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Institutional pressure and corporate green innovation—the influence of knowledge management process

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Abstract: Using a multiple linear regression model constructed on data from construction firms in a province in eastern China, we investigated the impact of three types of institutional pressures from outside the firm on corporate green innovation and how the three knowledge management processes affect the relationship between them. We found that all three institutional pressures significantly positively impact corporate green innovation, with normative pressure having the most significant impact on corporate green innovation, followed by coercive pressure. The results also indicate that all three institutional pressures have an important mediating effect on green innovation through knowledge integration. Knowledge acquisition and knowledge sharing do not moderate the relationship between imitative pressure and green innovation. Thus, the findings emphasize the importance of institutional pressure and its role through knowledge integration for firms to achieve green innovation. The findings also emphasize the need to differentiate between similarities and differences between organizations to understand the impact of knowledge sharing on the relationship between institutional pressure and green innovation, thus increasing research on the conditions under which knowledge sharing contributes to green innovation in firms.

Keywords: *Corporate green innovation, Institutional pressures, Knowledge acquisition, Knowledge integration.*

1. Introduction

In the last few years, the sustainability agenda has risen in importance for the industry, especially regarding environmental concerns. According to Xu(2022) , the abuse of natural resources and overexploitation of land—primarily due to decisions made about residential and commercial construction—are the primary causes of global warming. Companies have new opportunities to produce value due to consumers' growing awareness of their purchasing decisions' impact on the environment and their willingness to lessen their ecological footprint. On the other hand, more and more restrictive policies and the attention paid by NGOs and other environmental organizations to corporate pollution practices have encouraged companies to control their activities' environmental influence to lower reputational risks and avoid supernumerary costs(Xu et al., 2022). Therefore, many people accept and understand the significance of the green building. This comprehension and acceptance is gradually transformed into green building products, processes, and management measures. At the same time, some companies realize that sustainability is crucial in generating future growth. Shifting to less influential modes of production may ensure substantial economic gains for firms by stimulating innovations that aim to reduce environmental influences while offering economic profits. However, in the few cases where environmental activities and practices are adopted, green outcomes still need to be achieved, publicized, or effectively communicated to the masses. Because of the risk and cost uncertainty of green practices, it is difficult for enterprises to agree on the investment in green buildings. Therefore, the government must formulate laws, rules, and regulations to motivate enterprises to act green.

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Inspired by the rules and mandates formulated by the government, some active policymakers hope to use practical tools and methods for corporate green innovation(CGI).

So, if companies need to adopt and disseminate green building innovations, what methods, processes, and tools are available to choose from? Some scholars have conducted research from an institutional theory perspective, analyzing the impact of green development regulation, green development stewardship, and environmental policies on corporate innovation(Gupta & Barua, 2018; Li et al., 2021). Some scholars have explored the influence of knowledge management on CGI from a resource-based perspective (Song et al., 2020;). Various researchers have questioned the influence of CEO personal characteristics, managerial environmental concerns, stakeholder pressure, and corporate green innovation from the angle of view of managerial characteristics and stakeholders (Shahzad et al., 2020;Quan et al., 2021;Li&Shen,2021). Compared with other innovations, corporate green innovation has a relatively large difference in externalities and driving factors, which has been proved by previous theories and literature (Rennings, 2000); little is still known about how they have evolved and how the introduction of driving factors has influenced on the whole process of knowledge management and facilitated CGI (De Marchi, 2012).Previous studies have only considered the impact of external institutional pressure on corporate green innovation(Berrone et al., 2013; Borsatto et al., 2021) or the separate role of internal knowledge management processes on corporate green innovation alone(Arfi et al., 2018), but rarely in combination.And even though some literature has investigated the joint role of the two on corporate green innovation, it has only considered a certain aspect of institutional pressure or a certain process of knowledge management(Liao,2018), and has not compared and investigated the impact of different types of institutional pressure on corporate green innovation through the various activities of knowledge management. The research in this paper fills this gap to a certain extent by comparing and studying the impact of green innovation through various activities of knowledge management under different types of institutional pressures.

The first research objective of this paper is to identify the impact of three different institutional pressures on corporate green innovation. In emerging markets with underdeveloped formal institutions, the impact of different institutional pressures on corporate green innovation needs to be clarified. Our second research goal is to clarify whether the three knowledge management processes have moderating or mediating effects on the influence of institutional pressure on corporate green innovation. Driven by similar institutional pressures, corporate green innovation may have different effects (Rabadan et al., 2020). In addition to external driving factors, corporate green innovation may also be affected by organizational internal driving factors. Knowledge resources are a very important supporting element for enterprises to carry out corporate green innovation. However, previous studies often only considered the impact of a certain part of the knowledge management process on corporate green innovation.

The remaining parts of this study are structured as follows: The second part of this article provides a literature review, clarifies the current research status, and proposes hypotheses. Chapter 3 focuses on the methods used by researchers for data collection and analysis. We will discuss our results in Chapter 4. Finally, the researchers summarized the main findings, described the limitations of this study, and provided recommendations for further research.

