwang (2012) highlighted the strategies to enhance the implementation of GBP, including the support from the government by giving incentives for GBTs adoption, clients education related to benefits of green building, framework development for project management of green buildings, and financial support by government for green building R&D. In Hong Kong, Wong et.al (2016) identified several factors effective to ease green procurement adoption in building construction projects. They highlighted the top three factors among all 35 factors: environmental policies, government's obligatory, client’s requirement in tendering, and governments and NGOs' prerequisites. Moreover, they classified 10 group facilitators. they found government laws and guidelines, GB lifecycle considerations, and senior official management commitment to be the most significant facilitator groups. Darko et. al, (2017) reported that giving incentives, educating about cost and benefit analysis of GB, and ratings and labeling the buildings as crucial strategies to promote green building practices adoption in the US. From a global point of view, Chan et. al (2017) highlighted the critical promotion strategies for GBTs adoption. Qian and Chan (2010) compared and developed a conceptual model of the existing strategies to promote GB in the developed countries such as Canada, UK, the US, and China. Many measures were included in this model for the promotion of GBs such as subsidizing from the government for GB technologies and practices, research and development funding, monetary and non-monetary incentives, soft loans for energy efficient building practices enforcement, buildings certification and improved authorization of present principles. (Van Doren *et al.*, 2016) highlighted the factors to encourage the adoption of energy conservation initiatives. They highlighted policies such as creating and implementing regulatory measures, PPP funding mechanisms, dissipating information related to monetary and non-monetary benefits of energy conservation initiatives, educating and preparing stakeholders on energy preservation initiatives. Moreover, Potbhare et al., (2009) developed an execution technique to advance green building adoption in India; development of the institutional framework, availability of cost benefits analysis information, seminars, workshops to enhancing the public environmental awareness and educational programs for stakeholders were identified as important adoption strategies. Li et. al, (2014) tended to the issue of how to advance GBs practices in China, contending that improving environmental shrewdness of stakeholders, reinforcing GB technology R&D, and developing GB strategies are three essential steps to advance GBs. (Esa et. al, 2017) pointed out the vital techniques for driving development and destruction waste minimization techniques selection In Malaysia: guidelines upgrade, awards and incentives, and effective administration systems. Doan et al., 2017) contemplated the writing on GB certification frameworks and inferred that creating GB certification frameworks has a significant influence in supporting green structure improvement internationally.

2.6 DEFINITION OF STAKEHOLDER

The concept of stakeholder dated back to 1963 when this terminology was used very first time by researchers in a memorandum at Stanford Research Institute. Stakeholders are “those groups support the organization would cease to exist”(Olander, 2007). Freeman (1984) gave a more refined, broader, and robust definition in his published book for stakeholders “Strategic Management: A Stakeholder perspective”. According to him stakeholders are “any person or group people that have influence or influenced by achieving the firm’s goals and objectives”. Stakeholders may participate in the project or have interests that may be decisively or negatively affected by the implementation or termination of the project (PMI, 2013). According to (Mitchell et al., 1997), it is individuals/groups that are affected by the financial decisions and interests of related organizations. Project participants according to PMI (2017) is “individuals, groups or organizations that can be influenced, influenced or observed by project decisions, activities or results”. Similarly, Newcombe (2003) defined stakeholders as group of people or individuals having interest or any expectation from project outcome that may include internal or external stakeholders.

2.6.1 Classification of Stakeholder

(Aapaoja and Haapasalo, 2014) sequenced and classified stakeholders into primary project team members (project core team), key supporting members, tertiary stakeholders, and extended stakeholders. Where primary project team (PTM) and key supporting participants are termed as internal stakeholders, tertiary and extended stakeholders are regarded as external stakeholders. According to researchers the concerns of all the above stakeholders except extended stakeholders must be assimilated for project success. PTM inculcates client, main contractor and architect but may include others as well. Key supporting participants include consultants, sub-contractors, and designers. Tertiary stakeholders help in project implementation by delivering resources financially and logistically along with providing regulations. Whereas, extended stakeholders comprise media, NGO's and residents who may have some concerns related to the project. (Cleland, 1999) classified stakeholders into internal and external stakeholders, these stakeholders presented in figure can be divided into nine groups.

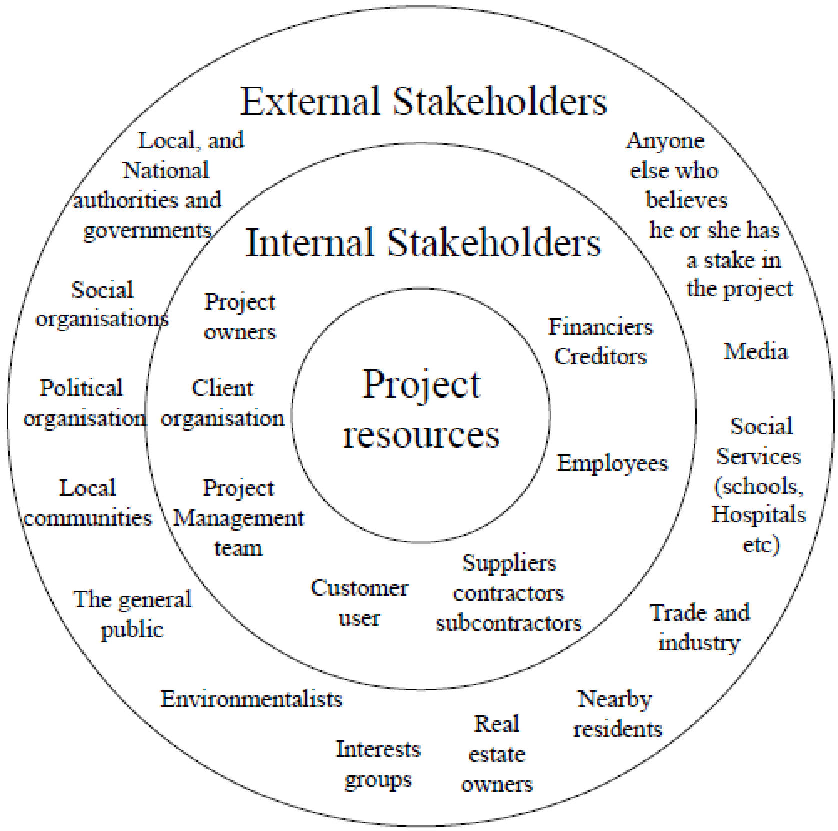


Figure 1 Classification of stakeholders

2.6.2 Importance of stakeholders in the construction industry

Generally, the primary members in a construction project are the client, the architect, and the contractor. The collaborations and interrelationships between them generally decide the performance of a project and have the critical duty for successful completion of project. However, digging deep into project life cycle, there are numerous other factors that play key role in the project success, and these factors depends on decisions made by different people, groups and organizations (Love et al. 1998a). These internal and external participants are perceived as stakeholders who are effectively engaged in the project who may positively or negatively affect their interests. (Jergeas et al. 2000)

A construction project includes many complex activities. Each stakeholder has its own interests and a different type of investment from other stakeholders. (Bourne and Walker, 2005) believes that how stakeholders perceive and expect or think have a strong impact in the success or failure of project. Inefficiency and flaws in stakeholders management can cause many severe issues in Construction projects, for instance error in scope estimation, definition of work, reduction in resource allocation to the project in terms of both quality and quantity and unexpected variation in scope and regulatory changes (Black, 1995) These all factors contribute in cost overruns and projects delay. Cleland (1999) and Karlsen (2002) opined that keeping a balance in the interest of multiple stakeholders by effectively management of number of stakeholders s critical for the Successful completion of the project. (Olander and Landin, 2005), reported stakeholders' negative role and attitude in a construction project causes severe obstructions in execution of the project leading to conflicts, delays and cost overruns related to design and execution of the project. Their research unfolded that consideration of interest and impact of the stakeholders is a mandatory and important part in each phase of any development project. (Ann and Hunter, 2007) considered that stakeholder management is a significant factor in briefing process of project through utilization of qualitative and quantitative surveys, and regarded as imperative to evaluate each stakeholder interest and force before the planning process and to proportionate the interests of all stakeholders'. (Olander and Landin, 2005) found that project managers should accommodate conflicts and needs of all types of stakeholders by clearly identify all of them. The stakeholders' power, interest and responsibility should be fully evaluated so that the major obstacles in the process of stakeholder management can be tackled by the project managers. (Jergeas et al., 2000-) recommended that the objectives and feedback of stakeholders related to project should be solicited to align the project team on the same lines with stakeholders. If the stakeholders are involved from initial phase of the project and included into project team, then number of problems can be avoided. By managing this way, the project priorities can be made, and expectation can be fulfilled. It can be deduced from the above studies that stakeholder management is the key to the success of construction projects. Management of stakeholders is necessary in construction projects because: The process of construction projects is complicated and there are many participants. The relationship between the people involved in the construction project is temporary. The type of investment and level of interest in a project vary from stakeholder to stakeholder. Due to which project manager must communicate with each stakeholder to protect and accomplish their interest and needs. On the other hand, every stakeholder must understand his role and responsibility in the project and act accordingly to plan requirements. Otherwise, Stakeholder mismanagement can lead to delays and cost overruns.

