GBMR

Global Business and Management Research: An International Journal
Vol. 15, No. 3s (2023)

Analysis of Factors for Sustainable Supply Chain Management of Construction Materials: A Case of Housing Construction in Wuhan, China

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Abstract
Purpose: Construction companies in Wuhan, China, are not yet fully engaged in green supply chain management. Therefore, the aim of the study is to identify the key factors influencing the sustainable supply chain management of construction materials through a professional quantitative and qualitative analysis. The difference in this research is the study of the influencing factors of construction materials and the combination of sustainability management and supply chain management. The gap of this study: few literatures have studied the factors affecting the sustainable supply chain of cities in central China. At the same time, the sustainability of supply chain rarely exists in construction materials.
Design/methodology/approach: The paper presents a new approach to hierarchical analysis in a new environment. The proposed approach introduces a model under a real construction project which analyses the factors influencing the green supply chain of construction materials. It can help construction companies to find the key factors.
Findings: The results of the study show that the key elements of the impact of sustainable construction materials can help construction companies to increase construction efficiency.
Research limitations/implications: The paper presents a future research agenda for sustainable supply chain management of construction materials and uses Wuhan housing construction as a case study. This study also presents the influencing factors of sustainable supply chain management of construction materials.
Practical implications: This research provides key elements for sustainable supply chain management in project management.
Originality/value: Construction companies can reduce construction costs and improve their efficiency based on a combination of their internal environment and key sustainable supply chain management factors.

Keywords: Construction project management, Construction materials, Sustainable management, Sustainable supply chain management

Classification: Research paper

1. Introduction

1.1 Background

Supply chain management (SCM) has been an integral part of business development since the 19th century. The development of the global economy has led to the construction of houses and buildings, and the supply chain and sustainable management of construction materials are particularly important in the construction process. In addition, SCM is also seeking a new direction of green and sustainable management, hence the emergence of sustainable supply chain management (SSCM). Due to the rise of real estate in China and the increasing number of houses each year, it is vital that construction materials are able to apply SSCM. Especially

in recent years, some construction enterprises in Wuhan, China have forgotten the importance of sustainable project management in the rapid development of projects, leading to the increasing importance of a sustainable supply chain. At present, sustainable supply chain management has become an important goal for construction enterprises in material management (Harouache et al., 2021), and the study of SSCM factors affecting the construction materials of construction enterprises is the most important, which is conducive to construction enterprises to reduce costs to obtain more profits and win the future.

The different and innovative aspects of the study as following. Firstly, the innovation of this study is that it is not just a theoretical study but tends to be a supply chain management study of actual engineering projects, while the study incorporates the new market environment of sustainable construction in China. Secondly, sustainable supply chain management is different from general supply chain management in that this paper is a new application of the combination of construction material supply chain and sustainable construction.

1.2 SSCM in the Construction Management Industry

The current increasing demand for sustainable materials in the construction sector and the rapid growth of the construction industry achieved by SSCM have contributed to the development of construction companies (Wibowo et al., 2018). In Latin America, SSCM can contribute to environmental and economic development. The normative use of SSCM is instrumental (Gold et al., 2017). It is clear that research conducted in Latin America can bring relevant and potential contributions to the understanding of SCS, and Wang et al. (2013) shows in their study that the USA is also one of the countries that relatively uses SSCM in construction materials (Wang & Sarkis, 2013). In Europe, the European Union (EU) considers sustainable development an influential issue. And SSCM has become an integral part of materials management in construction (Wibowo et al., 2018). In Asia, where the main initiative for companies to implement sustainability is the desire to promote the environment and the competitiveness of construction companies themselves, SSCM of materials for construction companies plays an important role (Esfahbodi et al., 2016). Chinese construction companies integrate SSCM in construction materials with the economic and environmental performance of each company (Wang & Dai, 2018). In summary, SSCM in construction materials has been widely used in various countries around the world.

The study utilizes a combination of qualitative and quantitative methods to analyse the influencing factors of SSCM for construction materials in housing construction. In order to provide new ideas in the SSCM of construction companies, research objectives are presented as follows:

1.2.1 To identify the Influencing Factors of SSCM for Construction Materials

1.2.2 To Analyze the Key Factors of SSCM for Construction Materials

1.2.3 To Propose Recommendations Suitable for SSCM in Construction Companies

2. Literature Review

In this section, the factors affecting the sustainability of construction materials of construction units have become the object of this research, through literature reading and analysis, the thesis will first review the relevant literature on sustainable supply chains for construction materials and housing construction, including definitions, barriers and developed strategies for sustainable management. By studying these factors，these elements contribute to this study of the factors influencing sustainable supply chains for construction materials.

