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Study on the Driving Path of Contractors' Low-Carbon Behavior under Institutional Logic and Technological Logic

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Abstract: Based on the analytical framework of the Theory of Planned Behavior (TPB), this paper decomposed the driving factors under institutional logic and technological logic, and empirically tested the driving path of the low-carbon behavior (LCB) of contractors from the perspective of corporate cognition. Moreover, this study further explored the differences in driving factors under different logic orientations and the formation mechanism of decoupling of heterogeneous LCB. The findings of this paper are as follows. Firstly, institutional logic and technological logic jointly drive the LCB of contractors. Perceived behavior control is not a sufficient condition. Secondly, institutional logic is more effective than technological logic in terms of the direction and coefficient of the driving path. Thirdly, institutional pressure does not directly lead to the decoupling of LCB of contractors but is mediated by intrinsic motivation. These findings provide support and help to the decision makers to cultivate and improve the level of contractors' LCB in China and many other such countries that are similarly involved.

Keywords: symbolic low-carbon behavior; substantive low-carbon behavior; institutional logic; technological logic; theory of planned behavior

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1. Introduction

The construction industry plays a key role in achieving the goal of emission peak and carbon neutrality in China, which has significant potential for reducing carbon emissions [1]. Carbon emissions during the materialization phase of buildings are short in time but high in intensity. As the main actors in implementation, contractors can contribute significantly to the promotion of energy saving and carbon emission reduction [2]. Starting from the micro perspective of the low-carbon behavior (LCB) of contractors, this study can provide effective strategic guidance for the government to regulate the LCB of construction market players. Currently, there are two main types of research around the LCB of contractors. One is to study the low-carbon behavioral evolutionary game of interest players from the perspective of environmental regulation [1,3], and the other is to empirically analyze the driving factors of LCB. It has gradually shifted from the macro-level analysis of internal and external drivers of corporate [4–6] to micro-level characteristics, such as leadership in corporate executive teams [7], or to issues such as "greenwashing" [8], to study the drivers of LCB. At this stage, the horizon of research on LCB is becoming increasingly deep.

This paper follows the second type of research. At present, there is a problem of superficiality in the LCB of contractors. It means that contractors focus on symbolic behaviors but neglect substantive behaviors to match, leading to the 'decoupling' of LCB [9]. He et al. [3], based on the new institutionalist theory, point out that the decoupling of LCB of contractors is an adaptive strategy for a specific institutional environment. New institutionalist theory emphasizes that corporates are influenced by the institutional environment formed by the legal system, social norms and cultural expectations in which they operate [10]. Corporates behave in a manner consistent with general social expectations to gain organizational legitimacy. This can effectively explain the absence of substantive behavior. However, related research assumes that corporate LCB is irrational and inefficient. As a result, corporates lack endogenous incentives. Thus, corporate motivation for LCB usually originates from exogenous institutional pressures [11]. The studies divide the relationship between institutional logic and technological logic, or legitimacy and efficiency, into a simple binary separation. Additionally, they emphasize the heterogeneous response of corporate LCB to institutional pressures only from an institutional logic, and as such the corporate's drive for intrinsic efficiency is ignored [9,12]. For example, Marquis et al. [13], in their study of Chinese corporate environmental behavior, defaulted the corporate adoption of symbolic strategies to respond to external low-carbon demands, with the degree of decoupling of LCB depending only on the level of external regulation.

In fact, there is no contradiction between implementing LCB, improving technical efficiency and gaining economic benefits, especially for contractors with high resource consumption [2]. In terms of implementation results, LCB is reflected in the effective control of carbon emissions and the reduction in the resource input–output ratio, which can effectively enhance the low-carbon competitiveness of contractors [14]. Therefore, the interpretation of LCB of contractors from the perspectives of institutional logic and technological logic can achieve the binary dialectic unity between structure and dynamism, and material and symbolic. It avoids the singularity and pattern of analysis paths [15]. Institutional logic is concerned with gaining recognition and support from a specific audience, i.e., legitimacy [16,17]. Technological logic considers efficiency enhancement and values the role of technological innovation in corporate development [18]. Both jointly construct the core path of LCB of contractors [19,20].

To summarize, this paper will adopt the analytical framework of the Theory of Planned Behavior (TPB) to empirically examine the drivers of LCB and their driving paths under institutional logic and technological logic, based on a clear understanding of the connotation of symbolic and substantive LCB of contractors. In addition, we further explore the differences in the role of drivers under different logical orientations and the mechanism of decoupling of LCB. This paper aims to explore suggestions for policies to effectively manage carbon emission reduction and energy consumption reduction in construction from the perspective of corporate cognition. It also endeavors to suggest a direction that needs special attention from government authorities, that is, the symbolic initiatives of carbon emission reduction by corporates should be regulated so that they are put into practice.

The remainder of the paper is organized as follows: Section 2 illustrates the theoretical basis and research hypothesis. Section 3 describes the research methodology and Section 4 provides the data analysis results. The implication of the study can be found in Section 5. The final section sheds light on our conclusions and limitations.

2. Theoretical Basis and Research Hypothesis

2.1. Low-Carbon Behavior of Contractors

LCB is a branch and scope extension of the behavioral control of carbon emissions in the study of corporate green behavior, which is an important part of corporate environmental behavior and reflects corporate social responsibility. Based on the definition of a low-carbon economy, corporate LCB is defined as corporate behavior related to low energy consumption, low pollution and low-carbon emissions [7]. Symbol and substance are the classic dichotomies in the field of environmental management, one denoting surface statements and the other denoting connotations. Jiang et al. [7] found through research interviews that LCB in practice also falls into these two categories. Symbolic low-carbon behavior (SYM) is flexible, low cost, produces low environmental achievement and is related to low-carbon perception, publicity and organizational operations with the aim of maintaining corporate image [21]. On the other hand, substantive low-carbon behavior (SUB) has specific data requirements and practical actions, is more costly, can significantly improve environmental achievement, and involve core business and production management [22].

It was found that such a heterogeneous classification of LCB is beneficial for governments and relevant organizations to evaluate, regulate and promote the low-carbon development of corporates in a more scientific manner [23]. Considering the special characteristics of contractors with projects as production units [24], this paper will identify project-based corporate LCB in terms of the heterogeneous characteristics of actual behaviors.