2.7 STAKEHOLDER'S PERCEPTION AND THE ADOPTION OF GREEN BUILDING PRACTICES

Success of a project vary from stakeholder to stakeholder. A project which may be unsuccessful for a contractor might be successful for a client (Toor and Ogunlana, 2008). Similarly, each stakeholder has different type of investment and interest from other stakeholders on a particular project that's why success perception also vary among stakeholders (Bryde and Brown, 2005). Particularly, in construction projects, there are usually many stakeholders, it is necessary to understand the views of all stakeholders on the success of the project. Cox et al. (2003) emphasized that from a management perspective, the perception of project success may also be different. They found that there is a big contrast between the views of the site manager and the project management on KPIs. Therefore, it is not surprising that different participants have different ideas when analyzing project performance. Cox et al. (2003).

The stakeholders' attributes such as culture, attitude, and behavior play an important role which cannot be neglected in GB industry. They strongly influence adoption of green building technology and practices. Stakeholders hold this position because of certain facts. Firstly, they are the people who funds the projects (Nwachukwu, 2009) which resultantly establish them in the position of decision making for the acceptance of GB practices. Secondly, (Hwang, B. G., and Tan, 2012) expressed that project team cannot adopt to the GB practices without the interest of the client. On contrary, if customers and clients are willing to adopt GBPs than the industry can accomplish more GB standards.(Li et al., 2014) On the basis of above stated facts, any negative attribute from the stakeholders has potential to affect the adoption of GBPs. For instance, Stakeholder's hesitance to convert to modern technologies from the conventional ones. Meryman and Silman (2004) verified the findings of Chen and Chambers (1999) and they continued to adhere to traditional architectural practices industry and resistance to changes is the biggest challenge for the adoption of GBPs. Due to deeply implanted traditional standards and opinions of stakeholders and immature concept of GB is local industries, (Hwang, 2013) the adoption of green practices become dubious of its performance and quality. This yields high level of disparity in the GB systems. (Winston, 2010) and adoption might need trust, confidence and beliefs of individuals (Luth ra et al., 2015). These complications can be mitigated by takeaways from the comparable preceding successful projects. Hence, unavailability of such similar projects (Potbhare et al, 2009) absence of reliable and tested green building practices, products provide stakeholders a firm ground to avoid the adoption of GBPs (Hwang and Ng 2013).

The market demand controls the supply of contactors, suppliers, and manufacturers. For example, if there is not demand GBs from the people then how green technologies can be implemented by a contractor? And how can the supplier deliver without contractor's interest or order placement? Different research repeatedly emphasized on hinderance in the adoption of GB is due to the lack of interest and demands of stakeholders. For instance, (Djoko, 2014) revealed that the absence of people interest and demand is the biggest obstacle in taking over GB practices. (Zhang et al. 2011) reported that loss of motivation from end users has poor consequences in the implementation of GBP in the construction industry. In addition, (Underwood, 2000) insisted on supplier data in the preliminary stage of design, (Koskela, and Vrijhoef, 2020) emphasized importance of a harmonious relationship between the supplier and the key figures in the UK project. Research in recent past (Lam, P. T., Chan, E. H., Chau, C. K., Poon, C. S., & Chun, 2009) and (Ruan, 2013) shows that the lack of reliable and genuine green market suppliers is the main obstacle to implementation in the UK. Because (Lam, P. T., Chan, E. H., Chau, C. K., Poon, C. S., & Chun, 2009) they have stated that “the green supply market is immature and lacks trust in suppliers affects the entire GB supply chain.

Chapter 3

METHODOLOGY

3.1 INTRODUCTION

Research methodology is beacon to achieve the desired objectives in research. It provides researcher to identify different tools and techniques to execute research within available time and resources. Therefore, the discussion in this chapter is related to tools and techniques utilized in this research. The research process used in this study has different steps i.e., literature review, preliminary survey, primary questionnaire survey and ordinal regression analysis.

3.2 RESEARCH STRATEGY

To attain the anticipated research objectives a detailed and comprehensive literature review was conducted and 46 factors for the adoption of green building practices were identified. To shortlist the crucial factors, a preliminary survey was circulated to take input of industry professionals. The preliminary survey was circulated to 30 international green building experts having at least 5 years of industry experience. Based on the responses from the experts, a normalized industry score was calculated by the model method. The literature score and industrial score were combined, and a 40-60 ratio was applied to shortlist 16 top significant factors implementation of GBP in the construction industry that were finalized for the further research process. The results are shown in Table 1. After the identification of the top 16 significant factors, a primary survey was conducted to find out stakeholder's perceptions in the adoption of GBPs. In this questionnaire, stakeholders were treated as independent variables while GB factors were considered as dependent variables for analysis. The survey questionnaire was developed according to 5-point Likert scale (1=no effect and 5=major effect). The questionnaire had to two main portions: (1) respondents' biodata and (2) the effect of stakeholder's perception in the adoption of GBP in the construction industry.

Table 1 Factors Ranking Table

Sr. No.	Factors for the adoption of GBP in the Building Construction	Normalized literature score	Normalized industry score	Total score	Cumulative normalized total score	Rank
1	Indoor Environment Quality (IEQ)	0.085	0.023	0.048	0.048	1
2	Environmental Protection in Site Aspect	0.064	0.023	0.039	0.087	2
3	Government Policies and Regulations	0.048	0.029	0.036	0.123	3
4	Innovative Design	0.048	0.029	0.036	0.159	4
5	Energy conservation	0.053	0.017	0.032	0.191	5
6	Education and Training	0.042	0.023	0.031	0.221	6
7	Low life Cycle Cost	0.042	0.023	0.031	0.252	7
8	Environmental Protection in Material Aspect	0.037	0.023	0.029	0.281	8
9	Environmental Protection in Water use	0.037	0.023	0.029	0.309	9
10	Adoption of Incentives Programs	0.042	0.017	0.027	0.337	10
11	Initial Design and Construction Cost	0.037	0.017	0.025	0.362	11
12	Building Value	0.037	0.017	0.025	0.387	12
13	Occupants Health and Productivity	0.037	0.017	0.025	0.412	13
14	Environmental Protection in energy use	0.037	0.017	0.025	0.437	14
15	Recycling and waste reduction	0.037	0.017	0.025	0.462	15
16	Future Maintenance and Operational Cost	0.026	0.023	0.024	0.486	16

The sample for the primary questionnaire was randomly chosen from civil engineers of developing countries. The survey included three primary stakeholders (clients, consultants, and contractors. The questionnaire was circulated and submitted online. Among 163 invitations, 98 complete replies were received, making it 61.4% respondents. The minimum sample size must be above 96, which guarantees representativeness and significance (Shash, 1993; Dilman, 2000). sing Microsoft Excel and SPSS 23 were used for data analysis, and statistical tests such as Cronbach coefficient was used for the reliability and normality of the data, respectively. Consistency and reliability of internal data is measured through Cronbach's alpha test. Its value ranges from 0 to 1. The validity and internal reliability of the data must be ensured before running other tests (Tavakol and Dennick, 2011). Finally, ordinal regression analysis is used to model the effect of independent variables on dependent variables.

