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Factors affecting intention to adopt Green Building Practices: A Journey towards meeting Sustainable Goals

Abstract

Aim: The construction industry and its activities harmfully affect the environment. Hence, adopting green building (GRB) practices can be helpful in achieving sustainable development goals (SDGs). Therefore, this study aims to identify the factors affecting the intention to adopt GRB practices by extending theory of planned behavior (TPB).

Methodology: Using non-probability purposive sampling technique, data was gathered from consultant and contractor engineers in the construction industry through a questionnaire. The analysis was done using partial least square-structural equation modeling (PLS-SEM) technique on a useful sample of 290.

Results: Findings revealed that the core constructs of TPB (i.e., attitude, subjective norms, and perceived behavioral control) significantly affect the intention to adopt GRB practices. Moreover, government support and knowledge of green practices were found to be critical influencing factors on attitudes, subjective norms, and perceived behavioral control. Lastly, the findings confirmed that environmental concerns play as a moderating between subjective norm and intention to adopt GRB practices, as well as attitude and intention to adopt GRB practices.

Implications: This study contributes to existing knowledge on GRB, offering evidence base for policy choices regarding climate change adaptation and mitigation in the construction industry.

Originality: This study provides insights from the perspective of a developing economy and confirms the applicability of TPB in the adoption of GRB practices. Moreover, this study confirms the moderation role of environmental concern in between TPB constructs and intention to GRB that is not tested earlier in the context of GRB. This study also confirms that government sustainable support positively affects perceived behavioral control, and knowledge of green practices significantly affects subjective norms.

Keywords: Green building, sustainable building, TPB, government support, green knowledge

1. Introduction

Consumption of fossil fuels by various sectors of the economy increases carbon dioxide (CO_2) emissions that have a destructive impact on the natural environment (Khan et al., 2020; Aslam & Jawaid, 2023b). Among all sectors, the construction industry is a major contributor to global environmental degradation (Saleh et al., 2020, Gray, 2018; Tseng et al., 2023), and it is substantially blamed for air pollution (Balasubramanian & Vinaya, 2017; Pollitt, 2016). The excessive energy consumption of natural resources by the construction sector poses existential threats, not only to the natural environment but also the construction sector itself (Yildirim et al.,

2014; Abbasi et al. 2021). As the rate of natural resource depletion is faster than the regenerative capacity of the natural environment, scarcity of building materials intensifies to raise construction costs with significant effects on affordability (Ebohon, 2022). This underpins the desire to decouple the construction sector and natural resource consumption intensity to mitigate the effects of climate change (Aslam et al., 2021; Mills & Schleich 2013). This observation has led to calls on the construction industry to build back better and adopt green construction policies and practices, as it can minimize the ecological footprints of buildings and enhance well-being (Nduka & Ogunsanmi, 2015). Moreover, it can benefit the natural environment and human health (Saleh & Al-swidi., 2019). Therefore, construction stakeholders are encouraged to adopt GRB practices (Saleh & Al-swidi., 2019), as these are referred to as "sustainable building techniques", aims to plan and create structures that have less negative environmental effects and increase their overall sustainability (Andriana, 2023). This includes the optimization of energy, water, and resource consumption, as well as the utilization of renewable energy sources like solar power (Valle, 2023). Additionally, GRB practices aim to mitigate pollution and waste, while also facilitating re-use and recycling practices by maintaining high-quality indoor air environments and incorporating alternative building materials (Andriana, 2023).

Several prevalent GRB practices encompass the: (1) utilization of sustainable materials, such as recycled or renewable material (Valle, 2023), (2) the design of energy-efficient buildings by incorporating features such as insulation, energy-efficient appliances, and the strategic utilization of natural lighting, (3) water conservation through the incorporation of low-flow toilets and faucets, as well as the implementation of rainwater harvesting techniques, (4) implementing waste reduction strategies, such as the incorporation of recycling and composting practices, and (5) enhancing the quality of indoor air by the implementation of various mechanisms, such as ventilation and filtration systems. The implementation of the GRB practices has the potential to mitigate the environmental ramifications (Andriana, 2023).

Devasting climate issues have emphasized countries to adopt GRB practices (Ayarkwa et al., 2022), including developed and developing economies. Pakistan is also extremely vulnerable to climate change which poses a danger to the country's water, food, and energy security (Waheed et al., 2021) and is one of the most affected countries in the last two decades (Eckstein et al., 2020). Currently, Pakistan is facing water insufficiency, electrical scarcities, poverty, poor industrialized conditions, economic depressions, rising urbanization, and natural resource depletion whereas the implementation of GRB practices and structure's design is both at the developing stages (Qureshi et al., 2019). Further, it relies mostly on thermal energy resulting in major environmental issues (Azeem et al., 2020; Sohail & Qureshi, 2011). To prevent this, present construction techniques must be altered and need to adopt green practice (Ahmed, 2014; Iqbal et al., 2021).

However, because of the various constraints, developing countries such as Pakistan contending with problems of poverty are not concerned about agreeing and executing sustainable practices in construction activities (Iqbal et al., 2021). Further, particularly in Pakistan, the perception of energy preservation in the construction industry is still in its preliminary phase and due to the shortage of awareness, insufficient government provision and shortage of skilled employees, the construction sector is not willing to alter traditional construction practices (Iqbal et al., 2021).

Furthermore, significant deficit of energy in Pakistan requires the implementation GRB, as it will save 30% of the electricity (Azeem et al., 2017). Therefore, there is a dire need to examine elements that require stakeholders' attention to overcome impediments to the adoption of GRB practices.

In past, Saleh et al., (2020) investigated the influential and environmental factors in Qatar regarding intentions to adopt GRB practices, and found that subjective norm, and perceived behavioral control have significant influences on intentions to adopt GRB practices. Dalvi-Esfahani et al., (2017) also used norm activation theory to investigate the factors that help in forming the intention to adopt green systems. Mohamad Bohari et al., (2016) explored the primary drivers and challenges that practitioners in the Malaysian construction industry encounters when implementing green projects. Evidently, most of the studies on the intention to adopt GRB practices are conducted in developed economies, whereas very few of the studies empirically examined the factors of GRB in Pakistan. Therefore, there is a need to examine the factors that promote the intention to adopt GRB practices in developing economies such as Pakistan.