As a development of green construction, low-carbon construction refers to the contractors' behavior of reducing fossil energy consumption and improving the efficiency of energy use as a means to reduce carbon emissions, without affecting construction quality and safety [14]. There are currently two main ways to identify SUB. From the perspective of specific activities, SUB is expressed in the selection of materials and equipment, construction transport, site layout and construction process [25]. From the perspective of constituents, it is expressed in materials, techniques, equipment and energy [7]. In addition, both include the management of the implementation of low-carbon construction as an important dimension of LCB. As the perspective of constituents is more concise and effective, this paper adopts the second identification approach. Combined with semi-structured interviews with three contractor managers, the SUB of contractors was classified into five dimensions in the production process. They are green or low-carbon building materials and turnover materials, energy saving and efficient machinery and equipment, green or low-carbon construction technologies and techniques, energy efficiency and the use of clean energy, and implementation of internal low-carbon control and monitoring systems.

In terms of SYM, Zott [26] defines it as a verbal statement that is consistent with social norms but has not been implemented. Focusing on purpose and role, Zhang et al. [27] argue that symbolic behavior is a class of actions that aims to change stakeholders' impressions and have a meaning–constructing effect. Berrone and Gomez-Mejia [28] found empirically that the low-carbon governance structures of the project play a symbolic role. Zhou et al. [22] extend SYM to documented requirements, such as written low-carbon management systems, charters and other guiding measures. On the basis of the identification results of the content analysis method by Gou et al. [23], and synthesizing the above analysis, this paper divided the SYM of contractors into four dimensions in daily operations. They are management of employees, the management of a low-carbon image, documentation of low-carbon management and structure of low-carbon management. Combined with the interviews, management of low-carbon image is reflected in low-carbon public service or educational activities, promotional marketing of low-carbon production perception (experiences and practices), and stated commitments to low-carbon management goals.

2.2. Drivers of Low-Carbon Behavior of Contractors

TPB was proposed by Ajzen based on the theory of reasoned action (TRA) for explaining and predicting actual behavior from a cognitive perspective. The theory integrates various factors, including internal control and the external environment of an organization, which can reflect the dual logic of institution and technology. Therefore, it can provide a systematic analytical framework for researching LCB. TPB has been well-applied and developed in several construction studies. Chen and Ding [29] used TPB as a basis to explore the influencing factors of contractors' behavior in promoting value-added engineering projects, taking into account the value-added engineering project context. Based on TPB, Yan et al. [30] constructed an analytical model of the factors influencing contractors' performance behavior. They used grounded theory to analyze interview data, and decomposed behavioral attitudes into the attitude of perceived benefit, attitude of perceived cooperation and attitude of perceived value. Wu et al. [31] introduced variables, such as project constraints based on TPB, to predict contractors' construction and demolition waste management. It is not difficult to find that the idea of extending or decomposing TPB according to the research context is necessary and feasible for application.

TPB consists of five elements. The actual behavior of an individual or organization is directly influenced by the behavioral intention, which reflects the combined utility of the three elements of behavioral attitude, subjective norm and perceived behavioral control. Therefore, the extent to which contractors implement LCB is first and foremost governed by low-carbon behavioral intention (BI), reflecting the extent to which contractors are willing to implement LCB and put effort into it [30]. Based on the TPB analytical framework, this paper decomposed the drivers of behavioral intention to implement LCB under institutional-technological logic. The results are shown in Table 1.

Table 1. Driving factors of contractors' low-carbon behavioral intention.

Elements of TPB	Connotation of the Elements	Logical Orientation	Post-Decomposition Factors	Connotation of the Factors
Perceived behavioral control	Contractors' judgements and perceptions of the ease of implementing LCB	Technological logic	Perceived behavioral control (PBC)	Assessment of the resources and capabilities required for corporates to develop and apply new carbon reduction technologies
Behavioral attitude	Contractors' expectations and evaluation of the likelihood of low-carbon behavioral outcomes	Technological logic	Attitude of perceived benefit (BA)	The idea of LCB due to the economic incentives created by technological innovation
		Institutional logic	Attitude of perceived value (VA)	Corporate social responsibility in the pursuit of low-carbon environment
Subjective norm	Contractors' perception of the expectations of key stakeholders and the willingness of contractor to conform to their implementation of LCB	Institutional logic	Coercive institutional pressure (CP)	derived from formal systems such as laws, norms, contracts, etc., which function through regulatory legitimacy
			Normative institutional pressure (NP)	Professional codes, codes of conduct, ethics, and values set by professional bodies, the media and the public, which function through normative legitimacy
			Mimetic institutional pressure (MP)	derived from a firm's perception of the LCB of its competitors in the market, functioning through cognitive legitimacy

Specifically, contractors' attitudes towards LCB reflect their psychological assessment of the extent to which they accept LCB. On the one hand, contractor improves market competitiveness and generates economic benefits by taking the initiative to learn new knowledge, develop, acquire and apply advanced technologies and establish new construction solutions. This can lead to a positive estimation of the results of the LCB [32,33]. On the other hand, corporates are responsible environmental actors under the institutional logic. In this condition, corporates not only pursue project profits, but also value the realization of values, such as taking social responsibility and being a model for the industry [34]. Therefore, the low-carbon behavioral attitude (LBA) of contractors was decomposed into the attitude of perceived benefit (BA) and the attitude of perceived value (VA). Secondly, perceived behavioral control (PBC) of contractors refers to the adequacy of their capabilities, which is another driver that should be considered under the technological logic orientation [19]. This implies a requirement for the corporate's competence in the development and application of new technologies [33]. In this paper, technology is not a narrowly defined concept but refers to specific methods and means of reducing carbon emissions [19,33]. Thirdly, subjective norm refers to perceived stakeholder pressure on contractors to implement LCB. In addition to the perspective of stakeholders that focus on the specific target of external pressure implementation, the new institutionalist theory also provides a different perspective for examining the role of the corporate external environment. It focuses on the situations in which the pressure is manifested. Although the two perspectives are different, they are not contradictory. The institutional environment consists precisely of the norms and expectations of stakeholders, such as the government, that shape the institutional pressure (IP) on contractors. Meanwhile, it guides and constrains contractors' choice to behave in a low-carbon manner. According to Dimaggio and Powell [35], IP is classified into three types, i.e., coercive institutional pressure (CP), normative institutional pressure (NP) and mimetic institutional pressure (MP).

2.3. Research Hypothesis

2.3.1. Behavioral Attitude and Behavioral Intention

Financial reward is the primary motivation for companies as "economic agents" to adopt a proactive low-carbon behavior. Existing research suggests that contractors can reap both tangible and intangible benefits from reducing carbon emissions [2]. Tangible benefits refer to the reduction in construction costs or increase in project profits through reduced energy consumption, material savings and avoidance of financial penalties. Intangible benefits are those that are earned through technological and management innovations, which enhance project management, image and reputation. Thus, contractors can gain a sustainable competitive advantage and increase business opportunities. These economic incentives allow contractors to perceive obvious or potential benefits of LCB, driving the willingness to action [30].