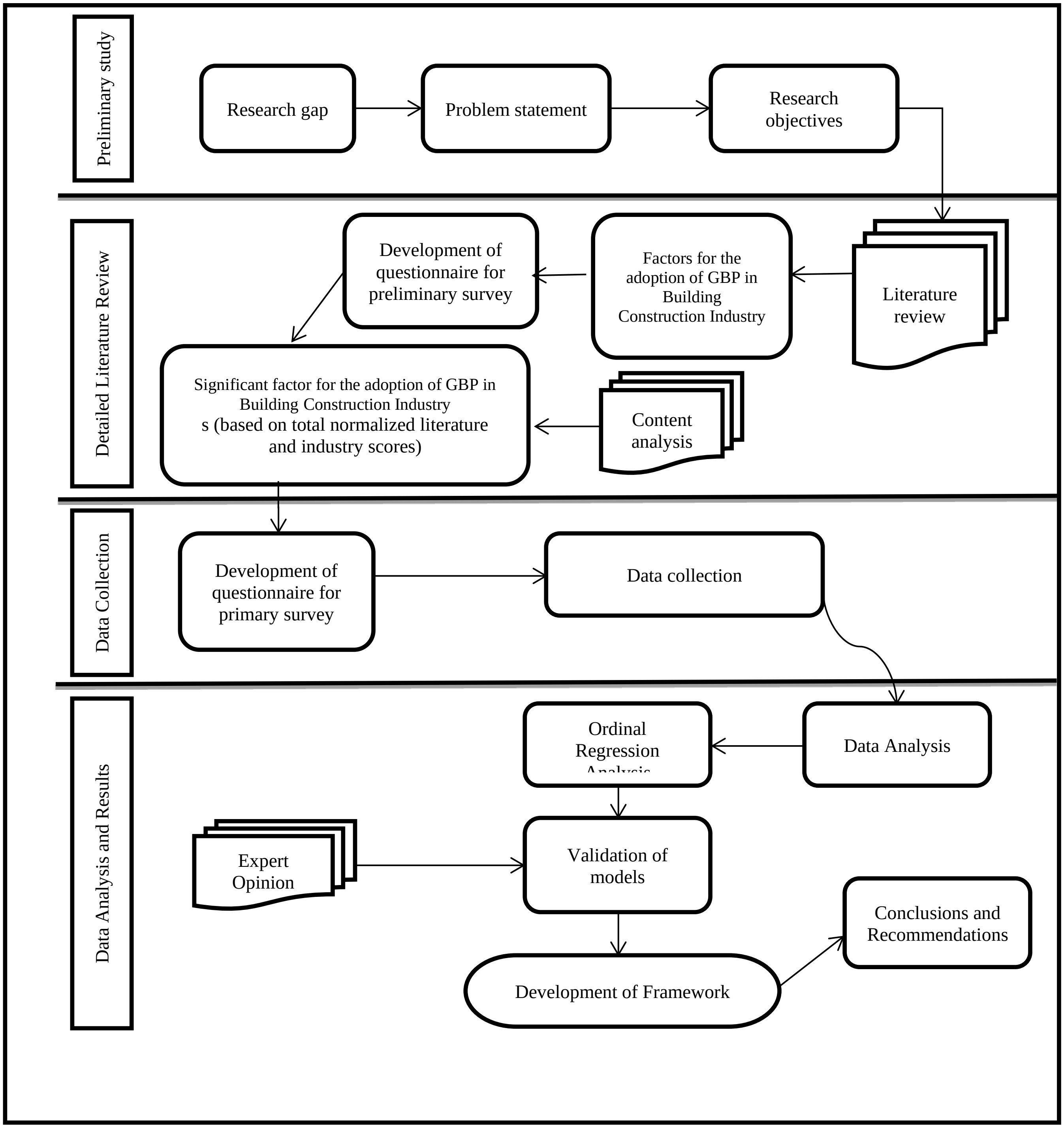


Figure 2 Research Methodology Flow Chart

3.3 PRELIMINARY SURVEY

The purpose of conducting a preliminary survey was to include the industry professional's input before performing content analysis. The preliminary survey questionnaire was circulated to 30 experts having industry field experience of more than 10 years. Based on the feedback of experts, the industry normalized score was computed by applying mode values obtained from the survey. Against weightages, normalized industry and literature scores were combined. After factor comparisons, the top 16 most significant factors resulting in adoption of GBP were finalized for further analysis. Expert's demographics are shown in Table 2.

Table 2 Respondent's Demographics

Organization type	No. of responses	Years of experience	Total no.	Educational level	Total no.
Client	8	01-10 years	7	B.Sc./B.Eng./B. Arch	14
Contractor	13	11-20 years	15	M.Sc./M.Eng./M.Arch. /P.G. Dip.	11
Consultant	9	21 and above	8	PhD/D.Eng.	5
Total	**30**				

3.4. FIELD DATA

3.4.1. Regional distribution of responses

Total 98 survey responses were collected out of which 38% were from Pakistan and 62% were international. Major countries that participated in the survey include Pakistan, China, Denmark, KSA, UK, the US, India, Malaysia, Jordan, Sri Lanka, UAE, and others as shown in Figure 2.

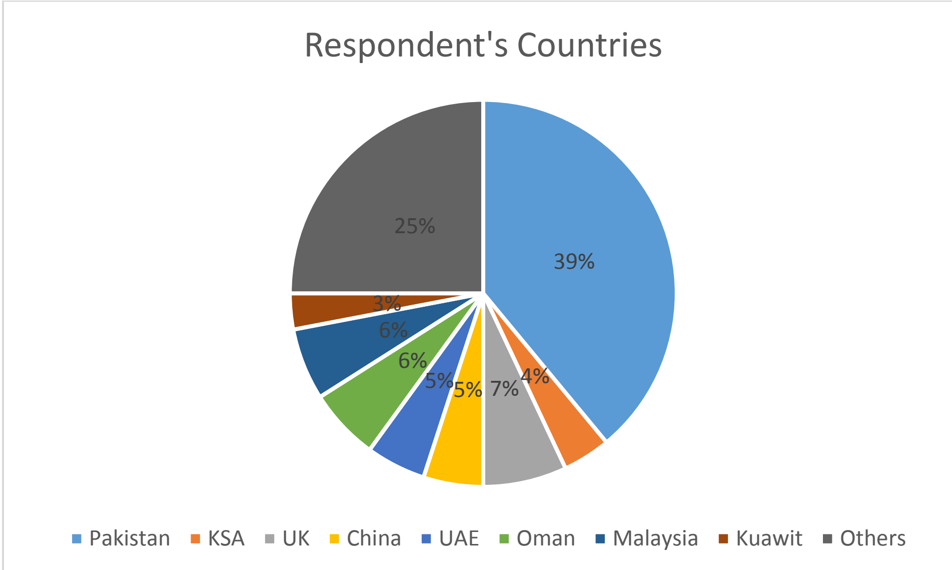


Figure 3 Response dent Countries

3.4.1. Responses of Stakeholders

Out of total 98 respondents, 36 are contractors, 30 clients and 32 consultants. Questionnaire was distributed evenly among three major stakeholders to have equal number of responses. Moreover, education and experience varied from respondent to respondent, and it has been displayed in the charts below.

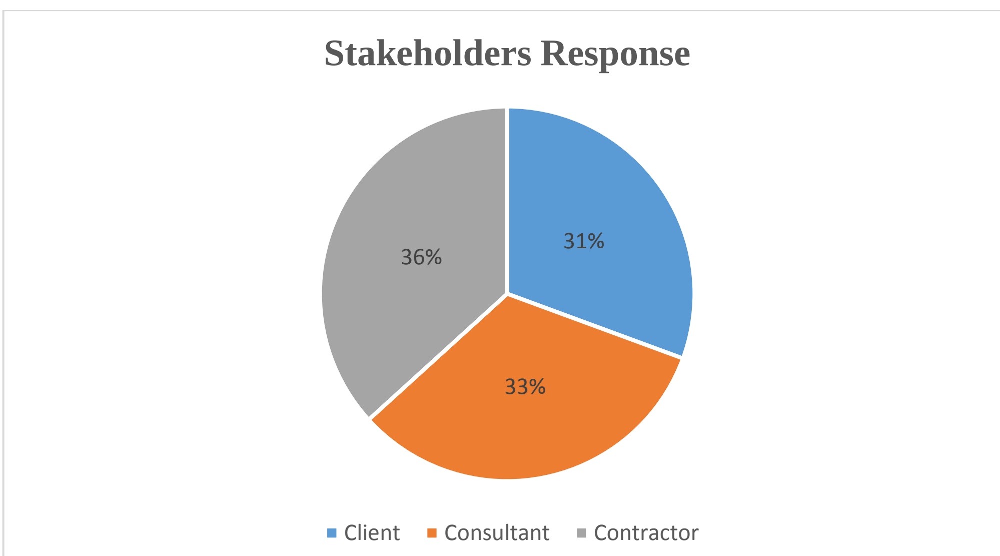


Figure 4 Stakeholder's Response

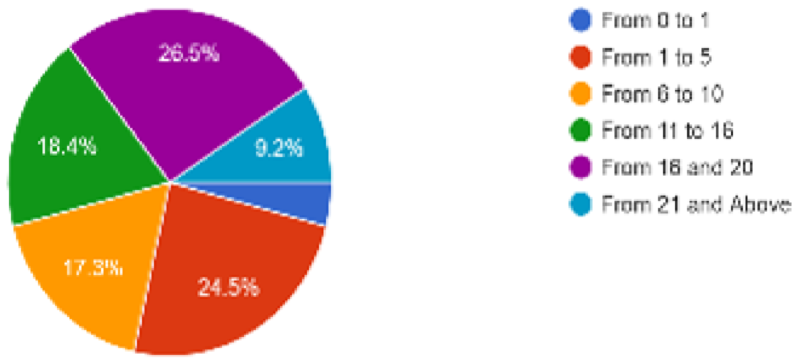


Figure 5 Work Experience

Chapter 4

RESULTS AND DISCUSSIONS

4.1 VALIDITY AND RELIABILITY

Cronbach’s Alpha test was performed to check the consistency and validity of data which was measured 0.863 for the given data making the given data reliable and valid for further analysis as acceptable value is between 0.70-0.95 (Tavakol and Dennick, 2011).