The study developed a conceptual model by using the widely used theory of planned behavior (TPB). This theory is considered appropriate because of its high applicability in the studies related to pro-environmental behavior (Tan et al., 2017; Aslam et al., 2021). In the past, some of the studies have used TPB for GRB practices and incorporated additional factors such as government sustainable support (Saleh & Al-Swidi, 2019) and identified a significant impact of it on subjective norms and attitude. Similarly, the other study incorporated knowledge of green practices, and identified its significant impact on attitude and perceived behavioral control (Saleh et al., 2020). Considering the importance of these factors, this study also used government sustainable support and knowledge of green practices as an antecedent of TPB core constructs (i.e., subjective norms, perceived behavioral control, and attitude). In the past none of the studies related to GRB have examined the impact of government sustainable support on perceived behavioral control. Also, according to authors knowledge, till yet none of the studies have examined the role of knowledge of green practices on subjective norms. Similarly, none of the studies considered environmental concern as a moderator in between TPB core constructs and GRB, though the literature related to sustainability claimed that environmental concern acts as catalyst in between TPB and green practices (Aslam et al., 2021, Aslam & Jawaid, 2023a).

To fill these gaps, this study aims to identify the role of government sustainable support, and knowledge of green practices on TPB core constructs (i.e., subjective norms, perceived behavioral control, and attitude). Furthermore, the study examines the role of TPB core construct on GRB practices. Lastly, the study examines the role of environmental concern as a moderator between TPB core construct and GRB practices. This study highlights the factors likely to lead to increased uptake of green construction initiatives to reduce the ecological footprints of construction projects and avoid adverse environmental consequences. This research will be of benefit to both construction practitioners and policymakers because it identifies the elements that influence adoption of GRB practices.

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2. Literature on GRB practices and Underpinning Theory

The popularity of GRB efforts has experienced significant interest, particularly in response to concerns around the depletion of renewable resources and the unpredictable nature of climatic changes. Appendix A provides the most popular GRB practices.

The studies on GRB practices have also gained popularity (Shan & Hwang, 2018) and highlighted challenges faced by the construction sector. One of the established barriers to the adoption of GRB practices is cost. Particularly, the high price of GRB technologies and dearth of governmental incentives discourage the adoption of GRB practices (Saleh & Al-Swidi, 2019). Moreover, lack of government incentives absence of GRB codes and practices, fear of associated risks with new and innovative practices, unavailability of skills and competences, and lack of awareness are also the critical obstacles to the adoption of GBP in Pakistan (Azeem et al., 2020). Further, Iqbal et al., (2021) found that lack of communication amongst stakeholders, traditional & behavioral conflict, lack of knowledge and attitudinal issues were the major obstacles to adoption of GRB practices in Pakistan.

Saleh et al., (2020) investigated the relationship between environmental factors in Qatar regarding intentions to adopt GRB, and found that subjective norm, and perceived behavioral control have significant influences on intentions to adopt GRB. Moral obligations also play a major role in the adoption of GRB (Dalvi-Esfahani et al., 2017). The findings of this study also indicate that managers who are more committed to self-transcendence values are more likely to embrace GRB practices.

In a similar vein, Mohamad Bohari et al., (2016) explored the primary drivers and challenges that practitioners in the Malaysian construction industry encounter when implementing green projects. They concluded that external pressure i.e., governmental legislation and industry guidelines), awareness and knowledge, and lack of strategies adversely affect the adoption of GRB practices. The study of Darko et al., (2018) also highlights the need for government to enhance its role in the promotion of GRB practices. In contrast, Tran, (2021) identified that planning, organization, onsite management, and control have significant effects on the outcome of GRB projects in Vietnam. Moreover, Liu et al., (2018) revealed that subjective knowledge, social trust, perceived usefulness, attitude generally and environmental attitude, are significant psychological factors determining the intention to adopt GRB practices.

Wu et al., (2019) identified the barriers that delay GRB practices in China and found that lack of policy and industrial strategy, undeveloped market environment, and a lack of environmental awareness are major obstacles to GRB practices. Also, Darko et al., (2017) examined the critical barriers and drivers of GRB technologies, and evident that opposition to change, a lack of familiarity and awareness, and higher charges are the major barriers, whereas; financial and other market-based incentives, greater information on the costs and benefits of GRB technologies, green labelling and information dissemination are essential for the uptake of GRB practices.

Sharma, (2018) also evidenced government and other stakeholders, including corporations, developers, buyers, and other regulatory entities, as critical players in promoting and in and adopting GRB practices. Qureshi et al., (2019) carried an assessment of GRB in Pakistan and showed that most of the key actors in the construction industry have no understanding of GRB. Mostly, respondents were unaware of assessment tools and energy rating as and emphasized the role of government in promoting GRB practices. Nduka and Ogunsanmi, (2015) also highlighted that GRB practices are hindered by lack of awareness and higher cost of training, and for professional bodies to educate their members on GRB principles.

Serpell, (2013) argued that lack of financial incentives, lack of integrated design, and affordability are the core impediments to GRB practices, but tax incentives for companies based on their level of investment effort in sustainable construction would be a major governmental policy to promote sustainable construction in Chille. Also, Qi et al., (2010) emphasized that companies that advance their environmental performance through green construction practices are whose management are aware of and concerned about the environment. Wang et al., (2018) revealed that knowledge about the GRB are important elements influencing sustainable adoption behaviors.

Consequently, upon the basis of literature reviewed, it has been observed that studies related to GRB adoption practices were mainly conducted in developed economies, and very few of the studies have addressed this raising concern in developing economies. Also, studies were mainly conceptual and there is a dearth of empirical studies that addressed GRB practices by considering TPB.