In addition, the construction industry is a pillar of China's national economy. Contractors should be more proactive in taking social responsibilities, such as environmental protection. Studies on the behavior of real estate corporates in green buildings and prefabricated buildings have shown that orientations of corporate value significantly influence behavioral intention [4]. Companies with a green and low-carbon value orientation will carry out their production and operation activities under this concept, and respond to the goal of achieving emission peak and carbon neutrality promptly. It is valuable for contractors to adopt and pursue low-carbon missions as a corporate strategy. It can be seen that the attitude of perceived value influences contractors' preferences for LCB. Based on the aforementioned discussions, this research posits the following hypothesis:

Hypothesis 1 (H1). *Low-carbon behavioral attitude positively influences low-carbon behavioral intention in contractors.*

2.3.2. Perceived Behavioral Control and Behavioral Intention

Perceived behavioral control is a corporate's assessment based on resources (talent, technology, capital, materials, equipment, etc.), knowledge and capabilities (management, learning, etc.), and conditions for external help. According to the resource dependence theory, the more resources a contractor has, the more control it has to tolerate the costs of developing and implementing technological innovations and to reduce the risks of LCB [32], and the more it can "change the environment in which they operate". This determines, in part, the likelihood of behavioral achievement. Contractors will have more enthusiasm to implement LCB, where LCB is perceived to be relatively easy to achieve. Hence, the following hypothesis is developed:

Hypothesis 2 (H2). *Perceived behavioral control positively influences low-carbon behavioral intention in contractors.*

2.3.3. Behavioral Intention and Low-Carbon Behavior

TPB and the technology acceptance model (TAM) suggest that behavioral intention can effectively predict individual or organizational behavior. The relationship is stable. For example, Kurdi et al. [36] found that behavioral intention to use Quick Response (QR) codes significantly contributed to actual behavior in a study of the Indonesian restaurant consumer psychology in a new coronary pneumonia scenario. Hagger et al. [37] used meta-analytic structural equation modeling (MASEM) to verify a stable relationship between behavioral intention and behavior. Therefore, only when contractors have a positive willingness to behave in a low-carbon manner will they improve the LCB of their construction processes and project operations. In summary, we propose the following hypotheses:

Hypothesis 3a (H3a). *Low-carbon behavioral intention positively influences SYM in contractors.*

Hypothesis 3b (H3b). *Low-carbon behavioral intention positively influences SUB in contractors.*

2.3.4. Institutional Pressure and Behavioral Attitude

Liñán et al. [38] point out that subjective norms do not directly explain behavioral intention, but act indirectly through behavioral attitude. Studies on institutional pressure support this conclusion. For example, Feng [39] reported that normative and imitative institutional pressures are drivers of CSR attitudes. Shi (2022) empirically tested the mediating role of expected economic returns between institutional pressures and corporate green behavior. In addition, contractors meet the requirements of legitimacy under institutional pressure by changing their internal institutional structure, while the need for technical efficiency drives contractors to establish informal institutions to resolve the structural contradictions arising from newly established formal institutions [40]. The process of institutional internalization of the contractors will also influence the attitudes towards low-carbon behavioral decisions [10]. Accordingly, the following hypothesis is formulated.

Hypothesis 4 (H4). *Institutional pressure positively influences low-carbon behavioral attitude.*

2.3.5. Institutional Pressure and LCB

New institutionalist theory is prominent in explaining the role of institutional pressure on corporate behavior. In particular, coercive institutional pressure is a key driver of LCB in contractors, forcing a direct response [39]. It can facilitate the transformation of companies into low-carbon production management models [41]. However, binding standards based on legal systems may be difficult to achieve quickly. Therefore, normative institutional pressure is needed to build a practical atmosphere outside the corporate to guide them [42]. For example, China Construction Industry Association promotes the concept and innovation of low-carbon construction in the form of development forums. China Construction Engineering Luban Prize, which is implemented by it for selection, takes green and low-carbon construction as an important evaluation indicator. The media actively discloses comparative information on green and low-carbon contractors. The symbolic efforts of contractors struggle to meet the legitimacy requirements in the face of more targeted public complaints. Thus, normative institutional pressure can significantly enhance substantive behavior. In addition, the implementation of LCB is a source of differentiation to build a competitive advantage in a socially perceived environment. Contractors threatened by legitimacy to maintain relative legitimacy to avoid loss of competitive advantage by imitating the LCB of exemplary corporates, partners or other competitors [39]. In the current context of high environmental uncertainty, such as greater complexity of low-carbon technologies and ambiguity of objectives, contractors are more likely to imitate other corporates, with more flexible symbolic behaviors being particularly evident [35]. Hence, the following hypotheses are developed:

Hypothesis 5a (H5a). *Institutional pressure positively influences SYM.*

Hypothesis 5b (H5b). *Institutional pressure positively influences SUB.*

2.3.6. The Mediating Role of Low-Carbon Behavioral Intention

Based on TPB, behavioral intention mediates between behavioral attitude, perceived behavioral control and actual behavior. The "revisionism", represented by Poter, believes the environmental behavior will bring benefits and competitive advantages to the company. In practical projects, LCB has become an effective way for contractors to improve technical efficiency. There are many examples of low-carbon technologies or techniques that have been adopted to save resources and costs [14]. According to Schwartz's three-domain model [34], corporate ethical responsibility is also a core domain that drives behavioral intention and behavior. Therefore, the more positive the corporate attitude towards the perceived benefits and perceived value of LCB, the stronger the willingness to behave in a low-carbon manner and the greater the likelihood that it will be translated into actual behavior.

In addition, resources are a major prerequisite for corporate strategic choices in strategic management research. Buysee et al. [43] also found that corporates need resources and capabilities to match if they are to move to higher levels of proactive LCB. A contractor's judgement and perception of its implementation conditions play a major role in the performance of LCB. The stronger the self-efficacy, the more robust its efforts, and the higher the level of decarbonization. In summary, the following hypotheses are proposed.