4.2 DESCRIPTIVE STATISTICS ANALYSIS

Descriptive statistics is applied to describe the characteristics of data and summarize the data in a simpler way (Kaur et al., 2018). Quantitative data are presented in a manageable form. It uses the different coefficients of measures to represent the data such as Mode, Mean, Median, and standard deviation (Mishra et al., 2019). In this research mean and standard deviation were considered as the coefficient of measures. The higher mean of a factor means that it is the most significant factor according to the experts. Likewise, a lower standard deviation depicts that those responses are less scattered from the mean value of respective factors. In this context, four factors, Energy conservation, Occupants Health and Productivity, Initial Design and Construction Cost, Environmental Protection in energy use are the most significant factors according to stakeholders as they have the mean and standard deviation less than 1. Table 3 shows all the 16 factors arranged in descending order in terms of mean which indicates that Energy conservation is the most impactful factor and indoor environment quality is the least impactful factor according to stakeholders.

Table 3 Descriptive Statistics Analysis Table

Factors	Mean	Standard Dev
Energy conservation	4.13	0.938
Initial Design and Construction Cost	4.13	1.042
Innovative Design	4.11	0.983
Occupants Health and Productivity	4.10	0.855
Resource Conservation	4.05	0.957
Future Maintenance and Operational Cost	4.01	0.947
Building Value	4.00	0.974
Environmental Protection in Energy use	3.94	0.901
Environmental Protection in Material Aspect	3.94	1.069
Recycling and waste reduction	3.91	1.022
Education and Training	3.86	0.970
Adoption of Incentives Programs	3.86	1.032
Environmental Protection in Water use	3.85	1.005
Indoor Environment Quality (IEQ)	3.80	1.137
Low Life Cycle Cost	3.78	1.067
Government Policies and Regulations	3.72	1.082
Environmental Protection in Site Aspect	3.61	1.001

4.3 KMO AND BARTLETT'S TEST

The Kaiser-Meyer-Olkin Measure of Sampling Adequacy is a statistical test usually performed to measure the variance among the variables (Vanmali et al., 2020). It has a value ranging from 0-1 where a value closer to 1 show that factor analysis will be beneficial on the given data while significance below 0.5 depicts that factor analysis might not be useful. In this study, value of KMO is .911 which is above 0.5, and approaching 1 which means factor analysis will be useful on the provided data.

Likewise, Barlett's test of sphericity tests has the assumption that your correlation matrix is an identity matrix indicating that factors are not correlated and therefore not suitable for structural testing. Those values having significance level less than 0.05 depicts that it is useful to apply factor analysis on given data. In the current research, a significant value is 000 which means factor analysis can run on the given data. The results are presented in Table 4.

Table 4 KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.906
Barlett's Test of Sphericity	Approx. Chi-Square	750.175
	df	105
	Sig.	.000

4.4 VARIMAX ROTATED FACTOR LOADINGS

Before the modeling process, the dependent variables were simplified into three groups to simplify interpretation and reduce empty cells counts that might influence the modeling process. The factor analysis shows the solution of the rotation factor generated by the maximum factor of the rotation variance. The high load is selected based on the limit of 0.5 (Maskey et al., 2018). The load factor indicates the contribution of each expression to the factor under consideration. The results in Table 5 depicts the expression load factors into three groups and obtain a clear factor load model. Cross loading of variables was considered during the analysis and those having loaded less than 0.5 in a factor was neglected and variable having higher than 0.5 value was retained in the respective factor. Similarly, those factors having value less than the cut off were omitted and analysis was repeated after their exemption of factors not fulfilling the above criteria and results are shown in Table 5.

The two statements of the three-factor model are omitted because they do not impose a significant load on any of the factors considered (considering the 0.5 cut-off value). Name the factors divided into three groups, including GB1, GB2, and GB3

GB1 = Recycling and waste reduction, Low life Cycle Cost, Future Maintenance and Operational Cost, Education and Training, Building Value, Initial Design and Construction Cost

GB2 = Environmental Protection in Material Aspect, Environmental Protection in Water use, Environmental Protection in energy use, Occupants Health and Productivity, Environmental Protection in Site Aspect

GB3 = Resource Conservation, Innovative Design, Energy conservation, Indoor Environment Quality (IEQ)

The two neglected factors are Adoption of Incentives Programs and Government Policies and Regulations because their values were smaller than the set cut-off value of 0.5. This categorization of factors shown in Table 5 will remain unchanged for all the regression models and will be used during the analysis process of ordinal regression analysis.

Table 5 Factor Analysis

VARIABLES	Varimax Rotated Factor Loadings (Components)		
	GB1	GB2	GB3
Recycling and waste reduction	.695	.460	
Low life Cycle Cost	.675		.401
Future Maintenance and Operational Cost	.673	.402	
Education and Training	.673		.413
Building Value	.659		
Initial Design and Construction Cost	.586		.437
Environmental Protection in Material Aspect		.815	
Environmental Protection in Water use		.809	
Environmental Protection in energy use	.409	.661	
Occupants Health and Productivity		.601	.358
Environmental Protection in Site Aspect		.536	
Innovative Design			.721
Resource Conservation			.717
Energy conservation			.668
Indoor Environment Quality IEQ			.607

4.5 ORDINAL REGRESSION ANALYSIS

It is performed to analyze impact of stakeholder perceptions in the adoption of GBP in the construction industry. As there are three groups of dependent variables, an equal number of regression models were proposed ordinal regression analysis has some assumption which are mandatory to be satisfied. This include (1) the response is measured at the ordinal level, (2) the assumption of parallel lines, that is, the parallel lines are used for test validity checks, which are proportional -Odds-Hypothesis

(Ogunlana et al., 2006) and (3) sufficient number of somatic cells. The point here is to understand that the number of cells is inversely proportional to the chi-square fidelity. The fewer cells counted, the truer the chi-square test (Armstrong & Sloan, 1989). For this reason, the responses of primary survey for the factors were reduced to 3 scale from the 5 scale to reduce the zero-cell count. The three scale include no effect, Neutral effect and major effect (Maskey et al., 2018).

Before the modeling process, the dependent variables were simplified into three groups to simplify interpretation and reduce the number of empty cells counts that might affect the modeling process. Therefore, the quality of the goodness test is utilized to ascertain the adequacy of the fitted model. Then a parallel line test is performed to verify the correctness of the proportional advantage hypothesis. The acceptable hypothesis for testing is:

H0: At each level of the response variable, all regression coefficients are the same.

H1: For each level of the response variable, all regression coefficients are different.

The resulting model's adequacy is assessed using the likelihood ratio deviation and Pearson's chi-square statistics (Eygu and Gulluce, 2017). The following are some of the test's probable assumptions:

H0: The model fits the data well

H1: The model does not fit the data well.

In the ordinal regression analysis, the effect of multiple independent variables effect can be calculated on a single dependent variable. This means number of regression models depend on number of dependent variables. In this research, there are three dependent factor GB1, GB2, GB3 while independent variables are Client, Consultant and Contractor. Similarly, client, consultant and contractor are nominal variables therefore, they need to be modified and must be given a quantitative number such as 1,2,3 to run the analysis. However, during the analysis, SPSS automatically makes a higher value independent variable as a reference variable whom value becomes zero and other independent variables are measured with respect to reference variable. There is freedom in choosing the reference variable from independent variables. In our case, we have chosen Contractor as our reference variable. As there is 3 level modified scale to reduce zero cell count, so number of levels will be one less which means 2. We will have two intercepts for each model as level for reference category is nor taken in account.

Model-1: Effect of Stakeholders' perception on the GB1 factors

From Table 6 parallel line test to investigate the validity of the proportional probability hypothesis shows that chi-square value = 1.170 while the p-value = 0.557. The significance value is much higher than accepted level of 5%. Hence, null hypothesis cannot be rejected on any statistical evidence. Therefore, the test confirms that the model satisfies the assumption of proportional probability.