2.1. Underpinning Theory

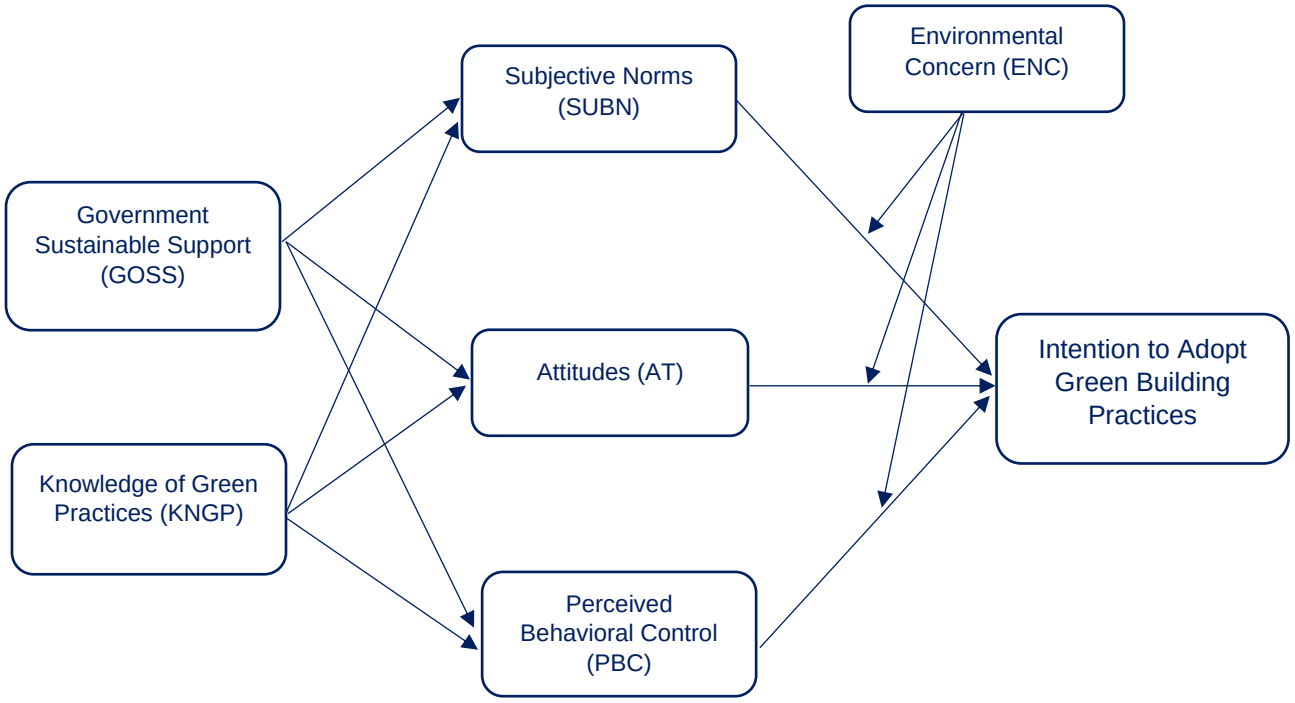
In past, several theories have been used to explain user's behavior towards the adoption of green products and practices such as normative activation theory, theory of reasoned action (TRA), theory of planned behavior (TPB), and theory of consumption value. For this study, the TPB is deemed more appropriate as it is widely used in pro-environmental behavior studies (Cai et al., 2019; Aslam et al., 2021). TPB theory proposed by Ajzen (1991) stated that the intention to assume specific behavior develops from attitude, subjective norm, and perceived behavioral control. It is one of the most persuasive frameworks that has been shown to be an effective tool for describing various elements of environmental behavior (Bamberg & Schmidt, 2003) and has been extensively utilized in the study of extensive range of human behaviors (Botetzagias et al., 2015). Numerous environmental studies used TPB due to its predictive capability (Paul et al., 2016; Varshneya et al., 2017; Hagger, 2019). The TPB is an extended form of TRA to predict behavioral intention (Ogiemwonyi, 2022, Aslam et al., 2021).

Past studies have sought to improve the explanatory power of TPB. For example, Tan et al., (2017) added moral norms in the determination of pro-environmental behavior while Chen and Tung (2014) added environmental concern. However, with regards to GRB practices, government sustainable support, green engagement, and environmental concern have been chosen as explanatory variable for developing attitude towards GRB practices in Qatar by Saleh & Al-Swidi (2019). The findings of this study clarify that government sustainable support largely affects GRB practices. The other study revealed that lack of knowledge is an obstacle to the adoption of GRB

practices (Saleh et al., 2020). Moreover, Azeem et al., (2020) revealed that GRB practices in Pakistan is low because of lack of public understanding of the necessity and benefits of GRB practices.

Considering the importance of government support and environmental knowledge, this study extends TPB by adding two more explanatory variables, including government sustainable support and knowledge of green practices. Also, the study adds environmental concern as a moderating variable to address intention to adopt GRB practices. According to authors knowledge, none of the studies related to GRB practices have considered environmental concern as a moderator. However, the literature related to pro-environmental behavior claims that environmental concern creates a multiplier affect in between TPB constructs and intention to adopt green practices (Aslam et al., 2021; Aslam & Jawaid, 2023a). Figure 1 depicts the proposed research framework.

Figure 1- Proposed Model



Source: Author's Own Creation

2.2. Hypotheses

2.2.1 Subjective Norms (SUBN)

Subjective norms reflect an individual's perception of the societal stress to act or perform in a manner that is expected or accepted by society's norms (Aslam et al., 2021; Saleh and Al-swidi., 2019; Ajzen, 1991). It is an individual's perception or inference about the behavior of others in relation to a certain act (Aslam et al., 2021; Finlay et al., 1999). Subjective norms have been shown to have a considerable impact on pro-environmental intentions in previous study (Aboelmaged, 2021). SUBN determines not only what is ethically right or wrong, but also whether it is valuable to act in a particular way (Bamberg and Möser, 2007). In numerous environmental related studies, SUBN has been found to be the most essential predictor of the intention to engage behaviors (Saleh et al., 2020; Han and Kim, 2010; Dezdar, 2017) which indicates that SUBN is necessary for having a positive intention to practice environmentally friendly behaviors. Following the same rationale, the following hypothesis was anticipated in the context of GRB.