2. Literature Review

2.1. Institutional Pressure and Corporate Green Innovation

Institutional theory holds that Organizations that follow institutional rules and meet expectations acquire legitimacy, which provides the necessary resources for their survival and development (Meyer&Rowan, 1977). Coercion, imitation, and homomorphism are the three mechanisms identified by the theory(DiMaggio and Powell, 1983). Political influence and legitimacy lead to coercive pressure in the institutional environment. In order to appear legitimate and progress, firms prefer to adopt new practices that conform to shared norms and values developed in the institutional environment. (Liang et al., 2007), for example, adopting green innovation strategies. Yuan and Xiang (2018) found that

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environmental regulation can promote energy efficiency and environmental efficiency, promoting corporate green innovation in China's manufacturing industry. Stucki et al. (2018) surveyed various energy-related regulatory policy instruments and found that taxes and regulations are negatively related to green product innovation. Sun et al. (2019) argue that institutional quality significantly impacts corporate green innovation and energy efficiency. Whether coercive pressure plays a positive role for corporate green innovation remains to be tested, so we propose the following hypotheses:

H_{1a} Coercive pressure for environmental sustainability positively influences the implementation of CGI.

Second, the successful practices of some companies (mainly referring to industry leaders) create imitation pressure on other competitors, forcing them to imitate proven effective business practices.Consumers pay more and more attention to environmental protection, so they prefer high-quality green products. The research and development of green products has become the imitation target of other companies, thus accelerating the diffusion of corporate green innovation in the industry. Zhu and Geng (2013) found through a survey of Chinese manufacturing industries that imitation pressure from benchmarking firms and competitors was an essential factor in promoting the adoption of green environmental protection. Lui et al. (2021) considered that the greater the imitation pressure exerted by competitors, the more inclined companies adopt energy-saving systems to improve economic efficiency. So, we make the following hypothesis：

H_{1b} Imitative pressure for environmental sustainability positively influences the implementation of corporate green innovations.

Finally, internal or external stakeholders usually exert normative pressures (related to adopting certifications and industry-accepted practices). For example, Terlaak (2007) argues that faced with the fact that more and more companies in the industry have obtained certification, business managers feel the pressure of competition and are more willing to adopt green certification. Hyatt and Berente (2017) found that internal normative stakeholder pressures primarily drive substantive commitments to environmental practices, while external normative pressures primarily drive symbolic commitments to environmental practices. So, we make the following hypothesis：

H_{1c} Normative pressures for environmental sustainability positively influence the implementation of corporate green innovations.

2.2. Institutional Pressures, Knowledge Acquisition and CGI

Knowledge acquisition is an important part of corporate green innovation. Organizations acquire new knowledge from external partners and combine it with existing knowledge within the organization to ensure the supply of knowledge required for sustainable development and to more accurately understand customer needs. (Qasrawi et al., 2017). When the coercive pressure is relatively high, enterprises will seriously study the regulations and policies promulgated by the government and have a greater motivation to identify, communicate useful green knowledge with upstream and downstream suppliers and customers and promote the improvement of absorptive capacity (Kammerer, 2009).Liao (2018)' study shows that knowledge acquisition positively promotes the relationship between regulatory pressure, normative pressure, and environmental innovation. We therefore hypothesize that:

H_{2a} The higher the level of knowledge acquisition ability, the more the coercive pressure of environmental sustainability can positively impact the implementation of corporate green innovation.

Competition in the modern economy and society is fierce, companies need to acquire unique and innovative knowledge to improve their existing products. Suppose peer companies in the market perform well in corporate green innovation. In that case, it will create imitation pressure on other competing companies. Companies will find ways to cross organizational boundaries to acquire various green knowledge needed for innovation and integrate it into the existing knowledge system, update the knowledge base of environmental protection, and lay the foundation for corporate green innovation practice. (Yu et al., 2017). We therefore hypothesize that:

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H_{2b} The higher the level of knowledge acquisition, the more the imitative pressure of environmental sustainability can positively impact the implementation of corporate green innovation.

The sustainable operation of a firm relies on the condition that the expectations of customers,community and media are met, these expectations are a source of normative pressure(Liao,2018). Normative pressures motivate companies to acquire knowledge from and gain buy-in from customers, suppliers, universities and strategic allies. For example,customers' demand for green products will prompt companies to acquire green knowledge to apply it to green practices (Zhou et al., 2019).We therefore hypothesize that:

H_{2c} The higher the level of knowledge acquisition, the more normative pressure on environmental sustainability can positively impact the implementation of corporate green innovation.

2.3. Institutional Pressures, Knowledge Sharing, and Corporate Green Innovation

Coercive institutional pressure comes mainly from regulatory policies of government departments, which create learning societies or develop knowledge-intensive industries by providing appealing conditions or dues incentives for the sustainability of innovation or development industries to promote corporate green innovation (Wu et al., 2012). Without the institutional pressure of environmental protection, firms will not prioritize investing resources in environmental management. Wu et al. (2012) found that under huge regulatory pressure, strict regulatory requirements make supply chain cooperative enterprises realize the value of reciprocal cooperation and be more willing to share knowledge and mutually cooperate. So, we make the following hypothesis：

H_{3a} The higher the level of knowledge sharing, the greater the positive impact of coercive pressure on corporate green innovation.

In particularly indeterminate environments, many organizations imitate the behavior of other organizations. When people are unsure of which activities to discipline or sanction, the imitation process provides a way to minimize negative outcomes. Therefore, if More and more enterprises attach importance to knowledge management, remaining organizations will bring in similar management activities where people are guided in their behavior by the reactions of other members in situations of uncertainty. Peer pressure and informal punishment can stimulate individuals or groups to engage in informal or unauthorized activities to gain cultural acceptance (Fortado, 1994). So, we make the following hypothesis：

H_{3b} The higher the level of knowledge sharing, the greater the positive impact of imitating pressure on corporate green innovation.