Table 6 Test of Parallel Lines

Model	**Likelihood**	**Chi-Square**	**Df**	**Significance**
Null	18.758			
General	17.558	1.170	2	.557

Similarly, for the likelihood ratios in Table 7, Pearson's deviation and chi-square are utilized to gauge the fitness of the model. These test shows that the p-values 0.951 and 0.949 above 0.05, so null hypothesis cannot be negated from statistical analysis. Hence, the fitting of model is sufficient.

Table 7 Goodness-of-Fit

Test	**Chi-Square**	**Df**	**Significance**
Pearson	.102	2	.951
Deviance	.104	2	.949

Furthermore, each response category has a frequency of minor effect=3, neutral effect=3, and significant effect=24 during the ordinal regression analysis. Because the distribution from frequency of satisfaction level demonstrates that the higher categories are more likely in the response category, the complementary log-log function link function was utilized in ordinal regression analysis(Yay and Akinci, 2009). The model known as the discrete proportional hazard model is presented in Equation 1, where i=1,2. Two equation will be developed as there are two intercepts to be used for all the regression models in the subsequent sections.

$$\log[-\log(1-Q_i)] = \alpha_i + \beta GB1 + \beta GB2 + \beta GB3 \qquad \text{(Equation 1)}$$

Table 8 Parameter estimate for GB1

Parameter	Estimate	Odds ratio (e^{β})	Standard error	Df	P-value	95% confidence interval	
						Lower bound	Upper bound
Threshold	-3.249	---	.608	1	.000	-4.441	-2.057
	-4.16	---	.255	1	.103	-.914	.083
Client	.337	1.40	.386	1	.383	-.420	1.094
Consultant	.576	1	.386	1	.330	-.380	1.133
Contractor	0	1		0			

From Table 8, It can be clearly extracted that the factors in GB1 are considered most important in the perception of the consultant, and it will directly impact the implementation of GBP in the construction industry. Consultant for GB1 (Recycling and waste reduction, Low life Cycle Cost, Future Maintenance and Operational Cost, Education and Training, Building Value, Initial Design and Construction Cost.) has regression coefficient of .576 in comparison with the contractor and as it is positive, which means consultant weighs GB1 0.576 times more than the contractors for the implementation of GB1 for the adoption of green building practices in the construction. To quantify the magnitude of consultant on GB1 with respect to contractor, it can be measured from the odd ratio equation as a complementary log-log link function has been utilized $e^{\beta} = e^{0.576} = 1.7$. This means consultant weighs GB1 as important factor for the adoption 1.7 times more than the contractor. This step will be used in all the regression models to calculate the odds ratio value. To avoid the repetitiveness in the steps, the detailed process has been shown only for the first model pertinent to the client's perceptions. This value depicts that keeping all other factors unchanged then rise or decline in GB1 will affect the rise or decline by a factor magnitude of 1.77 in the adoption of GBP according to the consultant.

Subsequently, coefficients for client with respect to contractor for GB1 is .337. Client has a positive value of 0.337 which makes GB1 more significant for client with respect to contractor. To calculate the impact of client, magnitude was measured with the odd ratio value which is 1.40 while contractor have 1. From the results, it is evident that client consider GB1 1.40 times more significant than contractor for the adoption of green building. Finally, it is evident that that consultant and client are more inclined to inculcate Recycling and waste reduction, Low life Cycle Cost, Future Maintenance and Operational Cost, Education and Training, Building Value, Initial Design and Construction Cost for the adoption of GBP than contractors. While in between client and consultant, latter consider it the most important.

Model-2: Effect of Stakeholders' perception on GB2 factors for the adoption of GBP in the construction industry

From Table 9, parallel line test to verify the validity of the proportional probability hypothesis shows that the chi-square = 2.055 while the p-value 0.358. The significance value is much higher than threshold value of 5%. Therefore, null hypothesis cannot be rejected on statistical tests. Therefore, the test suggests that the model satisfies the assumption of proportional probability.

Table 9 Test of Parallel Lines

Model	**Likelihood**	**Chi-Square**	**Df**	**Significance**
Null	15.710			
General	13.655	2.055	2	.358

Similarly, for the likelihood ratios in Table 10, Pearson's deviation and chi-square are utilized to gauge the fitness of the model. These test shows that the p-values 0.413 and 0.358 above 0.05, so null hypothesis cannot be negated from statistical analysis. Hence, the fitting of model is sufficient.

Table 10 Goodness-of-Fit

Test	**Chi-Square**	**Df**	**Significance**
Pearson	1.768	2	.413
Deviance	2.055	2	.358

Since the frequency distribution of responses shows higher category values i.e. minor effect= 2, neutral effect= 4, major effect= 29 are more credible, the link function utilized in the ordinal regression model is complementary log-log (Yay and Akinci, 2009). Hence, the model known as the discrete proportional hazard model, is presented in Equation 2, where i=1,2,3.

$$\log[-\log(1-Q_i)] = \alpha_i + \beta GB1 + \beta GB2 + \beta GB3 \quad \textbf{(Equation 2)}$$

Table 11 Parameter estimate for GB2

Parameter	**Estimate**	**Odds ratio (e^{β})**	**Standard error**	**Df**	**P-value**	**95% confidence interval**	
						Lower bound	**Upper bound**
Threshold	-4.485	---	1.022	1	.000	-6.488	-2.482
	-.582	---	.269	1	.031	-1.110	-.054
Client	.178	1	.397	1	.654	-.600	.956
Consultant	.115	1.1	.389	1	.767	-.647	.878
Contractor	0	1					

From Table 11, The factors in GB2 are considered most important in the perception of the client, and it will directly impact the implementation of GBP in the construction industry. Client for GB1 (Environmental Protection in Material Aspect, Environmental Protection in Water use, Environmental Protection in energy use, Occupants Health and Productivity, Environmental Protection in Site Aspect.) has regression coefficient of .178 in comparison with the contractor and as it is positive, which means client consider GB2 more significant for the adoption of GBP than the contractors. To quantify the magnitude of Client on GB2 with respect to contractor, it can be measured from the odd ratio equation as a complementary log-log link function has been utilized $e^{\beta} = e^{0.576} =$ 1.2. This means consultant weighs GB2 as important factor for the adoption 1.2 times more than the contractor. This value depicts that keeping all other factors unchanged then rise or decline in GB2 will affect the rise or decline by a factor magnitude of 1.2 in the adoption of GBP according to the client.

Subsequently, coefficients for consultant with respect to contractor for GB2 is .115. Consultant has a positive value of 0.115 which makes GB2 more significant for consultant with respect to contractor. To calculate the impact of client, magnitude was measured with the odd ratio value which is 1.1 while contractor have 1. From the results, it is evident that consultant consider GB2 1.1 times more significant than contractor for the adoption of green building. However, it is evident from the results that although client consider GB2 more significant for adoption of GBP, there isn't much any major difference among all the stakeholders for factors Environmental Protection in Material Aspect, Environmental Protection in Water use, Environmental Protection in energy use, Occupants Health and Productivity, Environmental Protection in Site Aspect.

Model-3: Effect of Stakeholder's perception on GB3 factors for the adoption of GBP in the construction industry

From Table 12, the parallel line test to verify the validity of the proportional probability hypothesis shows that the chi-square = .203 and the p-value 0.903. The significance value is much higher than the threshold value of 5%. Hence, null hypothesis cannot be rejected on statistical tests. Therefore, the test results yields that the model satisfies the assumption of proportional probability.

Table 12 Test of Parallel Lines

Model	Likelihood	Chi-Square	Df	Significance
Null	17.536			
General	17.333	.203	2	.903

Similarly, for the likelihood ratios in Table 13, Pearson's deviation and chi-square are utilized to gauge the fitness of the model. These test shows that the p-values 0.896 and 0.903 above 0.05, so null hypothesis cannot be negated from statistical analysis. Hence, the fitting of model is sufficient.