H_1 SUBN has a positive impact on the intention to adopt GRB practices**.**

2.2.2 Attitudes (AT)

The behaviors associated to the strength of a person's positive and negative decision-making process to carry out some activities are referred to as attitude and it is one of the variables in TPB (Aslam et al., 2021; Ha and Janda 2012). Saleh et al., (2020) defined attitudes as a mental and neurological state of readiness that affects a person's response to all objects and circumstances. Tajfel and Turner's (2004) theory of social identity, as well as Gutman's (1982) means-end mode, provide theoretical foundations for the relationship between people's attitudes and their behavioral choices. Manaktola and Jauhari (2007) investigated the elements that influence consumers' attitudes and behavior to sustainable practices in India's lodging business and the findings revealed that customers in Indian hotels are concerned about green practices and prefer to visit green hotels and people's attitudes toward sustainable living are the most important aspect in accomplishing a low carbon-built environment. The ultimate critical feature in achieving a low-carbon, green built environment is people's attitudes toward sustainable living (Wu, 2016). Hence, it can be stated that.

H_2 AT has a positive impact on the intention to adopt GRB practices.

2.2.3 Perceived Behavioral Control (PBC)

Perceived behavioral control is an important element in determining behavioral intention and behavior (Suki and Suki, 2015). It is determined by a person's conviction in the ability of both situational and internal elements to support the performance of a behavior (Saleh et al., 2020; Francis et al., 2004). PBC refers to people's opinions of how easy or difficult it is to conduct the behavior of interest (Ajzen, 1991). In green behavioral studies, perceived behavioral control has emerged as the most important factor of behavioral intention (Aslam et al., 2021; Hameed et al., 2019; Hua and Wang, 2019; Ko and Jin, 2017; Kai and Haokai, 2016). Prior study has found that people's perceptions of behavioral control have a major impact on their desire to pursue pro-environmental behaviors like food waste recycling (Aboelmaged, 2021; Russell et al., 2017). Hence, the following hypothesis is proposed:

H_3 PBC has a positive impact on the intention to adopt GRB practices.

2.2.4 Governmental Sustainable Support (GOSS)

Governmental sustainable support is the sum of the government's struggles to create and maintain conditions that meet the needs of present and future generations, particularly in society and the economy (Saleh and Al-swidi., 2019; Hess et al., 2014). The government serves as a focal point for improving sustainable development implementation and policies (Filho et al., 2016). Financial incentives, unique laws, financial allowances and/or funding, decreased governmental fees, and extra permissible building areas are all ways for the government to support GRB practices (Fung, 2014). Lee, (2008) found that government support for green projects has a beneficial impact on a company's desire to take part in the green supply chain in a study of Korean small and medium-sized businesses. According to Fung (2014), the government should create a set of sustainable policies that contain quantitative obligations for both new public and private buildings to honour to promote sustainability in a country. Developing such policies would allow for the management of sustainability at all levels (Lacovidou et al., 2017). Hence, to evaluate the relation among GOSS and TPB constructs, it was hypothesized that:

H_4 GOSS has a positive impact on SUBN.

H_5 GOSS has a positive impact on the AT.

H_6 GOSS has a positive impact on PBC.

2.2.5 Knowledge of Green Practices (KNGP)

Knowledge is the foundation of an individual's action or behavior (Badrulhisham and Othman, 2016) and one cannot give response to any facts without knowledge. It is also regarded as one of the primary motivators for the adoption of green practices. Environmental knowledge is a broad set of concepts, facts, and links between the environment and ecosystems (Fryxell and Lo, 2003). Individuals who have a good understanding of the environment and the implications of their activities are more likely to engage in environmentally friendly behavior (Aslam et al., 2021; Chan et al. 2014; Frick et al., 2004). Hence, the more knowledgeable the built environment experts and clients are, the greener building techniques can be adopted in building projects (Nduka and Ogunsanmi, 2015). Generally, knowledge has a good impact on one's actions (Singh and Bansal, 2012) and produces pro-environmental attitudes (Fisher et al., 2012; Moisander, 2007). Therefore, the expansion of a person’s knowledge might act as a catalyst for a change in person’s attitude (Schwartz, 2012; Mostafa, 2007).

According to the TPB, behavioral intention can be determined by attitudes, social norms as well as perceived behavioral control (Ajzen, 1991). As a result, it is possible to state that there is a link between knowledge, social norms, attitudes, and PBC. For example, Bamberg and Möser (2007) found that knowledge has a direct impact on PBC in the context of pro-environmental behaviour. Hence, based on these following hypotheses were generated:

H_7 KNGP has a positive impact on SUBN.

H_8 KNGP has a positive impact on the AT.

H_9 KNGP has a positive impact on PBC.

2.2.6 Environmental Concern (ENC)

Individual feelings towards a variety of ecological issues are referred to as environmental concern (Zimmer et al., 1994). Previous literature has shown that environmental concerns are a key element in the acceptance of green products i.e., environmentally friendly products (Aslam et al., 2021). If a person is environmentally concerned, it is more probable that persons are predicted to be more interested in pro-environmental activities (Tan et al., 2017; Zhang et al., 2015). Past literature represents that environmental concerns have a positive impression on behavioral intentions (Aslam et al., 2021; Chan et al. 2014; Hartmann and Apaolaza-Ibáñez, 2012). Environmental concerns can also moderate the relationship between TPB's core constructs (Bamberg, 2003; Schultz and Oskamp, 1996; Aslam et al., 2021; Diekmann and Franzen, 2019). Based on this, it can be hypothesized that:

H_{10} ENC positively moderates the relation between SUBN and intention to adopt GRB practices.

H_{11} ENC positively moderates the relation between AT and intention to adopt GRB practices.

H_{12} ENC positively moderates the relation between PBC and the intention to adopt GRB practices.

3. Methodology

3.1 Research Approach and Instrument

The strategy of the research is “survey” as it allows the researcher to collect data from the respondents through a questionnaire to figure out their perception and attitude (Johannesson & Perjons, 2014). The nature of the research approach is quantitative as the data was collected via a 7-point Likert scale questionnaire. The questionnaire was designed into two main sections. The first section was comprised of demographics in which questions related to gender, age group, current occupation, current role, and education level. The second section comprised of constructs of the research study with questions related to respondent’s intention to adopt GRB practices, environmental concern, subjective norms, attitudes, perceived behavioral control, government sustainable support, and knowledge of green practices. These constructs were adapted from precedent studies on the subject area. The sources are mentioned in Table 2. For each statement, respondents have to show their level of agreement ranging from 1= strongly disagree, 7 = strongly agree. The sources of the construct measures are mentioned in Table 2.