Hypothesis 6a (H6a). *Low-carbon behavioral intention mediates between low-carbon behavioral attitudes and SYM.*

Hypothesis 6b (H6b). *Low-carbon behavioral intention mediates between low-carbon behavioral attitudes and SUB.*

Hypothesis 7a (H7a). *Low-carbon behavioral intention mediates between perceived behavioral control and SYM.*

Hypothesis 7b (H7b). *Low-carbon behavioral intention mediates between perceived behavioral control and SUB.*

2.3.7. The Mediating Role of Low-Carbon Behavioral Attitude

Bansal et al. [44] suggest that corporate perceptions of external institutional pressure first influence their own perceptions of LCB, and then shape their rational motivations and actual behavior accordingly. Stronger institutional pressure can help improve contractors' perception of low-carbon values. Conversely, it can create a lack of legitimacy, leading corporate to avoid taking social responsibility and manipulating the institutional environment [22]. As government regulations and social norms become more stringent, construction companies are becoming aware that adhering to low-carbon standards will enable them to better survive and thrive in the organizational arena and get a head start on low-carbon issues. Therefore, the stronger the external institutional pressure, the more positive the attitude towards LCB of contractors, the stronger the incentive to align with external requirements, and then greater the incentive for actual LCB to emerge. Accordingly, the following hypotheses are formulated.

Hypothesis 8 (H8). *Low-carbon behavioral attitude mediates between institutional pressure and low-carbon behavioral intention.*

Hypothesis 9a (H9a). *Low-carbon behavioral attitude and low-carbon behavioral intention mediate between institutional pressure and SYM.*

Hypothesis 9b (H9b). *Low-carbon behavioral attitude and low-carbon behavioral intention mediate between institutional pressure and SUB.*

In summary, with the help of the TPB analytical framework, the theoretical model of this paper is proposed based on the perspective of institutional-technological binary logic, as shown in Figure 1.

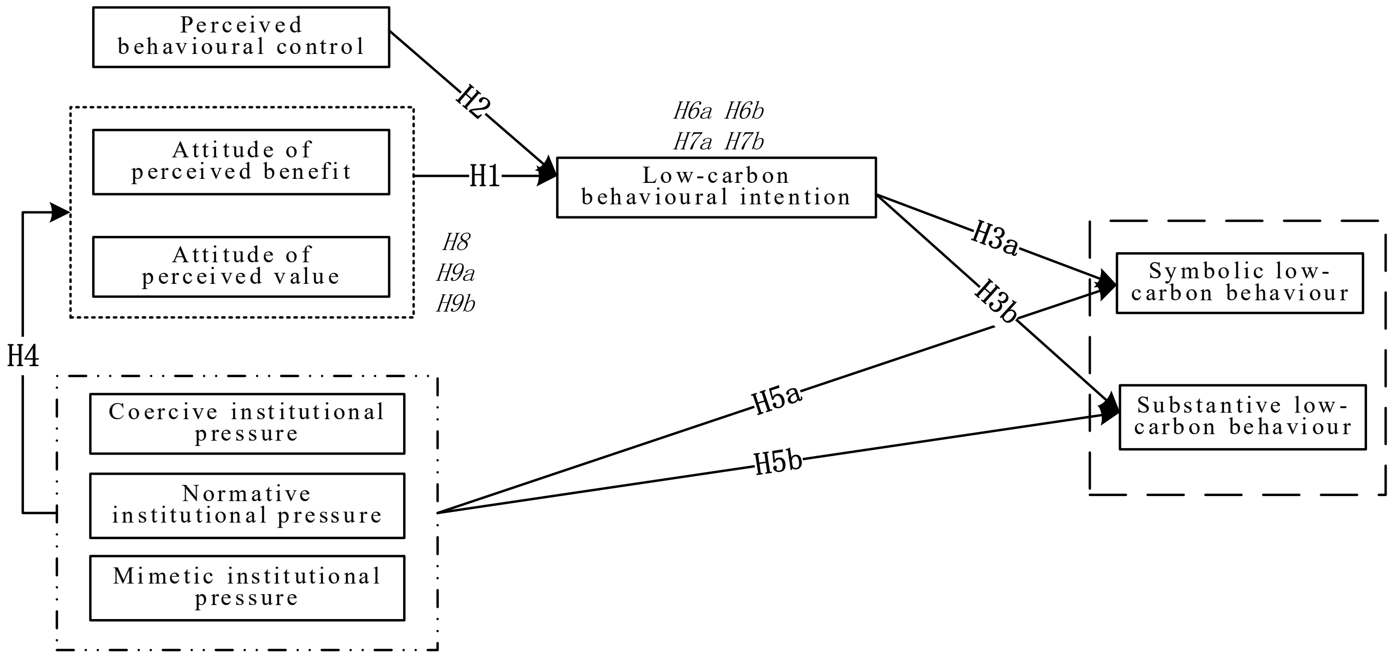

Figure 1. Theoretical model framework.

3. Methodology

3.1. Questionnaire Design and Data Sampling

A questionnaire was used to collect relevant data and was administered to the managers of contractors and their projects in all regions of the country from October 2021 to May 2022. A total of 205 questionnaires were distributed and returned in a variety of formats. Another87 were collected again using a snowball approach, for a total of 292. After eliminating questionnaires that were incomplete, incorrectly selected screening questions, had obvious patterns and were too neutral, 173 valid questionnaires were eventually obtained, for a valid return rate of 59.2%. This study used partial least squares structural equation modeling (PLS-SEM) for data analysis and hypothesis testing. The minimum sample size, as recommended by Hair [45], was 10 times the number of paths of the latent variable with the largest number of influenced paths. The minimum threshold for sample size in this paper was 110, so the data met the analysis requirements. The sample characteristics are described in Table 2. The distribution shows that the questionnaire data is well-represented.

3.2. Measurement of Variables

Although TPB gives principles for the design of each variable question item, it also points out that the connotation and composition of the elements vary in different areas of behavioral research [30]. Therefore, this paper is guided by the principles of TPB scale setting by drawing on scales of relevant concepts in the literature, setting questions in the context of LCB research in contractors, and modifying through interviews. Each description of measurement items is shown in Table 3. LBA, IP and LCB are second-order latent variables. The questionnaire was scored on a 5-point Likert scale, ranging from strongly disagree to strongly agree, with higher scores indicating higher levels of agreement.

Table 2. Descriptive statistical results of sample characteristics (N = 173).

Characteristics of Sample	Category	Number	Percentage/%	Characteristics of Sample	Category	Number	Percentage/%
Gender	Male	126	73	Corporate ownership	State-owned	80	46
	Female	47	27		Non-state-owned	93	54
Age (Year)	≤25	31	18	Type of project territory	Rural areas and counties	52	30
	26–30	42	24				
	31–40	50	29		Small and medium-sized cities	48	28
	41–50	40	23				
	>50	10	6				
Academic qualification	Postgraduate and below	29	17		Large cities	73	42
	Undergraduate	88	51	Project territory	Eastern China	78	45
	Master	36	21		South China	12	7
	PhD	10	6		Central China	14	8
Experience of working (Year)	≤5	36	21		North China	33	19
	6–10	42	24		Northwest China	14	8
	11–15	26	15		Southwest China	9	5
	16–20	22	13		Northeast China	10	6
	>20	47	27		Hong Kong, Macau and Taiwan	2	1
Level of Management	Middle and senior management	48	28		Overseas countries	2	1
	Grassroots managers	57	33	Type of project	Housing engineering	88	51
	Professional and technical staff	28	16		Municipal and public works	31	18
	General staff	40	23		Water resources, electricity engineering	36	21
General contracting qualification	Special grade	90	52		Road, bridge, port and navigation works	17	10
	Grade 1	64	37	Project size	Small-scale projects	42	24
	Grade 2	17	10		Medium-scale projects	31	18
	Grade 3	5	3		Large-scale projects	100	58

Table 3. Measurement of variables and reliability and validity analysis results (N = 173).