Table 13 Goodness-of-Fit

Test	Chi-Square	Df	Significance
Pearson	.221	2	.896
Deviance	.203	2	.903

According to Yay and Akinci (2009), the link function utilized in the ordinal regression model is a complementary log-log function because it is evident form the frequency distribution of responses i.e. minor effect= 3, neutral effect= 0 and major effect= 30. suggests that the higher categories are more credible. Again, the discrete proportional hazard model is used and shown in Equation 3, where i= 1,2,3.

$$\log[-\log(1 - Q_i)] = \alpha_i + \beta GB1 + \beta GB2 + \beta GB3 \qquad \textbf{(Equation 3)}$$

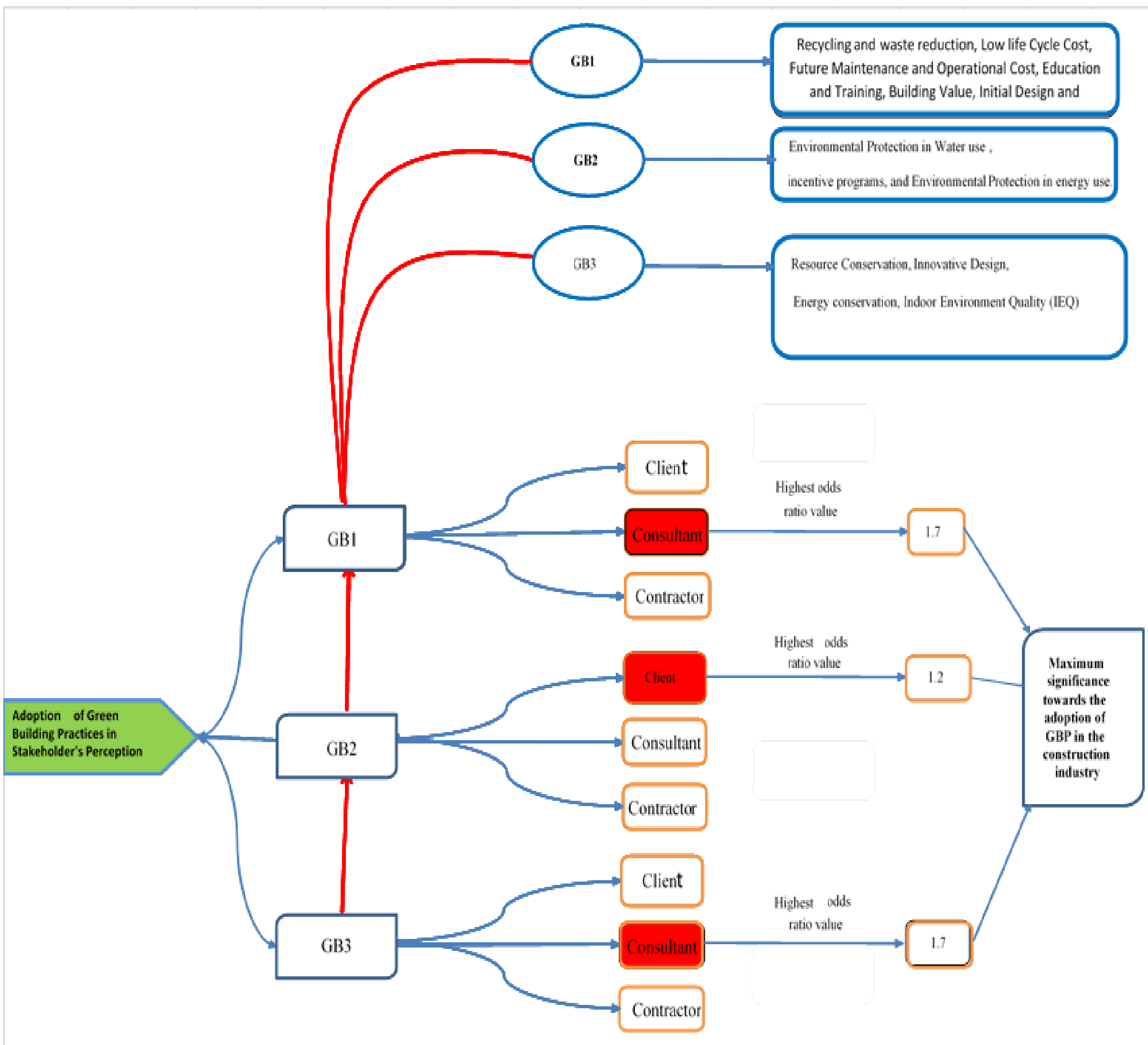
Table 14 Parameter estimate for GB3

Parameter	Estimate	Odds ratio (e^{β})	Standard error	Df	P-value	95% confidence interval	
						Lower bound	Upper bound
Threshold	-3.335	---	.615	1	.000	-4.540	-2.130
	-.597	---	.271	1	.027	-1.127	-.067
Client	-.041	0.66	.382	1	.915	-.790	.709
Consultant	.542	1	.429	1	.207	-.300	1.383
Contractor	0	1	.				

From Table 14, It is evident that the factors in GB3 are considered most important in the perception of the consultant, and it will directly impact the implementation of GBP in the construction industry. Consultant for GB1 (Resource Conservation, Innovative Design, Energy conservation, Indoor Environment Quality (IEQ)) has regression coefficient of .542 in comparison with the contractor and as it is positive, which means consultant Consider GB3 factors more significant than the contractors for the implementation of GB1 for the adoption of green building practices in the construction. To quantify the magnitude of consultant on GB3 with respect to contractor, it can be measured from the odd ratio equation as a complementary log-log link function has been utilized $e^{\beta}= e^{0.576}$= 1.7. This means consultant weighs GB1 as important factor for the adoption 1.7 times more than the contractor. This value depicts that keeping all other factors unchanged then rise or decline in GB3 will affect the rise or decline by a factor magnitude of 1.7 in the adoption of GBP according to the consultant.

Subsequently, coefficients for client with respect to contractor for GB1 is -0.41 Client has a negative value of -0.41 which makes GB3 less significant for client with respect to contractor. To calculate the impact of client, magnitude was measured with the odd ratio value which is 0.66 while contractor have 1. From the results, it is evident that Contractor consider GB3 smore significant than contractor for the adoption of green building. Finally, it is evident that that consultant considers GB3 most important for the adoption of GBP than contractors and clients. Moreover, Contractors also rate GB3 positively for the adoption of GBP while client does not consider it as significant factor in comparison to contractors.

Theoretical Framework of the Adoption of Green building Practices in Stakeholder's Perspective



Chapter 5

CONCLUSION AND RECOMMENDATIONS

5.1 CONCLUSION

Stakeholders are the key players in the adoption and execution of successful projects. Therefore, the point of view of each stakeholder and agreement on each other perception is imperative to incorporate new techniques and tools and cope up with the challenges associated with them such as in the case of green building practices. The consultant behavior is quite positive towards the adoption of green building practices as compared to client and contractors. Moreover, clients and contractors have difference of opinion on the factors for adoption. GB1 factors Recycling and waste reduction, Low life Cycle Cost, Future Maintenance and Operational Cost, Education and Training, Building Value, Initial Design and Construction Cost are the key factors in the adoption of GBP which are endorsed more by the consultant followed by client in comparison to contractors. These factors are mostly related to cost effectiveness and awareness which are more important for the clients and considered by consultant during every phase of construction project. Contractors are reluctant towards these factors due to less involvement in traditional contracts from the initial phases and these are considered in the initial phases.

Similarly, GB2 factors Environmental Protection in Material Aspect, Environmental Protection in Water use, Environmental Protection in energy use, Occupants Health and Productivity, Environmental Protection in Site Aspect have almost same response from all the stakeholders with client slightly giving it the most importance. It can be concluded from the results of GB2 that consensus on these factors can easily be developed among stakeholders by removing differences among them. Moreover, GB3 factors Resource Conservation, Innovative Design, Energy conservation, Indoor Environment Quality (IEQ) are most significant in consultant perspective while least significant for client.

It can be concluded from the above results and discussion that multiple factors govern the adoption of GBP. However, these factors are not of the same significance among the stakeholders and vary from each other. This shows that the green buildings practices, tools, and technologies adoption lag in developing parts of the world due to a lack of consensus among stakeholders. To remove these difference government rules and regulations are mandatory to adopt green building practices and initiation of incentive programs to encourage stakeholders to positively bring change in the construction industry by the adoption of GBP.

5.2 PRACTICAL AND THEORETICAL IMPLICATIONS

This research study has both practical and theoretical implications. It can act as a bridge to bring all the stakeholders on the same page which is currently the major problem in the adoption of GBP and resultingly cope up with the modern era construction and fulfill the SDG goals. This research has an objective descriptive framework following the line of which can lead to green revolution in developing countries by working on the specific grey areas varying from country to country. Similarly, it has theoretical implications as it can act as a gateway to more advanced and focused research related to green buildings and importance of stakeholders' perception in other areas of construction lagging the market in different parts of the world.

REFERENCES

A.P.C. Chan, A. Darko, E. E. A. (2017) 'Strategies for promoting green building technologies adoption in the construction industry—an international study'.