Normative pressures arise from unanimous recognition of the professionalism of the work, and these consensuses gradually form stable norms through inter-organizational transfer and dissemination (Teo et al., 2003),they are informal intangible rules.Tavallaei (2022) et al. argue that knowledge sharing is more likely to succeed in a specific institutional environment, such as a tangible management system, or informal intangible rules, such as similar social expectations, recognition, and customs. The results of Huang et al. (2016) discover that customer pressures promote green organizational responses (e.g., training and building collaborative networks to expand knowledge) that improve corporate green innovation performance. We therefore hypothesize that:

H_{3c} The higher the level of knowledge sharing, the more significant the positive impact of normative pressure on corporate green innovation.

2.4. Institutional Pressure, Knowledge Integration, and CGI

CGI is different from traditional innovation. It involves the support and cooperation of multiple professions and needs to meet various requirements (Ardito et al., 2019) and therefore requires companies to integrate different knowledge, especially combining generic and ecological knowledge to generate new knowledge that can be output to corporate green innovation (Dangelico et al., 2017). As

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green innovation has negative externalities, it requires pressure from government regulators to promote corporate sustainability activities. So we therefore speculate that:

H_{4a} Coercive pressure for environmental sustainability positively influences the implementation of corporate green innovation in firms through knowledge integration.

Transforming newly acquired knowledge into a transferable form and combining it with existing knowledge, then integrating it into a valuable form for innovation can support corporate innovation activities(Xu et al., 2010). Bansal (2005) found in his empirical research on Canadian forestry, mining, and oil and gas industries that imitationare essential powers for promoting sustainable corporate development. Green innovation is difficult to achieve when knowledge is not well integrated, absorbed and utilized. So we therefore speculate that:

H_{4b} Imitative pressure for environmental sustainability positively influences the implementation of corporate green innovation in firms through knowledge integration.

Learning from external organizations can help companies to relieve ecological problems and achieve CGI, while knowledge integration also includes the integration of knowledge inside and outside the organization, where unexpected ideas may emerge in the process of acquiring external knowledge and new ideas that can contribute to corporate green innovation. The prevalence of green awareness in society creates informal rules that facilitate knowledge integration between firms. Stepanova (2015) believes that informal interaction benefits stakeholders' knowledge integration in coastal governance. So we therefore speculate that:

H_{4c} Normative pressure for environmental sustainability positively influences the implementation of corporate green innovation in firms through knowledge integration.

Figure 1 shows the research model proposed for this study. This research looks at how the green knowledge management process affects the interaction between corporate green innovation and institutional pressure and how corporations mediate between institutional pressure and company environmental performance. Gender, age and education were the control variables.

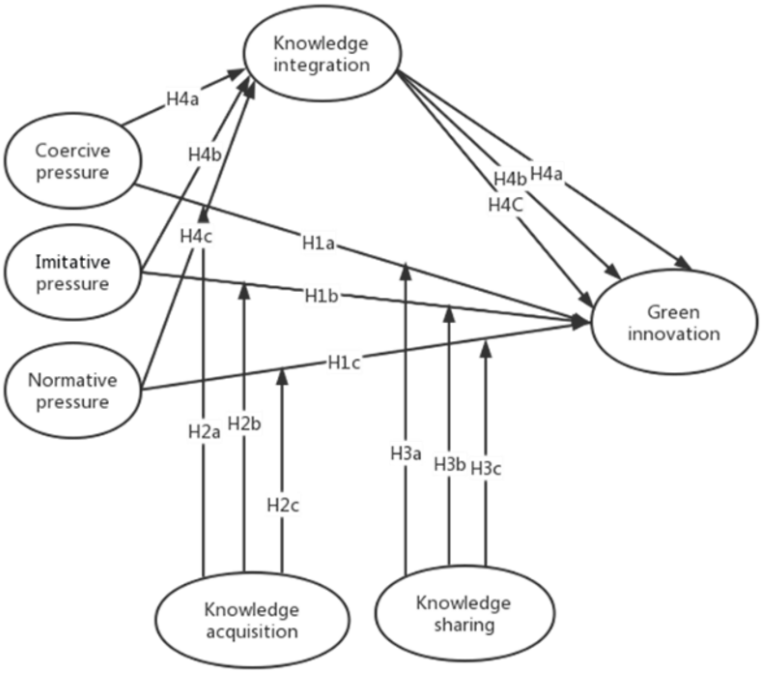

Figure 1.
Hypothesis model.

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3. Research Methodology

3.1. Research Methodology and Sample

We collected data using a cross-sectional survey method based on a deductive approach, employing self-administered offline and online questions. According to particular academics, there exists a favorable correlation between perceived corporate performance statistics and objective data. The utilization of survey methodologies in this study is deemed suitable and acceptable.

This study employed a comprehensive survey approach, targeting construction companies in China, to elucidate the intricate relationship between institutional pressures and corporate green innovation (CGI). The survey was distributed online and offline, with a detailed breakdown of 200 questionnaires distributed online and 191 offline, covering a period from January to March 2023. The respondents were primarily middle to senior management personnel, ensuring a strategic perspective on organizational practices. Our response rate was 72.89%, indicative of a robust sample size for analysis. The scales used in this survey were adapted from established instruments in the field, chosen for their demonstrated reliability and relevance to the constructs of interest.

To mitigate common method biases, such as common source bias, we implemented a two-stage data collection process, ensuring that the measures of independent and dependent variables were separated in time. Additionally, we utilized anonymous responses to encourage candid feedback. The statistical analysis was conducted using SPSS software, employing descriptive statistics, reliability and validity analyses, correlation analyses, and hierarchical regression to test our hypotheses rigorously.