Latent Variables		Numbers of Items	Description of Measurement Items	Key Source(s)	CR	Cronbach's Alpha	AVE
Second-Order	First-Order						
LBA	BA	BA1	Reduce material and energy consumption, thus reducing costs	Banerjee [46]	0.920	0.884	0.742
		BA2	Improve project management and thus increasing profits				
		BA3	Enhance corporate image and reputation				
		BA4	Expand the construction market, thus increase the chances of winning tenders				
	VA	VA1	Have a responsibility and a mission to reduce carbon emissions	Yan [30]	0.947	0.916	0.857
		VA2	Gain a sense of achievement and honor				
		VA3	In line with the direction of business development				
/	PBC	PBC1	Availability of resources, knowledge and competence	Beck [47]; Taylor [48]	0.896	0.827	0.742
		PBC2	Able to implement LCB				
		PBC3	Easy to implement LCB				
		PBC4	With policy support such as financial incentives and tax subsidies				
		PBC5	Suppliers are environmentally friendly.				

Table 3. *Cont.*

Latent Variables		Numbers of Items	Description of Measurement Items	Key Source(s)	CR	Cronbach's Alpha	AVE
Second-Order	First-Order						
IP	CP	CP1	National laws and regulations, standard specification requirements	Zhu [49]; Feng [39]; Teo [50]	0.927	0.898	0.760
		CP2	Legal and regulatory requirements of the project site				
		CP3	Government regulation and penalties for carbon reduction				
		CP4	Low-carbon requirements for employer				
	NP	NP1	Guidance from non-governmental organizations such as trade associations	Zhu [49]; Boiral [51]	0.795	0.655	0.571
		NP2	Press monitoring by the media				
		NP3	Low-carbon awareness and demand from the public (including the project's local community)				
	MP	MP1	Level of implementation by other contractors	Teo [50]; Giblin [52]	0.920	0.869	0.792
		MP2	Benefits of implementation for other contractors (practical effects)				
		MP3	Implementation benefits for other contractors (industry reputation)				
/	BI	BI1	Intention at the beginning	Zheng [53]	0.941	0.905	0.841
		BI2	Intention for the future				
		BI3	Intention to continue				
LCB	SYM	SYM1	Low-carbon concepts	Zhou [22]; Gou [15]; Jiang [7]	0.936	0.917	0.713
		SYM2	Low-carbon public service or educational activities				
		SYM3	Promotion of low-carbon production ideas, experience and practices				
		SYM4	Stated commitment to low-carbon management objectives				
		SYM5	Governing documents for carbon emission reduction				
		SYM6	Management structure for carbon emission reduction				
		SYM7	Carbon emission reduction training for staff				
	SUB	SUB1	Low-carbon building materials and swing materials	Zhang [5]	0.858	0.805	0.681
		SUB2	Energy-efficient machinery and equipment				
		SUB3	Low-carbon construction techniques and technologies				
		SUB4	Energy efficiency				
		SUB5	Proportion of clean energy used				
		SUB6	Implementing an internal low-carbon control and monitoring system				

In addition, this paper selected corporate characteristics and project characteristics as control variables. They are general contracting qualification, nature of business, type of project territory, type of project and project size. Then, they were virtualized separately. For example, 1 indicates a non-state-owned corporate and 0 indicates a state-owned corporate.

A small sample was pre-tested before the questionnaire was formally distributed. A total of 61 questionnaires were returned after being completed by the contractors' managers, of which 50 were valid. Cronbach's alpha and correlation coefficient of indicators (CITC) in SPSS 26.0 were used for reliability analysis. Exploratory factor analysis (EFA) was used for validity testing. The results showed that Cronbach's alpha of each latent variable was greater than 0.7 and the CITC was greater than 0.5. The items corresponding to the principal factors with eigenvalues greater than 1 extracted by the principal component analysis were all consistent with the scale item settings, indicating that the questionnaire was well set up.

4. Data Analysis

4.1. Reliability Analysis and Validity Analysis

The reliability and validity of the measurement model were tested using SPSS 26.0. Firstly, the validation factor analysis showed that the loadings of each factor were greater than 0.65 and could be tested in the next step. The consistency of the questions within the factors was then measured. Cronbach's alpha for each factor was greater than 0.7, indicating that the scale had good reliability. A validity analysis was then conducted. The validity analysis was divided into convergent validity and discriminant validity. In the model, the average variance extracted (AVE) for each factor was greater than 0.5 and the composite reliability (CR) was greater than 0.6, indicating good convergent validity of the measurement model (see Table 3 for the results of these tests). Finally, discriminant validity was analyzed using the Fornell–Larcker criterion [54]. The AVE square root of the first-order latent variables should be greater than the Pearson correlation coefficient between the variable and the other variables, as shown in Table 4, and the differential validity is satisfied.

Table 4. Square root of AVE and correlation coefficient between variables (N = 173).

	1	2	3	4	5	6	7	8	9	10	11	12	13	14
General Contracting Qualification														
Corporate ownership	−0.089													
Type of project territory	0.082	0.009												
Type of project	0.118	−0.208 *	−0.036											
Project size	0.390 **	−0.036	0.441 **	0.062										
LBA	0.029	−0.230	0.268 *	0.144	0.330 **	**0.862**								
VA	0.232 **	−0.206 *	0.196	0.247 *	0.163	0.830	**0.926**							
PBC	0.156 *	−0.210 *	0.160	0.144	0.129 *	0.612	0.398	**0.862**						
CP	0.204 *	−0.280 *	0.254 **	0.137	0.219 **	0.462	0.414	0.666	**0.872**					
NP	0.19	−0.268 *	0.245 *	0.189	0.152 *	0.331	0.608	0.507	0.527	**0.756**				
MI	0.204 *	−0.176	0.058	0.216	0.065	0.306	0.618	0.511	0.445	0.607	**0.89**			
BI	0.125 *	−0.241	0.236 **	0.142	0.212 **	0.535	0.615	0.659	0.564	0.599	0.557	**0.917**		
SYM	0.217 *	−0.121 *	0.205	0.075	0.152	0.303	0.483	0.316	0.426	0.579	0.486	0.409	**0.844**	
SUB	0.314 *	−0.019	0.175 *	0.129 *	0.174 *	0.441	0.421	0.395	0.498	0.591	0.404	0.433	0.744	**0.762**

Notes: (1) The diagonal line is the AVE square root value, and below the diagonal line is the correlation coefficient; (2) * and ** indicate that the correlation coefficients are significant at the statistical level of 0.05 and 0.01, respectively, and the correlation coefficients between the first-order latent variables are all significant at the statistical level of 0.01, so they are not shown in the table.