Aapaoja, A. and Haapasalo, H. (2014) 'A Framework for Stakeholder Identification and Classification in Construction Projects', *Open Journal of Business and Management*, 2, pp. 43–55. doi: 10.4236/ojbm.2014.21007.

Ahmad, M., Li, H., Anser, M.K., Rehman, A., Fareed, Z., Yan, Q. and Jabeen, G. (2020) 'Are the intensity of energy use, land agglomeration, CO2 emissions, and economic progress dynamically interlinked across development levels?', *Energy & Environment*, p. p.0958305X20949471.

Ahn, Y.H., Pearce, A.R., Wang, Y., & Wang, G. (2013) 'Drivers and Barriers of Sustainable Design and Construction: The percecption of Green Building Experience.', *International Journal of Sustainable Building Technology*.

Akadiri PO, O. P. (2012) 'Development of sustainable assessment criteria for building materials selection.'

Ann, T. W., Shen, Q., Kelly, J., & Hunter, K. (2007) 'An empirical study of the variables affecting construction project briefing/architectural programming', *International Journal of Project Management*, 25(2).

Augenbroe, G. L. M., & Pearce, A. R. (2009) 'Sustainable construction in the USA: A perspective to the year 2010. Paper presented at the International Conference on World Futures, Sri Lanka, and India. February 22–25Augenbroe, G. L. M., & Pearce, A. R. (2', in.

B.G. Hwang, J. S. T. (2012) 'Green building project management: obstacles and solutions for', *Sustainan. Dev*, pp. 335–349.

Baharetha SM, Al-Hammad AA, A. H. (2012) 'Towards a unified set of sustainable building materials criteria. In Proceedings of the International Conference on Sustainable Design Engineering and Construction'.

BCA, 2009 *BCA's 2nd green building masterpla—80% of buildings will be greened by 2030, Singapore.*

Berardi (2014) 'Green building research – current status and future agenda : A review Why ? How ? How ? What ?', *Renewable and Sustainable Energy Reviews*. Elsevier, 30, pp. 271–281. doi: 10.1016/j.rser.2013.10.021.

Black (1995) 'Causes of project failure: a survey of professional engineers', *PM Network*.

Bryde, D.J., Brown, D. (2005) 'The influence of a project performance measurement system on the success of a contract for maintaining motorways and trunk roads.', *Project Management Journal*, 35(4), pp. 57– 65.

Butera (2010) 'Climatic change and the built environment. Advances in Building Energy Research'.

Chan, A.P., Darko, A., Ameyaw, E.E. and Owusu-Manu, D. G. (2017) 'Barriers affecting the adoption of green building technologies', *Journal of Management in Engineering*, 33(3), p. p.04016057.

Chatterjee, A. K. (2009) 'Sustainable Construction and green building on the foundation of ecology.', *Indian concrete Journal,83 (5): 27- 30*.

Cleland (1999) 'Project Management Strategic Design and Implementation, McGraw-Hill, New York, N'.

Coelho A, de B. J. I. (2012) 'influence of construction and demolition waste management on the environmental impact of buildings.', *Waste Management*.

Cox, R. F., Issa, R. R., & Ahrens, D. (2015) *Management's perception of key performance indicators for construction.', Journal of Construction Engineering and Management*.

D.A, (2000) *Mail and Internet Surveys: The Tailored Design Method -- 2007 Update with New Internet, Visual, and Mixed-Mode Guide*. 2nd edn. John Wiley & Sons.

Darko, A., Chan, A. P. C., Ameyaw, E. E., He, B. J., & O. (2017) 'Examining issues influencing green building technologies adoption: the United States green building experts' perspectives, Energy Build. 144 ()', pp. 320–332.

Darko, A., Chan, A.P., Owusu-Manu, D.G. and Ameyaw, E. E. (2017) 'Drivers for implementing green building technologies: An international survey of experts.', *Journal of cleaner production*, 145, pp. 386–394.

Dhawan, A. P. (2011) *Medical image analysis*. John Wiley & Sons.

Djoko(2014).'BarrierstosustainableconstructionintheGhanaianconstructionindustry:consultants' perspec- tives. Journal of Sustainable Development 7(1): 134–143.'

Van Doren, (2016) 'Scaling-up energy conservation initiatives: Barriers and local

Egbu, M. A. and C. (2008) 'State of green construction in India: drivers and challenges'.

Esa, M. R., Halog, A., & Rigamonti, (2017) 'Strategies for minimizing construction and de- molition wastes in Malaysia',.

Et., J. (2000) *Stakeholder management on construction projects", AACE International Transactions, PM.12, AACE International, Morgantown,*.

Eygu, H. and Gulluce, A. C. (2017) 'Determination of Customer Satisfaction in Conservative Concept Hotels by Ordinal Logistic Regression Analysis', *Journal of Financial Risk Management*, 06(03), pp. 269–284. doi: 10.4236/jfrm.2017.63020.

Fischer (2010) 'Issues in Green Building and the Federal Response: An Introduction. Congressional Research Service. Retrieved August 13, 201'.

Freeman, R. . (1984) *Strategic management: A stakeholder perspective*. Boston: Pitmann.

Geng, Y., Dong, H., Xue, B., & Fu, J. (2012) 'No An overview of Chinese green building standards. Sustainable Development 20(3): 211–221. Geng Y, Dong H, Xue B, Fu J 2012. An overview of

Chinese green building standards. Sustainable Development 20(3): 211–221.’

Güngör, D.Ö. and Gözlü, S. (2017) ‘Investigating the relationship between activities of project management offices and project stakeholder satisfaction.’, *International Journal of Information Technology Project Management (IJITPM)*, 8(2), pp. 34–49.

Hardcastle, C., Edwards, P.J., Akintoye, A. and Li, B. (2005) ‘Critical success factors for PPP/PFI projects in the UK construction industry: a factor analysis approach’, *Construction management and economics*, 23(5), pp. 459–471.

Henn, (2008) ‘Overcoming the social and psychological barriers to green building.’, *Organ. Environ.*

Henry A, F.-L. N. (2012) ‘Comparing green structures using life cycle Life, assessment’.

Hwang, B. G., and Ng, W. J. (2013) ‘“Project management knowledge and skills for green construction: Overcoming challenges.”’, *Int. J. Project Manage., 31(2), 272–284.*

Hwang, B. G., and Tan, J. S. (2012) ‘“Green building project management: Obstacles and solutions for sustainable development.”’, *Sustainable Dev., 20(5), 335–349*.

Ibaseta, D., García, A., Álvarez, M., Garzón, B., Díez, F., Coca, P., Del Pero, C. and Molleda, J. (2021) ‘Monitoring and control of energy consumption in buildings using WoT: A novel approach for smart retrofit.’, *Sustainable Cities and Society*, 65, p. p.102637.

Irfan, M., Thaheem, M.J., Gabriel, H.F., Malik, M.S.A. and Nasir, A. R. (2019) ‘Effect of stakeholder’s conflicts on project constraints: a tale of the construction industry’, *International Journal of Conflict Management*, 30(4), pp. 538–565.

Israngkura Na Ayudhya, B. (2011) ‘Common disputes related to public work projects in Thailand’, *Songklanakarin Journal of Science and Technology*, 33(5), pp. 565–573.

Jo JH, G. J. (2009) ‘Incorporating built environment factors into climate change mitigation strategies for Seoul, South Korea: A sustainable urban systems framework’, *Habitat Int*.

Kamana, C.P., & E. (2011) ‘Building Green to Attain Sustainability.’, *International Journal of Earth Sciences and Engineering, 4(4): 725-729 Nwokoro*.

Karlsen, J. T. (2002) ‘Project stakeholder management’, *Engineering Management Journal*, 14(4), pp. 19–24.

Kats, G. H. (2003) *Green Building Costs and Financial Benefits*.

Kaur, P., Stoltzfus, J. and Yellapu, V. (2018) ‘Descriptive statistics’, *International Journal of Academic Medicine*, 4(1), p. 60.

Khoshbakht, M., Gou, Z., Lu, Y., Xie, X. and Zhang, J. (2018) ‘Are green buildings more satisfactory? A review of global evidence.’, *Habitat International*, 74, pp. 57–65.

Kibert, C. J. (2016) *Sustainable construction: green building design and delivery*. John Wiley & Sons.

Kibert, C. J. (2012) ‘Sustenance: Green building design and delivery’, *3rd Ed., Wiley, Hoboken,* Koskela, L., Vrijhoef, R. and Dana Broft, R. (2020) 'Construction supply chain management through a lean lens.', *Successful Construction Supply Chain Management: Concepts and Case Studies*, pp. 109–125.