2.1 Supply Chain Management and Sustainable Supply Chain Management

Moshood et al. (2021) and Yu et al. (2022) have been described the fact that both SCM and SSCM are interrelated, and that the difference with traditional SCM is that SSCM is able to address more green construction materials, so sustainability is gradually producing value for the business (Table 1). Secondly, globalized climate warming and environmental destruction have forced people to start thinking about whether the economic activities of the present are justified (Baldwin & Freeman, 2021). Wieland et al. (2021) describes in the literature that supply chain management as a basic product management tool is not able to adapt to environmental and social changes and that sustainable supply chain management can transform traditional management thinking, reduce waste of resources and lower the operating costs of materials in construction companies. GSCM is a management initiative to minimize and eliminate waste, energy, hazards and emissions with the help of the supply chain (Mojumder & Singh, 2021).

Table 1: Supply chain management versus sustainable supply chain management

Name	Definition	Author/Researcher
SCM	The management of products or flows, and also includes logistics, materials and goods.	Moshood et al. (2021)
		Yu et al. (2022)
SSCM	The strategic, transparent integration and achievement of an organization.	Baldwin & Freeman, (2021)
		Wieland & Durach, (2021)
SCM & SSCM	Does it reduce the waste of resources and reduce the operating costs of materials.	Mojumder & Singh, (2021)

2 Analysis of Factors and Barriers to Sustainable Supply Chain for Construction Materials

2.2.1 Theoretical Background and Factors to Sustainable Supply Chain for Construction Materials

SSCM is geared towards the management of sustainable projects, covering all aspects of green materials, the environment and the level of technology (Rinaldi et al., 2021), while Shetty et al. (2022) analyzed the drivers of corporate GSCM in the literature, which are influenced by internal factors such as institutional theory influenced by external factors such as environmental factors as well. In the literature, the factors that drive sustainable supply chain management in construction companies are classified as driven by four top factors: government regulation, customer requirements, supplier management and environmental awareness (Shetty et al., 2022). Meanwhile, some scholars have analyzed the bottom factors of sustainable supply chain management from the perspective of stakeholders, including waste management, energy savings, green materials and reverse logistics influencing factors (Centobelli et. al, 2021). Therefore, this study will integrate and analyse the relevant factors and identify the key influencing factors that are appropriate for sustainable supply chain management in Table 2.

Table 2: Factors to the sustainable supply chain for construction materials

Main influencing factors	Secondary influencing factors	Author/Researcher
Government regulation	Waste management	Kitsis et al. (2021) Shetty et al. (2022) Centobelli et al. (2021)
	Energy savings	
	Green materials	
	Reverse logistics	
Customer requirements	Waste management	
	Energy savings	
	Green materials	
	Reverse logistics	
Supplier management	Waste management	
	Energy savings	
	Green materials	
	Reverse logistics	
Environmental awareness	Waste management	
	Energy savings	
	Green materials	
	Reverse logistics	

2.2.2 Analysis of Barriers to Sustainable Supply Chain for Construction Materials

As a new management model, SSCM is used in housing construction projects. This study takes the housing and office building project in Wuhan, China as a case study. Jum’a et al. (2022) argues that SSCM is often hindered by surrounding environmental factors and the quality of managers. A green environment can accelerate the operation of SSCM, and managers with environmental protection and resource conservation can consider problems from the links of the supply chain, and can also promote SSCM. Some scholars believe that the development of SSCM is hindered by external and internal factors. External barriers include the shortage of green materials and lagging stakeholders, and internal factors include high cost and high technology level barriers (Li & Sarkis, 2021).

2.3 Research Issues and Motivation for Sustainable Supply Chain in Construction Materials

Different stakeholders representing different interests, such as suppliers of construction materials, are currently influencing the SSCM. Government requirements for project sustainability and construction materials construction, green materials and green procurement are stringent. The above literature review summarizes the efforts of researchers in major parts of the world to analyse the research issues of SSCM influencing factors (Mojumder & Singh, 2021). For the office building project in Wuhan, China, there is an even greater need for a sustainable environment for housing construction projects. As seen in Figure 1, the drivers of SSCM drive the implementation of SSCM and the process of SSCM implementation encounters different obstacles, all of which need to be analyzed to identify the factors influencing SSCM and to analyse the key factors. In the following sections, this study will analyse the influencing factors of SSCM from different perspectives.