After developing the study measurement items, we created a structured questionnaire as a study instrument. We submitted it to the building company to collect primary data to validate the study model and assumptions. A five-point Likert scale, including the options "never," "rarely," "sometimes," "mostly," and "always," was used to measure the survey instruments. Next, as part of the experiment phase, the questionnaire was critically reviewed to ensure the validity of its form and details and to check the development project's applicability in measuring the study's structure. This will be done by drawing on several experienced academics from leading business schools in Australia and Thailand who specialize in strategic management, innovation management, and knowledge management. In the experiment phase, some changes will be made to the wording, sentences, expressions, table formatting, and layout of the first draft of the questionnaire. We will translate the questionnaire from English to Chinese, and an identical group of scholars will examine the translations to ensure that the two versions express the same meaning. The aim was to ensure that all respondents comprehend precisely what was being said in their native language. The questionnaire will be sent to respondents via email. The researcher will remind participants a few times by phone and email to ensure that as many participants as possible participate in the survey. In general, the data collection work will take ten weeks. After completing the questionnaire design, distribution, and recycling, make a data statistics table and eliminate the questionnaires with obvious data problems. Next, The variables will be subjected to descriptive statistical analysis using STATA software to determine the core variables' overall performance. Next, the data's validity and reliability of the chosen scale will be examined. Subsequently, a correlation analysis will be conducted to ascertain the causal relationship between the variables, assess the reasonableness of the research model construction and assumptions, and establish whether multicollinearity among the variables is present.

Next, Statistical software is used for multiple linear regression (MLR) and hierarchical regression to verify the main effect and adjustment effect. Generally speaking, the explanatory variables are first entered into the regression model, followed by the mediator or modulating variables, and then the primary effect corresponding to the explanatory variables and the mediator or modulating variables is observed to be significant.

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3.2. Measurement of Variables

3.2.1. Measurement of Institutional Pressure

Following the establishment of the study model and hypotheses, the main variables under investigation needed to be measured to collect the critical data used to verify the study model and hypotheses. After reviewing relevant studies, items were listed to measure the study structure and dimensions. Table 1 shows the measurement terms for institutional pressure and the source of their operation.

Table 1.
Measurement of institutional pressure.

Factors	Items	Sources
Coercive pressure	My company faces several environmental regulations that set standards that must be met.	Majumdar and Macas. (2001) & Rothwell. (1992)
	There are negative consequences for companies not complying with national and provincial environmental laws.	Charan, P., Murty, L. S. (2018) & Colwell and Joshi (2013)
	Companies in our industry know that fines and penalties can be associated with environmentally irresponsible behavior.	Charan, P., Murty, L. S. (2018) & Colwell and Joshi (2013)
	My company is faced with several environmental regulations that provide financial incentives.	Majumdar and Macas. (2001) & Rothwell. (1992)
Imitation pressure	Leading companies in our industry set an example of environmentally responsible behavior.	Charan, P., Murty, L. S. (2018) & Colwell and Joshi (2013)
	Leading companies in our industry are known for their practices in promoting environmental protection.	Charan, P., Murty, L. S. (2018) & Colwell and Joshi (2013)
	The major companies in our industry are seeking to reduce their environmental impact.	Charan, P., Murty, L. S. (2018) & Colwell and Joshi (2013)
	The actions of our competitors have put pressure on our management to take environmental measures.	Delmas and Toffel, 2008
	Our main competitors have invested significantly in environmental innovation over the past three years.	Liang et al., 2007
Normative pressure	Our industry has trade associations (or professional associations) that encourage organizations to be more environmentally friendly.	Charan, P., Murty, L. S. (2018) & Colwell and Joshi (2013)
	Our industry experts all companies to be environmentally responsible	Charan, P., Murty, L. S. (2018)& Colwell and Joshi (2013)
	Environmental responsibility is a requirement for companies in this sector	Charan, P., Murty, L. S. (2018)&Colwell and Joshi (2013)
	The press and media pay close attention to our industry.	Zhu et al. (2013)

3.2.2. Measurement of Corporate Green Innovation

Innovation in this research refers in particular to CGI, which is the process of integrating green concepts into new products/services, process development, and management system establishment to develop the green ecological value of the organization. In previous literature, there has yet to be a broad

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consensus on measuring green innovation in construction enterprises. In this case, following the formative structural convention, we reviewed literature related to green innovation and innovation in the construction industry; considering green innovation in the management process and product production of enterprises, a six-item scale was designed to measure the degree to which firms can effectively develop innovations in new products, processes, management systems, and procedures (see Table 2).

Table 2.
Measurement of Corporate green innovation.

Factors	Items	Sources
Corporate green innovation	Over the past three years, our company has made great strides in updating our operational methods to achieve our goals and objectives.	Birkinshaw et al., 2008
	Start a new operating program or system.	Birkinshaw et al., 2008
	Proactively change what employees do and how they do it.	Birkinshaw et al., 2008
	In the past three years, the company has achieved a great deal in protecting the environment.	Zhou et al., 2019
	Our company regularly and innovatively updates its production processes to meet environmental law standards.	Cheng and Shiu (2015)
Corporate green innovation	We often improve existing processes to make them more environmentally friendly.	Dai et al. 2015

3.2.3. Measurement of Knowledge Management Process

KA means an organization's ability to access from outside the organization's boundaries. This capability involves exchanging information and actively contacting other stakeholders in the external environment, cultivating multiple contacts and links with them, and gaining new opinions and knowledge from different external sources. These stem from viewing the organization as an open system maintaining interaction with the outside environment, and obtaining external knowledge is highlighted as the primary method of knowledge creation. The organization and its partners (i.e., customers, suppliers, competitors, and partners) can complement each other in knowledge and expertise to compensate for gaps or shortages. On this basis, we design five items to measure the structure of 'knowledge acquisition' after reviewing the relevant literature (Charan & Murty, 2018; Zhang et at, 2020; Shujahat et at, 2019; JPérez López et al., 2005) (see Table 3).