3.2 Sampling & Pilot Test

Purposive sampling technique is used to gather responses from the respondents. It is a non-probability sampling technique commonly employed in quantitative research, and it allows researchers to selectively choose participants depending on certain features of the population (Campbell, 2020). In this study, the data was specifically acquired from consultant and contractor

engineers working in the construction sector of Pakistan (in both SMEs and large enterprises), therefore, purposive sampling technique is deemed most appropriate. Consultant and contractor engineers were considered because of their potential influence on developers' opinions and choices (Saleh & Al-Swidi, 2019), and they played an integral role in the planning and management of building projects (Parkin et al., 2003). The responses were gathered over a four-month period during September 2022 to Dec 2022. Responses were gathered through online and hardcopy formats of the questionnaire sent to the target audience via email, and in person. The respondents were also approached through LinkedIn and by visiting offices and sites. In the first phase of the data collection, considering the rule of thumb of having data of 12-50 for pilot study, 50 responses were collected (Sheatsley, 1983) to validate the research instrument (Aslam et al., 2021). The reliability analysis was performed to check the Cronbach's alpha values and the results for the pilot study indicated the value above 0.70 for all variables as recommended by Hair Jr et al., (2016).

3.3 Data Screening

The sample size was calculated through Daniel Soper's sample size calculator that recommended the minimum sample of 210 (Soper, 2022), and therefore 310 responses were collected so that after data screening, the remaining sample meet the minimum requirement of sample size. On collected data of 310, data screening steps were applied to weed out incomplete/unusable responses. This reduced the sample size to 290, which also meets the minimum sample size condition of 10 times the number of arrows pointing to the latent construct (Hair et al., 2013). In data screening missing values were substituted by series mean values. Univariate outliers were spotted by the Z score method while for multivariate outliers, the Mahalanobis distance method was applied. Altogether, 20 outliers were detected and removed from the original data set of 310 responses.

3.4. Statistical Technique

The PLS-SEM technique was applied to test the hypotheses of the study. PLS-SEM technique is widely used by researchers because of several benefits. For example, it has minimal assumptions related to the normality of data and easily deals with complex models (Hair et al., 2016). Moreover, within the variables under investigation, this technique has other advantages such as: clearly distinguishing which item can cause which kind of consequence; accepting small samples of less than 40 individuals; not necessitating the testing of the most fundamental statistical assumptions, such as normality, homoscedasticity, and nonlinearity. Furthermore, PLS-SEM allows the evaluation of impact and causal consequences, as well as the confirmation or denial of theories (Romo-González et al., 2018; Lowry and Gaskin, 2014; Hair et al., 2011).

4. Results

4.1 Profile of the Respondents

Information related to demographics was asked in the questionnaire to get an understanding of the respondents' characteristics. Out of 290 useful respondents, 68.97% were males. In Pakistan, the major chunk employed in the construction industry is male and this is the reason of having high male responses. Moreover, most of the respondents were between the ages of 34 - 39 i.e., 27.59% followed by the age group of 40-45 i.e., 24.83%. The academic credentials for most of respondents were reported as a graduate i.e., 53.79%. Moreover, 53.10% were consultant engineers and 46.90% were contractor engineers. The detailed profile is present in Table 1.

Table 1- Profile of the Respondents

	N	%
Gender		
Male	200	68.97
Female	90	31.03
Age		
22-27	34	11.72
28-33	36	12.41
34-39	80	27.59
40-45	72	24.83
46-50	40	13.79
≥ 50	28	9.66
Current Role		
Consultant	154	53.10
Contractor	136	46.90
Education Level		
Undergraduate	36	12.41
Graduate	156	53.79
Postgraduate	98	33.79

Source: Author's Calculation

4.2. Inner Model Measurement

The first step of the analysis is to calculate the values of internal consistency of the constructs (Hair et al., 2016). The traditional way to calculate the internal consistency is by means of Cronbach's Alpha which should be ≥ 0.70 (Hair et al., 2016). On the other hand, Hair et al., (2016) suggested that composite reliability (CR) is a better indicator of the construct's internal consistency, and it is suggested that the value of CR should be ≥ 0.70. These indicators explain the

reliability of the construct. Table 2 presents the values of CR and confirms that all values meet the standard criteria of > 0.7 shows sufficient reliability.

In the second step, convergent validity is assessed that measures the degree to which the components of a single construct correlate with one another and it is obtained when the construct's average variance extracted (AVE) value is ≥ 0.50 and outer loadings are ≥ 0.708 (Hair et al., 2016). However, the values of outer loadings in between 0.4 and 0.7 can be accepted if it contributes to the minimum criterion value of CR and AVE. Table 2 represents the values of outer loadings and AVE and demonstrate sufficient item convergence for each construct, indicating that the items accurately represent the construct.

In the third step, discriminant validity of the constructs was measured that evaluates the uniqueness of each variable. The Fornell & Larcker criterion, the HTMT criterion, and the cross-loading criteria are used to assess discriminant validity. Fornell and Larcker compare the square root values of the AVE to the correlation between the constructs (Fornell & Larcker, 1981). The square root values of AVE must be greater than the correlation between the two construct pairs (Chin, 1998). The results confirmed that the specified requirement is met, implying that discriminant validity is confirmed.

Another methodological norm used to determine discriminatory validity is the HTMT criterion, which states that the values must be less than 0.85. The findings confirmed all values have met the standard criteria, hence discriminant validity is established from this criterion too. Lastly, the cross-loadings method was used to assess discriminant validity. According to this method, each construct should have the maximum loadings with its own constructs. The results confirm that all the loadings are greater in their respective row, hence discriminant validity is achieved. The results of discriminant validity are mentioned in Appendix B.