Figure 1: The main flow of the research question

2.4 Research Hypotheses

The research objectives of this study are to discuss and analyse the factors that influence sustainable supply chain management of construction materials for building housing projects and to identify the impact of key factors on sustainable should chain management. Within these objectives, two concepts need to be explored in order to understand these objectives. These concepts are (1) impediments to supply chain management, including shortages of green materials, lagging stakeholders' high cost and high technology level barriers (Mojumder & Singh, 2021) (2) the influencing factors of supply chain management including government regulation, customer requirements, supplier management and environmental awareness. In order to be competitive in sustainable supply chain management and the company itself, key supply chain management factors are studied (Daddi et al. 2021). The strategy requires the integration and coordination of the entire supply chain, as well as the analysis of secondary influencing factors from waste management, energy savings, green materials and reverse logistics through literature studies and actual case studies of office buildings in Wuhan, where construction companies can effectively work with material suppliers, manufacturers, distributors and customers to improve long-term business performance and supply chains (Siagian & Tarigan, 2021). In this study, the key influences of SSCM practices are defined as those aimed at corporate construction cost savings and improved construction efficiency.

This study explores the content of the definition, barriers and influencing factors by sustainable supply chain management for this study to be able to analyse more the influencing factors of SSCG of construction materials. Therefore, the following hypotheses will be tested in Figure 2.

H1: The influencing factors for SSCM of construction materials in this study are all factors that produce a positive correlation.

H1a: The government regulation factors in this study are positively and positively associated with sustainable supply chain management of construction materials SSCM.

H1b: The customer requirements factor in this study is positively related to sustainable supply chain management SSCM of construction materials.

H1c: The factor of supplier management in this study is positively related to sustainable supply chain management SSCM of construction materials, with a positive impact.

H1d: The environmental awareness factor in this study is positively associated with sustainable supply chain management of construction materials SSCM, with a positive effect.

H2: The barriers to sustainable supply chain management SSCM of construction materials in this study are all affected by the factors studied and can be addressed.

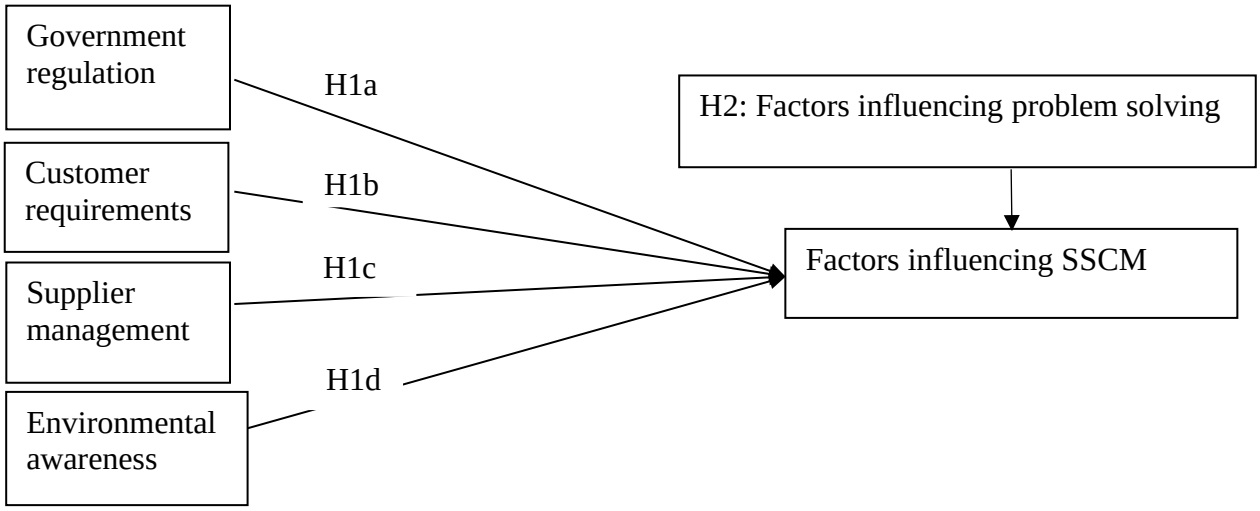

Figure 2: Research Hypotheses Conceptual Framework

This hypothetical approach allows the variables in the study objectives to be run in a defined direction and ensures the viability of the data. The first research hypothesis assumes that the four influencing factors of SSCM (Environmental awareness, customer requirements, customer requirements and environmental awareness) are positively correlated to help find the key factors and research objectives. The second research hypothesis is to help construction companies find new ways in SSCM, which further fulfills research objectives of this paper. Therefore, the hypothesis model discussed in this paper is helpful for the research.

3. Method

Based on Wuhan housing construction, descriptive analysis and the hierarchical analysis process (AHP) are the most effective methods to find the objectives of this study. descriptive analysis allows the ranking of the underlying factors in the literature review from the perspective of the stakeholders (Centobelli et al., 2021) and the analysis of the links and differences between the different factors. the AHP method allows the combination of the underlying factors with the The AHP method can be used to analyse the top-level factors in conjunction with the bottom-level factors to find the key influencing factors (Shetty et al., 2022). These factors include the learning ability of the construction company, the management ability of the project manager, competing companies in the industry, government policies and other influencing factors. The whole analysis process is shown in Figure 3.