4.2. Common Method Bias Test

In this paper, the Harman one-way test was used to check for common method bias. All question items were subjected to common factor extraction. A total of nine principal component factors, with initial eigenvalues greater than one were obtained, which were consistent with the structure of the scale. The explained variance of the first factor before rotation was 33.89%, which did not reach the judgement criterion of 40%, indicating that the problem of common method bias was not serious.

4.3. Hypothesis Testing

Firstly, a structural model fit test was conducted. The main evaluation indicator of structural goodness of fit in PLS-SEM is the amount of explainable variance (R^2) in the endogenous structure. In this study, the R^2 values for SYM, SUB, LCB and BI were 0.608, 0.658, 0.660 and 0.760, respectively, indicating that the model has a good explanatory power [55]. Secondly, the cross-validated redundancy (Q^2) for the above variables, calculated using the Blindfolding Procedure were 0.454, 0.458, 0.586 and 0.691, respectively, which are all greater than 0, indicating that the model has good predictive power. Finally, the absolute goodness-of-fit index, standardized residual mean root (SRMR), was calculated to be 0.066, which is less than the judgement criterion of 0.08, indicating that the model fits well [56].

The paper uses Smart-PLS 3.0 to calculate the path coefficients and test their significance, using the Bootstrapping method with 5000 samples. The results of the direct effect test are shown in Figure 2, after controlling variables of corporate characteristics and project characteristics. The results of the mediating effect test are shown in Table 5 which indicate that the path coefficient is significant if the 95% confidence interval does not contain 0.

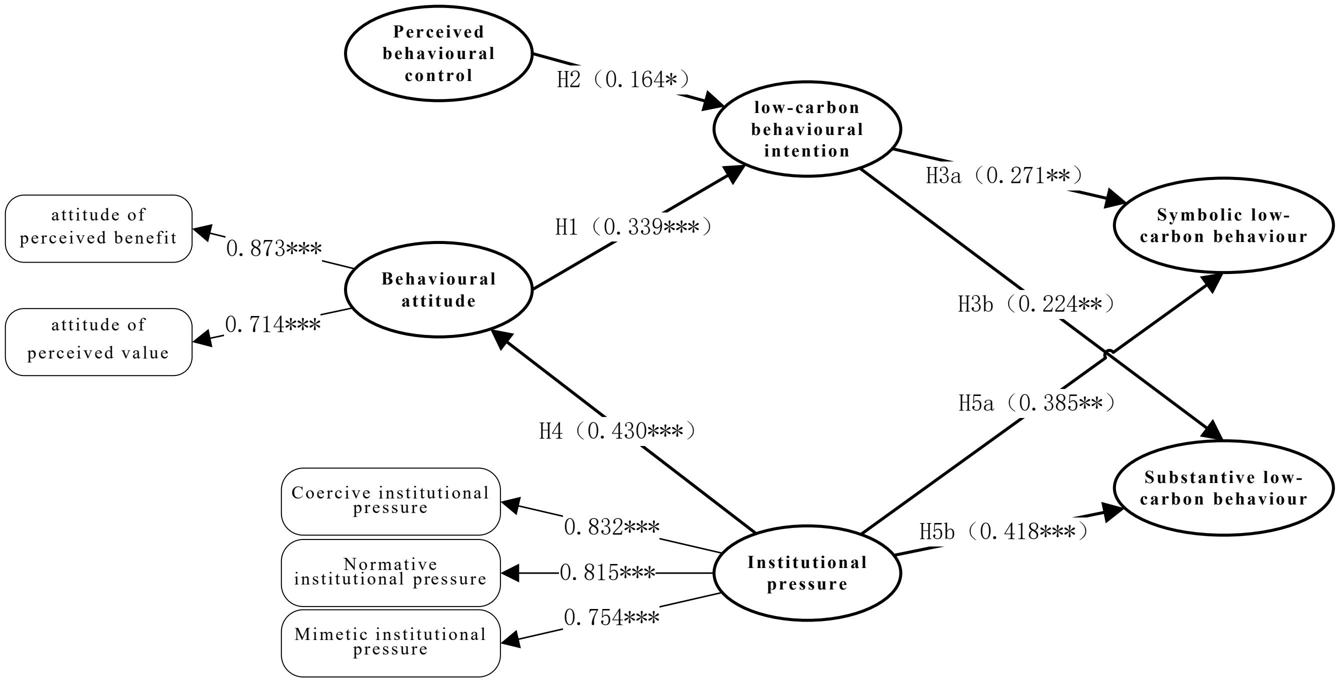

Figure 2. Test results of direct action (N = 173). Note: *, ** and *** indicate that the correlation coefficients are statistically significant at the 0.05, 0.01 and 0.001 levels, respectively.

Table 5. Mediation test results (N = 173).

Hypothetical Relationships	Description of Path	Path Coefficient	95% Confidence Interval		Comment
			Upper-Bound	Lower-Bound	
H6a	LBA→BI→SYM	0.091 **	0.009	0.173	Significant
H6b	LBA→BI→SUB	0.076 **	0.007	0.158	Significant
H7a	PBC→BI→SYM	0.092	−0.001	0.251	Not Significant
H7b	PBC→BI→SUB	0.044	−0.015	0.041	Not Significant
H8	IP→LBA→BI	0.146 ***	0.016	0.298	Significant
H9a	IP→LBA→BI→SYM	0.056 **	0.004	0.194	Significant
H9b	IP→LBA→BI→SUB	0.033 *	0.002	0.103	Significant

Note: *, ** and *** indicate that the correlation coefficients are statistically significant at the 0.05, 0.01 and 0.001 levels, respectively.