Grant's (1996) knowledge base theory expounds on knowledge integration. He believes that the integration of various knowledge bases and skills possessed by members of an organization is of great significance to the establishment and renewal of organizational capabilities. This knowledge integration capability comprises three main aspects: integration efficiency, the extent to degree an organization can acquire and utilize the expertise owned by employees personally; integration scope, the capability to assemble and integrate old and new knowledge; and integration flexibility, the assemble to which an organization can change existing abilities and establish new ones by gaining and integrating external knowledge. Based on this, knowledge integration is connected to acquiring and sharing knowledge by promoting employees with different expertise and specialties to exchange, communicate, share, and eventually integrate knowledge. Based on the above discussion, five items are used to measure knowledge integration.

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Table 3.
Measurement of knowledge management processes.

	Items	Sources
Factors knowledge acquisition	The company gathers industry information informally (e.g., through lunches with industry friends and meetings with trading partners)	Charan& Murty (2018)
	The company organizes regular ad hoc meetings with third parties (clients, consultants, etc.) to acquire new knowledge.	Charan& Murty (2018)
	We spend many resources acquiring knowledge from other companies	Zhang et at. (2020)
	Our company's new or less experienced employees are trained and educated by experts to gain knowledge.	Shujahat el at. (2019)
	Our company encourages employees to join formal or informal networks of people outside the company.	Pérez López et al. (2005)
Knowledge sharing	Knowledge exchange and sharing between different parts of our organization is effective.	Shujahat el at. (2019)
	We often share knowledge based on our experience	Lei et at. (2021)
	We often share knowledge based on our expertise	Lei et at. (2021)
	We are often encouraged by knowledge-sharing mechanisms	Lei et at .(2021)
	Our company often offers various training and development programs	Lei et at. (2021)
Knowledge integration	Businesses have a clear understanding of and access to environmental knowledge about market demand and competitive situations.	Johnson and Filippini (2013)
	The company can consider the environmental needs of its clients in the GI process.	Johnson and Filippini (2013)
	Companies can combine expertise and environmental knowledge to create ecological knowledge.	Johnson and Filippini (2013)
	The company is capable of producing environmentally friendly products.	Johnson and Filippini (2013)
	Effective integration and application of new areas of knowledge from universities, research institutes, and government to reduce damage to the ecological environment.	Cui et at. (2020)

4. Results

4.1. Descriptive Statistical Analysis

72.89% of the respondents were male and 27.11% were female. It is reasonable that there are more male respondents than female respondents, and it is also in line with the objective law that the object of our study is the construction industry. The characteristics of this industry lead to a significantly higher proportion of male practitioners than female practitioners.The 26-35 age group accounted for 77.75% of the total, more than half of the respondents. This is followed by the 36-45 age group, with 18.41%. the distribution of respondents by position shows that more than half, or 69.57%, were in junior managerial positions. Middle management followed, accounting for 25.83%.Regarding the distribution of the nature of enterprises interviewed, state-owned and privately-owned enterprises accounted for the majority of the respondents, with a total of 84.66%. This is followed by other types of enterprises (e.g., foreign/joint

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ventures), which account for 15.35%.Regarding the scale and strength of the surveyed enterprises, we use the qualification of construction enterprises as a measurement index. Construction enterprises have requirements on the number of employees, registered capital of enterprises, performance of enterprises, and qualification of employees when applying for qualification so that the qualification level can reflect the strength and scale of the enterprises well. the most significant proportion of enterprises is those with level 3 qualification, with a proportion of 34.27%, followed by those with Integrated Qualification, with a proportion of 32.48%.

4.2. Reliability Analysis

Reliability analysis measures the degree of consistency with which a variable measurement scale reflects its content, and this study used academic.

The widely recognized Cronbach's α value was used to determine the reliability. Statistical software was applied to measure the reliability of the variables involved in the study. Cronbach's alpha is a widely recognized measure of internal consistency or reliability within a set of items in a questionnaire or test. It assesses how well a set of items or indicators measures a single unidimensional latent construct. Essentially, it estimates the degree to which a set of items is consistent with each other in measuring the same concept. A higher Cronbach's alpha value indicates that the items in the scale are more homogeneous and, thus, more reliable in representing the underlying construct. In social sciences, a Cronbach's alpha value of 0.7 or above is typically considered acceptable, while values above 0.8 often indicate a high-reliability level. This metric is crucial in ensuring that the scales used in research are dependable and that the results can be trusted to reflect accurate measurements of the intended constructs. The Cronbach's α values for the institutional pressure dimension (coercive pressure CP, imitative pressure IP, normative pressure NP), knowledge management dimension (knowledge acquisition KA, knowledge sharing KS, knowledge integration KI), and corporate green innovation are all greater than the critical value 0.7. In addition, the CITC values for all the questions are more significant than 0.4, so the scales used in this study have good reliability. The statistical results show that after deleting item KA4, the α The coefficient value is 0.748, significantly higher than the coefficient a of 0.735. It may be considered to delete this item and reanalyze it.