Lam, P. T., Chan, E. H., Chau, C. K., Poon, C. S., & Chun, K. P. (2009) 'Integrating green specifications in construction and overcoming bar- riers in their use', *Engineering Management Journal*.

Low, S. P., Gao, S., & Tay, W. L. (2014) 'Comparative study of project management and critical success factors of greening new and existing buildings in Singapore.'

Luthra, S., Kumar, S., Garg, D., and Haleem, A. (2015) '"Barriers to renewable/sustainable energy technologies adoption: Indian perspec- tive."', *Renewable Sustainable Energy Rev., 41, 762–776*.

Maskey, R., Fei, J. and Nguyen, H. O. (2018) 'Use of exploratory factor analysis in maritime research', *Asian Journal of Shipping and Logistics*. Elsevier B.V., 34(2), pp. 91–111. doi: 10.1016/j.ajsl.2018.06.006.

Mishra, P., Pandey, C.M., Singh, U., Gupta, A., Sahu, C. and Keshri, A. (2019) 'Descriptive statistics and normality tests for statistical data', *Annals of cardiac anaesthesia*, 22(1), p. 67.

Nduka, D., Nduka, D. O. and Ogunsanmi, O. E. (2015) 'Stakeholders Perception of Factors Determining the Adoptability of Green Building Practices In Construction Projects In Nigeria Implementation of zero energy building in building projects in Nigeria View project Building Informatics Research Group of Buil', 5(2).

Newcombe, (2003) 'From client to project stakeholders: A stakeholder mapping approach', *Construction Management and Economics*, 21(8), pp. 841–848. doi: 10.1080/0144619032000072137.

Nwachukwu, C. C. (2009) '"Client's constraining factors to construc- tion project management success in Nigeria: A systems analytical approach."', *Int. J. Dev. Manage. Rev., 4(1), 207–219.*

Nwokoro, I. and Onukwube, H. (2011) 'Sustainable or Green Construction in Lagos, Nigeria: Principles, Attributes and Framework', *Journal of Sustainable Development*, 4(4). doi: 10.5539/jsd.v4n4p166.

Nykamp, (2017) 'A transition to green buildings in Norway.', *Environmental innovation and societal transitions*, 24, pp. 83–93.

OECD (2003) *Environmentally Sustainable Building – Challenges and Policies, OECD: Paris.*

Ogunlana, (2006) *International Symposium on Globalisation and Construction*, *International Symposium on Globalisation and Construction AIT Conference Centre, Bangkok, Thailand*.

Ogunsanmi, (2015) 'Stakeholders Perception of Factors Determining the Adoptability of Green Building Practices In Construction Projects In Nigeria'.

Olander, S. and Landin, A. (2005) (2005) 'Evaluation of stakeholder influence in the implementation of constructionprojects",' *International Journal of Project Management,* 23.

Olander, (2007) ‘Stakeholder impact analysis in construction project management’, *Construction Management and Economics*, 25(3), pp. 277–287. doi: 10.1080/01446190600879125.

Otegbulu, (2011) ‘Economics of Green Design and Environmental Sustainability.’, *Journal of Sustainable Development*.

Otegbulu, (2011) ‘Economics of Green Design and Environmental Sustainability Valuation of Shock and health related damages arising from oil Industry activities View project’

Pan, N.F. Dzeng, R.J., & Yang, M. D. (2011) ‘Decision Making Behaviors in Planning Green Building.’, in *Proceedings of the International Conference on Computer Distributed Control and Intelligent Environmental Monitoring, 1710-1713, 19- 20 February, Changsha Hu*.

Potbhare, V., Syal, M., & Korkmaz, S. (2009) ‘Adoption of green building guidelines in developing countries based on US and India experiences’, *Green Buildlngs*.

Q.K. Qian, E.H. Chan (2010) ‘Government measures needed to promote building energy efficiency (BEE) in China.’

Robichaud, L. B. and Anantatmula, V. S. (2011) ‘Greening project management practices for sustainable construction’, *Journal of Management in Engineering*, 27(1), pp. 48–57. doi: 10.1061/(ASCE)ME.1943-5479.0000030.

Ruan, (2013) ‘Time for a real shift to relations: Appraisal of Social Network Analysis applications in the UK construction industry’, *Australasian Journal of Construction Economics and Building*, 13(1), pp. 92–105. doi: 10.5130/ajceb.v13i1.3174.

Schwalbe, (2015) *Information technology project management*. Cengage Learning.

Sharma, (2018) ‘Development of a ‘Green building sustainability model’for Green buildings in India.’, *Journal of cleaner production*, 190, pp. 538–551..

Sicurella F, Evola G, W. E. (2012) ‘A statistical approach for the evaluation of thermal and visual comfort in free-running buildings.’, *Energy Building*.

Tavakol, M. and Dennick, R. (2011) ‘Making sense of Cronbach’s alpha’, *International Journal of Medical Education*, 2, pp. 53–55. doi: 10.5116/ijme.4dfb.8dfd.

Toor, S.R., Ogunlana, S. O. (2008) ‘Critical COMs of success in large-scale construction projects: evidence from Thailand construction industry.’, *International Journal of Project Management*, 4, pp. 420–430.

Umar, U.A., & Khamidi, M. F. (2012) . ‘Determined the Level of Green Building Public Awareness: Application and Strategies.’, in *International Conference on Civil, Offshore and Environmental Engineering, Kuala Lumpur Malaysia.*

Underwood, J., Alshawi, M. A., Aouad, G., Child, T., & Faraj, I. Z. (2000) ‘Enhancing building product libraries to enable the dynamic definition of design element specifications.’, *Construction Management & Economics*.

UNEP (2009) . *Buildings and Climate Change. Summary for Decision-Makers*.

United, Nations and Environment (2017) *Towards Zero-Emission Efficient and Resilient Buildings: Global Status Report 2017*. Available at: www.worldgbc.org.

United States Green Building Council (USGBC) (2005) ‘LEED for New Construction and Major Renovations’. Green Building Council, Washington, D.C.

USA, E. (2004) *United States Environmental Protection Agency (US EPA). Buildings and the Environment: a Statistical Summary Compiled by U.S. Environmental Protection Agency Green Building Workgroup, Washington, DC.*

USGBC (2003) *Building momentum: National trends and prospects for high performance green buildings.*

Vanmali, B., Osadchiy, V., Shahinyan, R., Mills, J. and Eleswarapu, S. (2020) ‘001 Taking Matters Into Their Own Hands: Men Seeking Pornography Addiction Advice From a Nontraditional Online Therapy Source’, *The Journal of Sexual Medicine*, 17(1), p. 1.

Williams, C.C. and Shahid, M. S. (2016) ‘Informal entrepreneurship and institutional theory: Explaining the varying degrees of (in) formalization of entrepreneurs in Pakistan’, *Entrepreneurship & Regional Development*, 28((1-2)), pp. 1–25.

Winston, N. (2010) ‘“Regeneration for sustainable communities? Barriers to implementing sustainable housing in urban areas.”’, *Sustainable Dev., 18(6), 319–330.*

Wu, S. W., Chen, T., Xuan, Y., Xu, X. W., Pan, Q., Wei, L. Y., ... & Wang, Q. (2015) ‘Using plan-do-check-act circulation to improve the management of panic value in the hospital’, *Chinese Medical Journal*, 128(18), pp. 2535–2538. doi: 10.4103/0366-6999.164984.

Y. Li, L. Yang, B. He, D. Z. (2014) ‘Green building in China: needs great promotion’, *Sustain. Cities Soc*.

Yay, M. and Akinci, E. D. (2009) ‘Application of Ordinal Logistic Regression and Artifical Neural Networks in a Study of Student Satistaction’, *Cypriot Journal of Educational Sciences*, 4, pp. 58–69.

Zhang, X., Plattern, A., & Shen, L. (2011) ‘Green Property Development Practice in China: Costs and Barriers. Building and Environment’.

Zhang, X., Platten, A. and Shen, L. (2011) ‘Green property development practice in China: Costs and barriers’, *Building and Environment*, 46(11), pp. 2153–2160. doi: 10.1016/j.buildenv.2011.04.031.

Zhang Y, A. H. A. (2011) ‘comparison of the occupant comfort in a conventional high-rise office block and a contemporary environmentally-concerned building.’, *Build Environment*.

Zhao, D., Miotto, A.B., Syal, M. and Chen, J. (2019) ‘Framework for Benchmarking green building movement: A case of Brazil’, *Sustainable Cities and Society*, 48, p. p.101545.

Zid, C., Kasim, N. and Soomro, A. R. (2020) ‘Effective project management approach to attain project success, based on cost-time-quality.’, *International Journal of Project Organisation and Management*, 12(2), pp. 149–163.