Table 2- Outer Loadings

Constructs	Loadings	Sources
Intention to Adopt GRB Practices (ITA) (CR= 0.853; AVE= 0.659)		
ITA1	0.825	Al-Swidi et al., (2014); Saleh et al., (2020)
ITA2	0.832	
ITA3	0.779	
ITA4	Deleted	
ITA5	Deleted	Al-swidi et al., (2014)
Environmental Concern (ENC) (CR= 0.850; AVE= 0.654)		
ENC1	0.782	Urban and Scasny, (2012); Tan et al., (2017)
ENC2	Deleted	
ENC3	0.804	
ENC4	Deleted	
ENC5	0.840	
Subjective Norms (SUBN) (CR= 0.914; AVE= 0.780)		
SUBN1	0.887	

SUBN2	0.885	Al-Swidi et al., (2014); Saleh et al., (2020)
SUBN3	0.878	
SUBN4	Deleted	
Attitudes (AT) (CR= 0.846; AVE= 0.648)		
AT1	0.715	Al-Swidi et al., (2014); Saleh et al., (2020)
AT2	0.844	
AT3	Deleted	
AT4	Deleted	
AT5	0.848	
Perceived Behavioral Control (PBC) (CR= 0.868; AVE= 0.568)		
PBC1	0.723	Al-Swidi et al., (2014); Saleh et al., (2020)
PBC2	0.775	
PBC3	0.730	
PBC4	0.801	
PBC5	0.737	Alam et al., (2014)
Government Sustainable Support (GOSS) (CR= 0.861; AVE= 0.673)		
GOSS1	0.817	Lin and Ho (2011); Lee (2008); Lin et al., (2020)
GOSS2	0.806	
GOSS3	0.837	
Knowledge of Green Practices (KNGP) (CR= 0.807; AVE= 0.584)		
KNGP1	0.722	Haron et al., (2005); Saleh et al., (2020)
KNGP2	0.744	
KNGP3	Deleted	
KNGP4	0.822	

Source: Author's Calculation

4.3. Outer Model Measurement

The hypotheses were assessed using the bootstrapping approach by considering 5000 bootstrap samples, as advised by Hair et al., (2016). The results of hypotheses are present in Table 3. The findings reveal that perceived behavioral control is a strong contributor in predicting intention to adopt GRB practices, where $\beta = 0.447$ and $p < .05$, followed by attitude ($\beta = 0.243$ and $p < .05$), and subjective norms ($\beta = 0.100$ and $p < .05$), respectively. This shows that control over the decision making and ability to act, positive attitude towards GRB, and social circle influences intention to adopt GRB practices. Furthermore, government sustainable support positively affect attitude ($\beta = 0.272$ with $p < .05$), perceived behavioral control ($\beta = 0.273$ with $p < .05$), and subjective norms ($\beta = 0.216$ with $p < .05$). This revealed that government sustainable support largely affects perceived behavioral control followed by attitude and subjective norms,

respectively. This clarifies that government sustainable support is essential in developing positive attitudes and motivating people to act responsibly.

The results further highlight that knowledge of green practices positively affect attitude ($\beta = 0.217$ with $p < .05$), perceived behavioral control ($\beta = 0.250$ with $p < .05$), and subjective norms ($\beta = 0.132$ with $p < .05$). This also revealed that knowledge of green practices largely affects perceived behavioral control followed by attitude and subjective norms, respectively. This highlighted that knowledge and information plays a key role in indulging positive attitude and ability to take sustainable decision.

For the moderation role of environmental concern, the moderation path showed $\beta = 0.136$ with $p < .05$ on the relationship between intention to adopt GRB practices and attitude. The moderation role of environmental concern is found insignificant between perceived behavioral control and intention to adopt GRB practices as path modeling showed $\beta = 0.074$ with significance $p > .05$. Moreover, the moderation path on the relationship between subjective norms and intention to adopt GRB practices showed $\beta = 0.091$ with significance $p > .05$ and hence, signifying absence of significant interaction effect. This shows that for developing the intention to adopt GRB, it is important to be one's concern towards the environment. Environmental concern acts as catalyst in between attitude and intention to adopt GRB practices, and perceived behavioral control and intention to adopt GRB practices.

The coefficient of determination values for the foregoing stated relationships which is also known as R^2, emerged as 0.534 for intention to adopt GRB practices, 0.159 for perceived behavioral control, 0.140 for attitude, and 0.073 for subjective norms. Also, predictive relevance of the model was attained which is also named as Q^2. Blindfolding is a way of testing Q^2 that is built-in into the Smart-PLS software (Hair et al. 2016). Result of blindfolding showed that the Q^2 value = 0.324 for intention to adopt GRB practices, Q^2 value = 0.084 for attitude, Q^2 value = 0.082 for perceived behavioral control, and Q^2 value = 0.049 for subjective norms. Value of Q^2 greater than zero is regarded considerable evidence for the proposed model's predictive usefulness in a study and the relevant predictors (Fornell & Cha 1994).

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Table 3- Hypotheses Testing

	Coefficient	T Statistics	P Values
Subjective Norms ⟶ Intention to adopt GRB Practices	0.100	2.085	**0.038**
Attitude ⟶ Intention to adopt GRB Practices	0.243	4.230	**0.000**
Perceived Behavioral Control ⟶ Intention to adopt GRB Practices	0.447	8.850	**0.000**
Government Sustainable Support ⟶ Attitude	0.272	4.799	**0.000**
Government Sustainable Support ⟶ Perceived Behavioral Control	0.273	4.699	**0.000**
Government Sustainable Support ⟶ Subjective Norms	0.216	3.630	**0.000**
Knowledge of Green Practices ⟶ Attitude	0.217	4.543	**0.000**
Knowledge of Green Practices ⟶ Perceived Behavioral Control	0.250	4.299	**0.000**
Knowledge of Green Practices ⟶ Subjective Norms	0.132	2.181	**0.030**
Attitude*Environmental Concern ⟶ Intention to adopt GRB Practices	0.136	3.101	**0.002**
Perceived Behavioral Control * Environmental Concern ⟶ Intention to adopt GRB Practices	0.074	1.606	**0.109**
Subjective Norms * Environmental Concern ⟶ Intention to adopt GRB Practices	0.091	2.001	**0.046**

Source: Author's Calculation

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5. Discussion

To address the growing environmental issues due to the construction sector, this study has examined the drivers of intention to adopt GRB practices. The study extended the TPB by adding additional constructs i.e., government sustainable support and knowledge of green practices. Moreover, the study further considers environmental concern as a moderating factor in between TPB core constructs and intention to adopt GRB practices.