4.3. Validity Analysis

Validity reflects the extent to which a measurement instrument truly reflects what it is measuring, and in this study, this was done through content validity; discriminant and convergent validity were measured in three aspects. First, choosing to apply well-established domestic and international research scales After suggestions and discussions among experts and scholars, and based on the feedback received after the pre-survey for further amendments to ensure excellent content validity for the Barrier Scale. Second, convergent validity refers to the consistency of the same variable in different measurement methods. The degree of consistency is usually determined based on indicators such as factor loadings. The findings of variables' validation factor analysis indicate that all of the factor loadings are greater than 0.5, the variables' AVE value is more significant than 0.5, or the variables' CR value is more significant than 0.7 (one of them can be satisfied). The indicators above indicate that the measurement scale has a reasonable convergent validity.

Distinguishing validity reflects the extent to which variables can be distinguished. Existing studies have primarily been conducted through a variable's AVE. The decision is reached by contrasting the variable's square root value with its correlation coefficient and that of other variables. The correlation analysis displayed the square root values of the AVEs for each variable, as well as the correlation coefficients between the variables. This indicated that every variable's AVE square root values are more significant, as shown in Table 4.

4.4. Correlation Analysis

Currently, the correlation between variables is mainly measured by the Pearson coefficient, which contains the strength, and the statistics show the correlation between variables used in the study.

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Except for the correlation between the control variables and some variables that are not significant, the correlation between any two variables and their dimensions is essential. It confirms the rationality of the hypotheses proposed in this study and lays a good foundation for the subsequent empirical research,as shown in Table 4.

Table 4.
Correlation coefficients and distinguishing validity (Pearson's correlation vs. AVE root value).

	CP	IP	NP	KA	KS	KI	CGI
CP	0.696						
IP	0.42***	0.77					
NP	0.472***	0.604***	0.812				
KA	0.26***	0.312***	0.137***	0.653			
KS	0.456***	0.462***	0.517***	0.277***	0.804		
KI	0.428***	0.547***	0.596***	0.35***	0.563***	0.824	
CGI	0.505***	0.552***	0.629***	0.237***	0.584***	0.663***	0.837

4.5. Hypothesis Testing

As mentioned earlier, this paper chooses regression analysis, which is widely used in academia, to verify the hypotheses proposed in this paper. At the same time, because Bootstrap can repeat sampling and be applied to the case of non-normal distribution of data, this study also adopts this method to analyze and verify the proposed hypotheses to ensure the conclusions' reliability.

4.5.1. Examining the Role of Institutional Pressures on Corporate Green Innovation

As determined by examining the F-test results, the significant P-value is 0.000***, indicating significance at the level and rejecting the initial hypothesis that the regression coefficient is 0. As a result, the model satisfies the specifications. The covariate covariance performance VIF is all less than 10, indicating that the model is well-constructed and has no multicollinearity issue. The hypotheses H1a, H1b, and H1c are accepted because of the formula for model 1, which is as follows: y = -0.167 + 0.258*CP + 0.371*NP + 0.184*IP.

Table 5.
Results of multiple linear regression analysis1 (n=391).

	Non-standardized coefficient		Standardized coefficient	t	P	VIF	R^2	Adjustment of R^2	F
	B	standard error	Beta						
a constant (Math.)	-0.167	0.243	-	-0.687	0.492	-	0.474	0.470	f=116.188 p=0.000***
CP	0.359	0.06	0.258	5.994	0.000***	1.363			
IP	0.196	0.058	0.184	3.383	0.000***	2.176			
NP	0.399	0.059	0.371	6.758	0.001***	2.213			
Dependent variable: CGI									

Using stratified regression by statistical software, this study investigated the hypotheses to create Models 2 and 3. Only the control variables chosen for this work are included in Model 2, necessitating the virtualization of the category variables. Model 2 adds three dimensions of institutional pressure and again conducts regression. The results show that institutional pressure can effectively explain 50.2% of the variance in the performance of start-ups, with a significant change in R2, and the regression coefficients $\beta 1=0.331$, $\beta 2=0.211(p<0.001)$,$\beta 3=0.399(p<0.001)$, which once again suggests that

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institutional pressure can significantly and positively affect the corporate green innovation of the enterprise, i.e., H1a, H1b, H2c is established.

This study's tests support that imitation and normative pressure favor corporate green innovation. This study delves into the intricate mechanism of action between the two. It suggests that integrating green information has a mediating function in the influence of institutional pressure on the mediating effect test. We use the stepwise regression approach commonly accepted by scholars, as suggested by Baron and Kenny (1986). First, make sure it has an impact on the dependent variable. Subsequently, confirm the influence of the independent variable on the mediator variable, incorporate both the independent and mediator, and examine the partial regression coefficients derived from the data above to confirm the validity of the postulated mediation effect.

Furthermore, the Bootstrap technique has been utilized to assess mediation (Preacher & Hayes, 2004). This benefits not being restricted to the requirement that the data have a normal distribution. In the event of more complex variable interactions, it can validate numerous mediators or mediation. The technique focuses on hypothetical return sampling of the sample, which is typically chosen 5000 times. The sample mean distribution is used to compute the confidence interval, with a 95% confidence level used by default. The regression coefficients are significant if the upper and lower bounds of the confidence interval do not contain zeros and insignificant if they do. In this study, both stepwise regression and Bootstrap were used to test the mediation effect hypothesis.

4.5.1.1. Examining The Role of Institutional Pressures on Green Knowledge Integration

First, a stepwise regression analysis was conducted using SPSS software to shows its components on corporate green innovation. The results show that the three dimensions of institutional pressure—coercive pressure (CP), imitative pressure (IP), and normative pressure (NP)—have a significant positive effect on corporate green innovation (CGI), as indicated by regression coefficients $\beta 1=0.223$ ($p<0.001$), $\beta 2=0.275$ ($p<0.001$), and $\beta 3=0.426$ ($p<0.001$).