4.3.1. Direct Effect Tests

The results of the direct effects test are shown in Figure 2. β is denoted as the path coefficient. P implies the significance of the path coefficient. *, ** and *** indicate significance at the statistical level of 0.05, 0.01 and 0.001, respectively. Firstly, LBA and PBC significantly contribute to BI. The data results show that the path coefficient between LBA and BI was β = 0.339 ($p < 0.001$), supporting hypothesis H1. Comparing the first-order factor loadings of LBA, the effect of BA under technological logic orientation was greater than VA under institutional logic orientation, indicating that corporate evaluation of low-carbon behavioral outcomes favors the benefits of increased technological efficiency. PBC is another driver under the technological logic orientation. The path coefficient between PBC and BI was β = 0.164 ($p < 0.05$), supporting hypothesis H2.

Secondly, IP significantly contributes to LBA and LCB. The path coefficient between IP and LBA was β = 0.43 ($p < 0.001$), supporting hypothesis H4. Meanwhile, the data showed that the path coefficients of IP directly acting on SYM and SUB were 0.385 ($p < 0.01$) and 0.418 ($p < 0.001$), respectively, supporting hypotheses H5a and H5b. The results indicated that institutional environmental pressure can affect both the LBA of contractors and directly cause passive responses from corporates due to the different effects of multiple institutional pressures [39]. Comparing the first-order factor loadings of institutional pressure, this paper revealed that coercive pressure has the strongest effect and mimetic pressure the weakest. This is because the role of mimetic mechanisms is only more pronounced when LCB becomes the practice and rule [42].

Thirdly, BI significantly contributes to LCB. Hypothesis H3a and H3b were supported by path coefficients β of 0.271 ($p < 0.01$) and 0.224 ($p < 0.01$) for the effect of BI on SYM and SUB. The study by Yan [30] also supports this finding. In the field of construction engineering, the behavioral intention has a direct driving effect on actual behavior. Contractors are motivated to implement LCB when the organization believes from within that improving low-carbon levels is beneficial to the organization and is willing to implement it.

4.3.2. Mediating Effect Test

The results of the mediating effect test are shown in Table 5. The mediating effects of BI between LBA and SYM and SUB were 0.091 and 0.076, respectively, both significant at the 0.01 level, and with 95% confidence intervals not containing 0, supporting hypothesis H6a and H6b. This suggests that contractors are concerned with the issue of whether adopting LCB is profitable, and also have an intrinsic motivation to take social responsibility, which is an effective entry point to enhance the willingness and performance of LCB [2].

Secondly, the results show that hypotheses H7a and H7b are not supported, i.e., that PBC is effective in promoting a willingness to adopt LCB, but is not significant in enhancing LCB. This result is consistent with the findings of Zhou et al. [57], where corporates with dynamic capabilities have the willingness to change but do not necessarily translate into positive behavior. The reason for this may be that most contractors do not recognize the importance and value of LCB. Therefore, they lack the motivation to pursue long-term performance due to short-term cost concerns and risk–loss aversion [32]. In summary, strong corporate resource capacity is not a sufficient condition for implementing LCB.

Thirdly, LBA mediates between IP and BI. LBA and BI play a chain mediating role between IP and LCB, with path coefficients that are both significant and have 95% confidence intervals that do not contain 0. Hypotheses H8, H9a and H9b are supported. This is consistent with the findings of Gou et al. [15], who found that corporates have cognitive flexibility. Institutional changes often cause dramatic shifts in the behavior and cognition of contractors within the field. In the face of changes in the external environment, contractors identify and make judgments based on their empirical knowledge, examine the situation, and thus make changes, such as optimizing resource allocation or even transforming and upgrading.

4.4. Analysis of Pathway Differences

To further assess the significance of the differential results of drivers acting on heterogeneous LCB, this paper used Cohen's T-test [58] to compare the path coefficients of different driver pathways. On the one hand, the significance of the difference in the path coefficients of the same driver acting on heterogeneous LCB was estimated, referred to as Group A, to explore the formation mechanism of decoupling of LCB. On the other hand, the significance of the difference in the path coefficients of different drivers acting on the same LCB was estimated, referred to as Group B, to examine the difference in the role of factors under different orientations of institutional logic and technological logic. The results are presented in Table 6.

Table 6. Comparison results of path coefficients (N = 173).

Groups	Description of Path	Comparison	T-Value	Conclusion
Group A	P1: LBA→BI→SYM P2: LBA→BI→SUB	P1 vs. P2	2.124 *	P1 > P2
	P3: IP→SYM P4: IP→SUB	P3 vs. P4	−1.092 (ns)	P3 = P4
	P5: IP→LBA→BI→SYM P6: IP→LBA→BI→SUB	P5 vs. P6	1.994 *	P5 > P6
Group B	P1: LBA→BI→SYM P3: IP→SYM	P1 vs. P3	−3.342 ***	P1 < P3
	P2: LBA→BI→SUB P4: IP→SUB	P2 vs. P4	−4.763 ***	P2 < P4

Note: * and *** indicate that the correlation coefficients are statistically significant at the 0.05 and 0.001 levels, respectively.

Based on the results of Group A, LBA can significantly promote both SYM and SUB, through the mediation of behavioral intention, but P1 > P2, and T-test analysis shows that the difference between the two paths coefficients is more significant, indicating that contractors themselves prefer to obtain benefits and realize value through symbolic behavior. The reason for this is that corporates have less input to implement symbolic behavior, but can also appropriate the benefits gained from substantive behavior [19]. In addition, the mean values of SYM and SUB in contractors were 3.87 and 3.54, respectively, which were significantly different when using independent samples T-test, again supporting this finding.

Moreover, IP significantly promotes both SYM and SUB, but the difference in effect between the two is not significant at P3 = P4. Although the results suggest that IP achieves a coupling of symbolic and SUB, the combination of interviews suggests that this may be due to the low level of IP on LCB, currently perceived by contractors. For example, mandatory government rules are within the reach of contractors, the social low-carbon climate has not created practical constraints on contractors, and there is a lack of emphasis on low-carbon competition within the industry.

In addition, the comparative results of P5 and P6 show that IP mediated by intrinsic motivation has a significantly greater effect on promoting symbolic than substantive behavior. This supports the conclusion of many scholars, such as Haque and Ntim [59] and Yao et al. [8], that symbolic behavior requires only short-term impression management and is a priority strategy for corporates. In particular, contractors who are unable to perceive low-carbon benefits in a timely manner or have deficient resource capacity are more inclined to passively avoid institutional pressure, adopt symbolic behavior to distract stakeholders and achieve social legitimacy.

Based on the results of Group B, both IP and LBA significantly promote both types of LCB, but P1 < P3 and P2 < P4. The path coefficients differ significantly. This indicates that the promotion effect of IP dominates both SYM and SUB, i.e., LCB require constraints from the external environment and have not yet become a product of economically rational considerations such as cost–benefit analysis of corporates [9]. Taking into account both legitimacy and efficiency, the current logic of LCB of contractors is in the mode of "having to do, but not worth doing" [42]. The role of market mechanisms needs to be brought into play.