The findings clarify that all the core constructs of TPB (i.e., attitude, subjective norm, and perceived behavioral control) have a significant impact on intention to adopt GRB. Also, perceived behavior control largely contributes in the intention to adopt GRB practices followed by attitude and subjective norms. Hence, H_1, H_2 and H_3 are accepted. This revealed that control over the decision making and ability to act influences one's capacity to adopt GRB practices. Also, from the commencement of TPB, studies related to pro-environmental behaviors have explored and identified perceived behavioral control as an essential factor in determining behavioral intentions (Aslam et al., 2020; Alam et al., 2014; Yazdanpanah et al., 2015). Another finding from this study reveals that when individuals have ability and control over the adoption of GRB practices, they are highly like to implement GRB practices. This further confirms that attitude towards GRB practices affects its adoption. The result also revealed that attitude has a significant impression on the intention to adopt GRB practices. In the past, various studies have also confirmed that attitude evokes behavioral intention. For example, studies related to green behavior also suggest the significant role of attitude on intention (Aslam et al., 2021; Tan et al., 2017; Waris and Ahmed, 2020; Saleh et al., 2020; Rahman, 2013; Manaktola and Jauhari, 2007; Cunningham and Kwon, 2003). In simple words, consultant and contractor engineers with a positive attitude looked to have greater intentions to follow green practices than those with a negative attitude. This also supports the concept that the more positive the attitude, the greater the acceptance of GRB practices. Results from this study show that subjective norms have also significantly influenced the intention to adopt GRB practices. This confirms that buying decision and adoption decisions are influenced by friend, family etc., and reflects what has been established in past studies (Saleh et al., 2020; Kim et al., 2011; Tarkiainen and Sundqvist, 2005; Bamberg, 2003).

The results also revealed a significant impact of sustainable government support and knowledge of green practices on the core constructs of the TPB. Hence, we fail to reject the hypotheses H_4, H_5, H_6, H_7, H_8, H_9. This shows the having awareness about the green practice plays a role in developing the attitude of the consultant and contractor engineers and develops behavioral control. Similar findings identified in the studies of Aslam et al., (2021) and Saleh et al., (2020). Hence, if the consultants have an idea of the harm non-green practices create can develop positive attitude of implementing green practices. Studies in the past have mentioned that people who have knowledge of the harm created by non-green practices are more willing to adopt green practices (Levin, 1990). Past studies such as Jaiswal and Kants (2018) and Li et al., (2019) also confirmed the impact of environmental knowledge on attitude and on subjective norms.

Furthermore, the results on government sustainable support help in developing the required attitude among contractor and consultant engineers. The findings confirm that government sustainable support influences behavioral control of the contractor and consultant engineers and affect the subjective norms. The findings highlight that government sustainable support almost equally affects perceived behavioral control and attitude. Similarly, knowledge of green practices also largely affects perceived behavioral control followed by attitude and subjective norms.

Concerning the moderating role of environmental concerns in TPB constructs and intention to adopt GRB practices. This study finds that environmental concern moderates the relationship between subjective norms and intention to adopt GRB practices, as well as the relationship between attitude and intention to adopt GRB practices. Hence, we fail to reject hypotheses H_{10} and H_{11}. Environmental concern, on the other hand, did not alter the relationship between perceived behavioral control and intention to adopt GRB practices. Hence H_{12} is rejected. Consultant and contractor engineers who have a positive attitude toward GRB practices and are environmentally conscientious are more likely to adopt them.

5.1. Conclusion

The growing environmental problems have heightened the need to develop sustainable plans to improve the overall quality of the planet and well-being (Aslam & Jawaid, 2022). Overall, every business sector contributes to pollution and global warming, and therefore it is necessary to act environmentally responsible (Aslam & Jawaid, 2023a). The construction sector also significantly contributes to the destruction of the worldwide environment and air quality (Saleh et al., 2020). This necessitates the adoption of GRB practices by the construction industry.

Pakistan exhibits a high degree of susceptibility to the impacts of climate change (Waheed et al., 2021), and the perception of energy conservation within the construction industry remains at an early stage (Iqbal et al., 2021). This can be attributed to a lack of awareness, inadequate government support, and a shortage of skilled workforce. Consequently, the construction sector exhibits a reluctance to deviate from conventional construction practices. Therefore, it is essential to address the drivers that can lead to the intention to adopt GRB.

The findings highlight that the positive attitude of the consultant and contractor engineers towards GRB develops the intention to adopt GRB. Moreover, subjective norms play an important role in the intention to adopt GRB. This confirms that friends, competitors, and other social circles have influenced one's action to adopt GRB. Finally, perceived behavioral control is found to be one of the most influencing elements of intention to adopt GRB. This finding indicates that individuals' ability to make decisions and act has a significant impact on their likelihood of adopting GRB practices. The results further explained that attitude, subjective norms, and perceived behavioral control are influenced by government sustainable support and knowledge of green practices. Hence, government should develop supporting policies and educate the construction sector, as it all will lead to positive attitude, better control, and ability to take decision (i.e., perceived behavioral control) and improves norms. Furthermore, environmental concern is also very important as it works as catalyst in between TPB core constructs and intention to adopt GRB

practices. The study offers numerous benefits to environmentalists, construction sector, government, and policymakers, as the findings will help them to develop strategies that are inline to achieve SDGs.

5.2. Practical and Theoretical Implications

The study offers various implications such as the research aids environmentalists and lawmakers in developing much-needed regulations for a safer environment by reducing energy usage. The findings also aid construction companies in developing successful ways to encourage consultant and contractor engineers to adopt GRB practices.

The findings of this study are useful for government officials and high-ranking officials in Pakistan who want to develop and accelerate the use of GRB practices in the construction industry. It is important for decision makers to establish campaigns or commercials to raise awareness about the need to adopt GRB practices. Further, there is a need to offer incentives to encourage consultant and contractor engineers to use GRB practices and provide technical training to improve engineers' knowledge and skills in the field of green construction. It is highly advised that the government may develop regulations to increase and sustain the adoption of GRB practices and to reduce the harmful effects on the environment.