Secondly, to further verify the effect of green knowledge integration on corporate green innovation, models were constructed. Under the influence of conceive pressure ($\beta=0.488$, $p<0.001$), as well as under the influence of imitation pressure ($\beta=0.467$, $p<0.001$) and normative pressure ($\beta=0.406$, $p<0.001$), green knowledge integration has a significant positive effect on corporate green innovation, so the mediating effect of knowledge integration is practical. Hypotheses H4a, H4b, and H4c are accepted, the analysis results are shown in the Table 6.

4.5.1.2. A Test of the Moderating Effect of Knowledge Acquisition on the Relationship Between Institutional Pressure and Corporate Green Innovation

The moderating effect of knowledge acquisition between coercive coercion and corporate green innovation of enterprises is depicted in the Table 6. According to the model, corporate green innovation is positively impacted by coercive pressure ($\beta =0.605$, $p<0.001$) and knowledge acquisition ($\beta =0.196$, $p<0.001$). Based on this, the model incorporates an interaction term between knowledge acquisition and coercive pressure; the coefficient of this interaction term is significant, suggesting that knowledge acquisition attenuates coercive pressure, and H2a is accepted. The Table 6 shows the corporate green innovation of firms and imitation pressure. According to the model, knowledge acquisition ($\beta = 0.159$, $p<0.001$) and imitation pressure ($\beta = 0.467$, $p<0.001$) have a beneficial effect on corporate green innovation. In light of this, the model incorporates an interaction term—whose coefficient is insignificant—between imitation pressure and knowledge acquisition. Therefore, learning influences imitation pressure positively and does not moderate the relationship between corporate green innovation inside businesses and H2B rejection. Table 6 presents the results of the knowledge acquisition moderating link between normative pressure and corporate green innovation. According to the model, normative pressure ($\beta = 0.604$, $p<0.001$) and knowledge acquisition ($\beta = 0.2$, $p<0.001$) have a favorable effect on corporate green innovation. This leads the model to include an interaction between

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knowledge gain and normative pressure. Since the interaction term's coefficient is significant, it is accepted that knowledge acquisition moderates the relationship between normative pressure and corporate green innovation, the analysis results are shown in the Table 6.

4.5.1.3. A Test of the Moderating Effect of Knowledge Sharing on the Relationship Between Institutional Pressure and Corporate Green Innovation

The findings demonstrate how the relationship between coercive pressure and corporate green innovation in enterprises is moderated by information sharing. According to the model, coercive pressure ($\beta = 0.419$, $p<0.001$) and information sharing ($\beta = 0.451$, $p<0.001$) have a beneficial effect on corporate green innovation. This leads to the inclusion of an interaction term between coercive pressure and knowledge sharing in the model; the coefficient of this interaction term is significant.Since information sharing cannot serve as a buffer between corporate green innovation and coercive pressure, H3a is rejected. The information shows how information exchange moderates corporate green innovation and imitation pressure. According to the model, imitation pressure ($\beta = 0.342$, $p<0.001$) and knowledge sharing ($\beta = 0.433$, $p<0.001$) have a favorable effect on corporate green innovation. This leads the model to include an interaction term between knowledge sharing and imitation pressure, meaning that knowledge sharing does not moderate the relationship between imitation pressure and corporate green innovation in businesses, proving that H3b is false. The Table 6 shows how knowledge sharing moderates the relationship between normative pressure and corporate green innovation.

According to the model, normative pressure ($\beta = 0.464$, $p<0.001$) and information sharing ($\beta = 0.368$, $p<0.001$) have a positive effect on corporate green innovation. Based on this, the model adds an interaction term between normative pressure and information sharing. The significant interaction term's significant coefficient suggests that information sharing may moderate normative pressure, which would establish H3c, the analysis results are shown in the Table 6.

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Table 6.
Results of hierarchical regression model analysis.

Dependent variable (Y)	**CGI**		**KI**	**CGI**								
A constant (Math.)	4.059***	-0.011	0.076	0.362	1.114***	0.779***	-2.042*	0.471	-0.744	1.194	0.894	2.557***
Gender	-0.121	-0.116*	-0.091	-0.065	-0.072	-0.091	-0.052	-0.068	-0.074	-0.105	-0.115*	-0.117*
(A person's) age	-0.223***	-0.102*	-0.078	-0.091	-0.088	-0.082	0.159*	0.144*	0.06	0.161**	0.149*	0.091
Highest level of education	0.56**	0.263	0.058	0.25	0.325**	0.315**	0.402**	0.462**	0.434***	0.314*	0.388**	0.336**
CP		0.331***	0.223***	0.385***			1.171***			0.201**		
IP		0.211***	0.275***		0.26***			0.71***			0.316*	
NP		0.399***	0.426***			0.379***			0.909***			-0.043
KI				0.488***	0.467***	0.406***						
KA							0.968***	0.457**	0.615**			
CP*KA							0.171**					
IP*KA								-0.072				
NP*KA									0.092*			
KS										0.187*	0.409**	-0.184
CP*KS										0.059*		
IP*KS											0.006	
NP*KS												0.131**
R^2	0.054	0.502	0.434	0.522	0.508	0.539	0.339	0.354	0.453	0.441	0.463	0.51
Adjustment of R^2	0.039	0.49	0.421	0.512	0.498	0.53	0.323	0.339	0.44	0.428	0.45	0.499
F	F(6,391) =3.65， P=0.002***	F(9,390) =42.627， P=0.000***	F(9,390) =32.524，P=0.000***	F(8,390) =52.079，P=0.000***	F(8,390) =49.392，P=0.000***	F(8,390) =55.905，P=0.000***	F(9, 381)=21.678，P=0.000***	F(9, 381)=23.181，P=0.000***	F(9, 381)=35.104，P=0.000***	F(9, 381)=33.402，P=0.000***	F(9, 381)=36.454，P=0.000***	F(9, 381)=44.108，P=0.000***
ΔR^2	0.054	0.448	0.406	0.22	0.177	0.122	0.339	0.354	0.453	0.441	0.463	0.51