5. Implication of the Study

This study has several theoretical implications. First, we create the constructs of SYM and SUB of contractors based on theoretical analysis and semi-structured interviews, reflecting the connotation of heterogeneous LCB, breaking through the limitations of measuring corporate environmental behavior with a single indicator. This study helps scholars to explore the drivers of different corporate LCB, as well as the impact of different behaviors on corporate low-carbon achievements, and promote research on corporate

LCB to develop further. Second, the study integrates TPB with the logic of corporate behaviors, providing the corporate cognitive perspective for examining the decision making of heterogeneous LCB of contractors. At the same time, it improves the explanatory power of TPB for corporate LCB and expands the research boundary of TPB applied to organizational behavior. Third, this study enriches the research on the driving paths of LCB under the institutional logic and the technological logic. The findings demonstrate the value of technical efficiency in promoting corporate willingness to implement LCB, break through the limitations of available research on corporate LCB under institutional logic, and fill the gap in the application of new institutionalist theory to the study of corporate behavior. In addition, this study provides an empirical test of the mechanism of the formation of differences in the role of drivers, and decoupling of LCB under institutional logic and technological logic.

The study also has practical implications. First, government regulators and construction units should pay attention to distinguishing the low-carbon behavioral performance of contractors. Studies have shown that process-oriented environmental behaviors of corporates under government environmental regulation are symbolic and cannot effectively enhance environmental management performance [60]. Similarly, the LCB of contractors in response to external low-carbon demands, as expressed in management of employee, management of low-carbon image, documentation of low-carbon management and structure of low-carbon management, are process-oriented SYM, which are symbolic expressions of SUB. Therefore, government supervisory departments and construction units should pay more attention to whether corporates fulfil the corresponding commitments. The functional role of the governing documents and regulatory bodies should be exercised, as well as the monitoring of substantive results-oriented behavior in production processes involving equipment, materials, energy use and technical processes.

Second, the current institutional pressure on contractors are important drivers for implementing LCB. Systems, such as penalties and taxes, can increase the cost of legality for contractors and inhibit decoupling behavior in low-carbon construction [3], but there is still a problem of low institutional pressure. Therefore, in terms of mandatory institutional pressure, government departments should first measure the level of low-carbon construction in the country. Then, they can gradually clarify the low-carbon construction requirements in the form of policies, legal norms, standards and other documents, and establish the relevant basis for penalties [8]. In addition, they can establish a management capacity that is commensurate with the level of low-carbon construction, set up dedicated staff for low-carbon construction supervision, and develop training programs to strengthen the practice capacity. Moreover, they also can establish a market platform for carbon trading in contractors as well as a carbon trading supervision and feedback mechanism, and promote the internalization of the external costs of carbon emissions. In terms of normative institutional pressure, they should strictly disclose the list of defaulters to increase the exposure of corporates to social norms and increase the cost of decoupling camouflage [3], standardize green and low-carbon construction certification to enhance the reliability of transmitted information so that the regulatory cost of monitoring is reduced, and carry out green and low-carbon education to increase the supervision of social opinion. In mimetic institutional pressure, substantive communication between contractors is promoted through technical network cooperation and other means.

Third, the key driver of the technological orientation is the attitude of perceived benefit, which is also a key factor in the formation of decoupling. Therefore, enhancing the performance of LCB of contractors lies not only in strengthening the institutional environmental pressure and its regulation, but also in improving the perceived benefits of corporates in the technological environment and strengthening the economic incentives for low-carbon construction. In terms of explicit incentives, the government should regulate and encourage the development of markets for green building materials, energy-efficient equipment and low-carbon technologies, develop economic incentive policies to compensate corporates for the initial high costs of purchasing new low-carbon products. These steps can raise expectations of the economic and control capacity of corporates to implement LCB. In terms of implicit incentives, the government should help benchmarking companies to leverage the benefits of low-carbon brands and provide good reputation incentives. In addition, contractors should properly understand the impact of symbolic behavior. While symbolic practices do not consume significant financial resources, the economic benefits they can translate into in terms of enhancing their low-carbon image and reputation are very limited [60]. Seeking sustainable rates of return from substantive behavior is the key to long-term corporate development.

6. Conclusions and Limitations

Through empirical analysis, this paper has examined the drivers of LCB in contractors and their driving paths under the institutional-technological dual logic, and further explored the differences in the role of drivers under different logical orientations, as well as the formation mechanism of decoupling of LCB. The main research findings are as follows.

Perceived behavioral control can enhance contractors' willingness to engage in LCB, but is not a sufficient condition for implementing LCB. Therefore, only the attitude of perceived benefit contributes to actual behavior under a technological orientation. The results of the analysis of path differences suggest that decoupled low-carbon behavioral attitude exists in corporates. The first-order factor loadings of low-carbon behavioral attitude reveal that corporate evaluation of LCB is mainly influenced by perceived benefit. That is, contractors perceive that the benefits gained from SYM are greater than those from substantive behavior, leading to a tendency to decouple.

In addition, institutional logic is the main driver of LCB in current contractors, with a total effect of 0.892. In terms of the direction of the drive path, institutional pressure can act both directly on actual behavior and indirectly by influencing corporate perceptions. In terms of the drive path coefficients, the effect of institutional pressure on actual LCB is both more significant than the effect of the drivers under the technological logic. Moreover, the direct effect of institutional pressure does not lead to a decoupling of symbolic and substantive behavior, possibly due to the current low level of institutional pressure on LCB. In contrast, differences in the indirect drive paths of institutional pressure suggest that there is a tendency for corporates to decouple by responding to institutional pressure with symbolic strategies, mediated by intrinsic motivation. Therefore, only the simultaneous evolution of the drivers in the institutional-technological dual logic can lead to a stronger determination of purpose to improve environmental performance and avoid the tendency to formalize LCB [61]. This means that contractors see LCB as a way to improve organizational efficiency and economic effectiveness, while gaining legitimacy.

This paper presents an empirical study of the pathways driving the LCB of contractors. It provides an important reference for enhancing performance of corporate LCB in the context of low-carbon economy. However, there are shortcomings in the study, which can be improved in two aspects in the follow-up. Firstly, LCB of contractors has significant project-based characteristics, which is confirmed by the correlation coefficients and significance of the variables in this paper, but the specific differentiation of the drivers on the control variables has not been further analyzed due to space constraints. Secondly, some studies have shown that SYM and SUB are statistically correlated, but whether there is a causal relationship between the two needs to be further examined [7].

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