The study has several theoretical contributions. Such as, the study contributes to the literature of green practices that are much required to achieve the SDGs. Past studies related to GRB practices were conducted largely in the developed economies. Hence, this study is pioneering in how it explores GRB practices in the context of a developing economy such as Pakistan by considering additional construct of government sustainable support in determining adoption intention of GRB practices. The study established that government sustainable support plays a significant role for developing contractor and consultant engineer’s attitude, perceived behavioral control and subjective norms. Moreover, to the best of author’s knowledge none of the study have considered the moderating role of environmental concern in between core TPB constructs and intention to adopt GRB practices. Hence, this study also highlights that environmental concern is essential in creating a multiplier effect in the adoption of GRB.

5.3. Limitations and New Area for Research

The study offers numerous implications but still there are few areas that can be considered by future researchers. This study considered TPB and additional constructs (government sustainable support, environmental concern, and knowledge of green practices). However, there are other theories that also cater to the behavioral intention such as norm-activation theory. Therefore, it is essential to consider them to get further understanding of the behavioral intention towards GRB practices. In addition, this study is based on contractor and consultant engineers of Pakistan and there is need to expand and compare the scenarios in other developing economies. It is also important to consider the perception of architects in identifying adoption intention of GRB practices. Future studies can also consider the factor of cost as it can be a barrier to the adoption of GRB practices. The studies can also consider specific enterprises such as small, medium, or large to gain better insights of the adoption trend of GRB practices by the construction sector.

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Future studies can also consider any specific GRB practices and can highlight the specific need of that practices in construction industry.

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Appendix A

GRB Practices	Description
Net-Zero Buildings	Many contractors want to design net-zero buildings in which energy consumption equals energy output. This type of building project reduces carbon emissions, water use, and landfill waste. Building a net-zero building usually requires on-site and off-site renewable energy generation. Popular on-site generation methods include wind turbines, solar water heating, and photovoltaics. Off-site solutions include enormous wind farms, solar, geothermal, and hydropower projects.
Climate Resiliency	Improving infrastructure to withstand extreme weather and natural calamities is a top green initiative. Developers are still looking for ways to design stronger frames and boost weather resistance to reduce weather damage and insurance costs like flood and fire claims.
Green Star Certification	The global Green Star certification supports environmentally friendly integrated building designs. An independent panel of sustainability specialists rates a contractor's building or project after certification. This ranking verifies a building or community project's sustainability.
LEED Certification	LEED, the most popular sustainability certification system, certifies 1.85 million square feet of building daily. Anyone can claim sustainable building. A structured, points-based scoring system holds builders accountable in LEED certification.
Distributed Energy Systems	Distributed energy systems (DES) manage generation, storage, and monitoring. Sensors, meters, and actuators allow the system to monitor a building's heating, cooling, lighting, and other systems and recommend ways to save money and improve reliability.
EDGE Certification	Excellence in Design for Greater Efficiencies (EDGE) certification improves energy, water, building materials, and waste efficiency in construction. Starting with downloadable software to assess the optimum building strategies. Panel audit the project after completion to ensure it fulfills standards.
Alternative Building Materials	Usage of alternative building materials include grasscrete, bamboo, recycled plastic, wood, hempcrete, papercrete, engineered timber, cob, steel frame, and insulating concrete foam.

Source: Matthews (2019)

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Appendix B

Discriminant Validity (Fornell and Larcker Criteria)

	AT	ENC	GOSS	ITA	KNGP	PBC	SUBN
AT	**0.805**						
ENC	0.342	**0.809**					
GOSS	0.307	0.298	**0.820**				
ITA	0.556	0.331	0.376	**0.812**			
KNGP	0.261	0.197	0.163	0.210	**0.764**		
PBC	0.539	0.286	0.314	0.665	0.294	**0.754**	
SUBN	0.434	0.178	0.237	0.487	0.167	0.551	**0.883**

Note: Diagonal values are square root of AVE and off-diagonal values are correlation values.

Discriminant Validity (HTMT Criteria)

	AT	ENC	GOSS	ITA	KNGP	PBC	SUBN
AT							
ENC	0.469						
GOSS	0.407	0.404					
ITA	0.750	0.438	0.498				
EK	0.383	0.331	0.251	0.311			
PBC	0.702	0.360	0.396	0.853	0.399		
SN	0.551	0.216	0.287	0.599	0.216	0.661	

Source: Author's Calculation

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Discriminant Validity (Cross-loadings Criteria)

	AT	ENC	GOSS	ITA	KNGP	PBC	SUBN
AT1	**0.715**	0.261	0.158	0.441	0.170	0.342	0.293
AT3	**0.844**	0.316	0.283	0.500	0.202	0.475	0.376
AT5	**0.848**	0.244	0.291	0.396	0.258	0.474	0.374
EC1	0.297	**0.782**	0.246	0.239	0.166	0.207	0.153
ENC3	0.257	**0.840**	0.219	0.322	0.107	0.265	0.180
ENC5	0.287	**0.804**	0.270	0.222	0.228	0.212	0.084
KNGP1	0.183	0.213	0.067	0.144	**0.722**	0.157	0.168
KNGP2	0.215	0.202	0.252	0.210	**0.744**	0.217	0.055
KNGP4	0.202	0.064	0.069	0.136	**0.822**	0.285	0.157
GOSS1	0.273	0.265	**0.817**	0.371	0.152	0.262	0.238
GOSS2	0.240	0.270	**0.806**	0.268	0.133	0.206	0.165
GOSS3	0.240	0.200	**0.837**	0.276	0.116	0.298	0.173
PBC1	0.449	0.174	0.237	0.443	0.177	**0.723**	0.498
PBC2	0.513	0.231	0.165	0.527	0.279	**0.775**	0.468
PBC3	0.376	0.186	0.219	0.451	0.305	**0.730**	0.331
PBC4	0.398	0.216	0.273	0.543	0.189	**0.801**	0.452
PBC5	0.303	0.263	0.287	0.532	0.163	**0.737**	0.337
ITA1	0.534	0.218	0.274	**0.825**	0.166	0.560	0.516
ITA2	0.407	0.272	0.317	**0.832**	0.121	0.549	0.349
ITA3	0.401	0.325	0.330	**0.779**	0.228	0.508	0.303
SUBN1	0.394	0.155	0.229	0.410	0.091	0.482	**0.887**
SUBN2	0.424	0.185	0.147	0.443	0.084	0.444	**0.885**
SUBN3	0.339	0.134	0.246	0.435	0.252	0.528	**0.878**