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The hypothesized model was validated by statistical analysis of the data and the results are shown in Figure 2, It suggests that institutional pressure has had a significant positive impact on institutional pressure and businesses' corporate green innovation is positively moderated by knowledge acquisition (H2a, H2c) and that the relationship between institutional pressure and businesses' corporate green innovation is moderated by knowledge sharing (H3a, H3c),where all the hypotheses are accepted except for H3b and H4b.

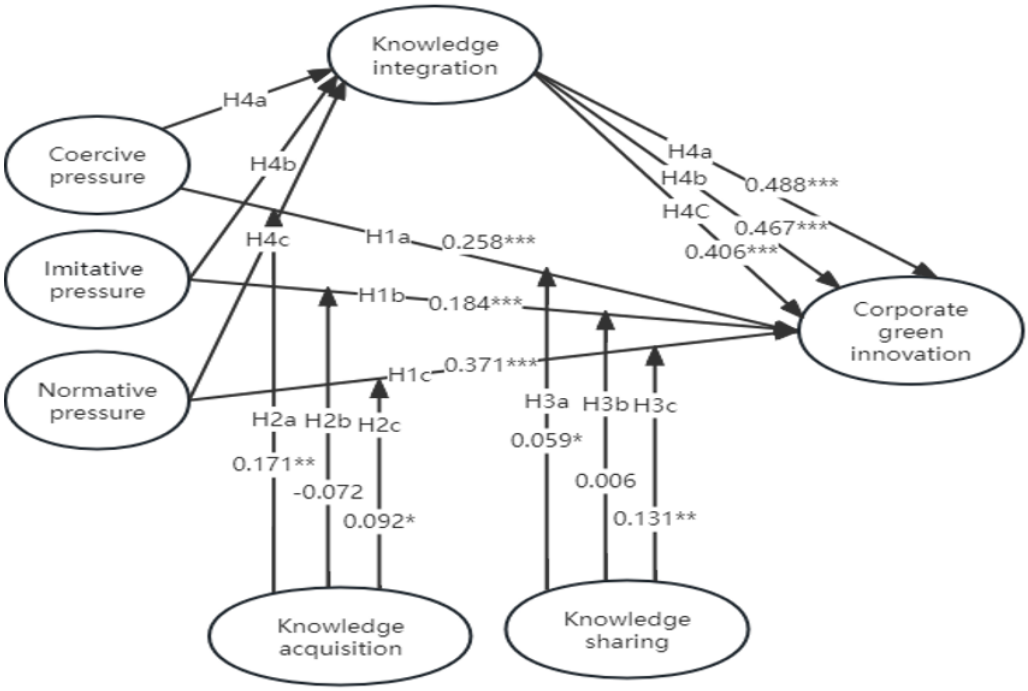

Figure 2.
Hypothesis model.

5. Conclusions

In this study, we investigate the causes and mechanisms of CGI by utilizing institutional and knowledge resource base theories' viewpoints. The results show that institutional pressure is one of corporate green innovation's most important external drivers，this is consistent with previous research(Berrone et al.,2013; Chakraborty & Chatterjee,2017; Borsatto et al.,2021). We also discovered that Knowledge acquisition and knowledge sharing positively moderated the relationship between coercive pressure, normative pressure, and corporate green innovation, but their effects on the relationship between imitative pressure and corporate green innovation were not significant. Mimicry between organizations promotes similarity in organizational processes, organizational structures, and the way of thinking of organizational members, so it can provide appropriate conditions for KM activities. However, Wang et al.(2014) argue that institutional forces lead to the creation of isomorphic pressures, which have both facilitating and inhibiting effects on knowledge exchange, especially as intra-domain differences inhibit knowledge transfer and exchange. If there are relatively large differences between organizations and organizations, although imitation behaviors between firms lead to knowledge acquisition and sharing activities, the knowledge acquired and shared is not always suitable for the green innovation development of the firm. Additionally, the findings demonstrate the mediating role of knowledge integration between institutional pressures and corporate green innovation,they somewhat supports previous research(Morant et al.,2016;Jiao H. et al.,2022).

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In an era where environmental sustainability is a global imperative, this study addresses a critical gap in understanding how institutional pressures shape corporate behavior towards green innovation, particularly in emerging economies like China. Despite a growing body of literature on corporate green innovation (CGI), the nuanced influence of institutional pressures and the mediating role of knowledge management still need to be explored. This research aims to investigate the impact of these pressures on CGI, focusing on the mediating role of knowledge integration and the moderating effects of knowledge exchange and acquisition. The study provides a novel lens to examine the mechanisms driving sustainable innovation by integrating institutional and knowledge resource-based theories. The findings offer empirical evidence and practical implications for policymakers and corporate leaders, suggesting strategies to enhance knowledge management capabilities and respond effectively to environmental demands, ultimately contributing to the broader understanding of CGI in dynamic institutional environments.

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