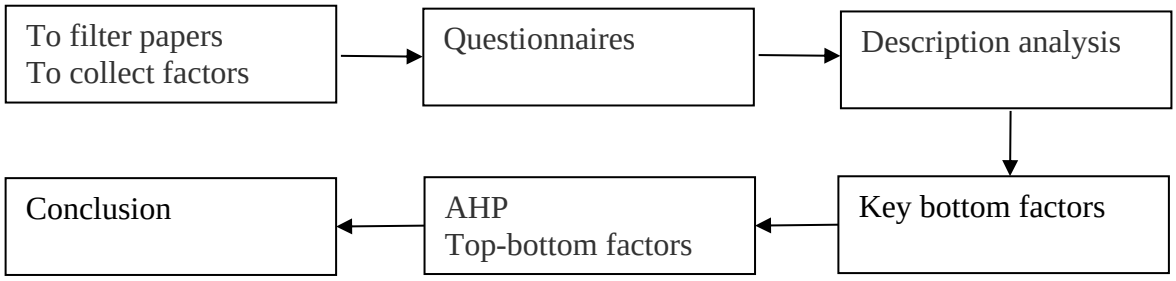

Figure 3 Research framework of method

Notice:
Bottom factors are waste management, energy savings,green materials and reverse logistics
Top factors are government regulation, customer requirements, supplier management and environmental awareness

3.1 Research Design Process

3.1.1 Locating and Defining Issues

Purposive sampling was used for the study's questionnaire for the following reasons: (1) Purposive sampling is more suitable for the achievement of this research objectives, SSCM does not apply to all companies, while purposive sampling helps to capture the key influencing factors of SSCM. (2) Purposive sampling allows for an in-depth understanding of the study population and can find recommendations that are appropriate for SSCM in construction companies. (3) The small sample size of this paper do not allow for the utilization of probability sampling instead. The purpose of using this research method is to analyse the construction material SSCM and find the key influencing factors.

3.1.2 Interpreting Research Data

The study used descriptive analysis and AHP, a purposive sampling method questionnaire to complete the data collection.

an excel sheet to mark and summarize the data, and independent sample testing to analyze the data through SPSS software to uncover and analyze the key influencing factors of SSCM in construction materials.

3.2 Designing the Research Project

Based on the *directory of construction foundation engineering companies in Wuhan*, the sample size of 414 for this questionnaire survey was determined. According to the sample reference *Krejcie and Morgan table* (Table 6) for this study, and using the interpolation calculation method (Figure 3), a sample size of 200 building construction companies was obtained for this study. Next, the main influencing factors were scored by experts using a AHP method, where the experts came from senior managers and senior engineers in the field of housing construction in Wuhan building foundation construction companies, and Table 3 shows the scoring criteria for expert scoring.

$$Y = Y1 + (X - X1) \times \frac{(Y2 - Y1)}{(X2 - X1)}$$

Formula 1: Interpolation Formula
Source: What is Interpolation? by Madhuri Thakur. (2020)
Notice: Y1=196, Y2=201, X1=400, X2=420, X=241

Table 3 Scoring criteria for expert scoring

Intensity of Importance	Definition	Explanation
1	Equal direct influence	Both of elements are same with objective.
3	Weak direct influence	Slightly affect the evaluate process between factors.
5	Moderate direct influence	Medium effect on the evaluate process between factors.
7	Strong direct influence	Very useful process between another factors.
9	Very strong direct influence	Extreme processes factor compares with all the factors.

Source: Cavallo & Ishizaka, (2022). Evaluating scales for pairwise comparisons. Annals of Operations Research

3.2.1 Factors influencing the design of construction materials SSCM for questionnaire

Table 4 Number of people in Factors influencing of construction materials SSCM

Factors influencing construction materials	Number of construction companies
Waste management	
Energy savings	
Green materials	
Reverse logistics	

The first design direction can be derived from the research questions and research objectives of this study. This section is to design a questionnaire on the influencing factors of SSCM for construction materials, where four secondary influencing factors are set in Table 4(waste management, energy savings, green materials and reverse logistics).

3.2.2 Factors influencing the design of construction materials SSCM for questionnaire

Secondly, this study uses a hierarchical analysis of the main factors, including government regulation, customer requirements, supplier management and environmental awareness, as shown in Table 5.

Table 5 Pairwise Comparison of the Alternatives for each criterion

Criteria:				
Alternative	Waste management	Energy savings	Green materials	Reverse logistics
Waste management				
Energy savings				
Green materials				
Reverse logistics				
Sum				

3.4 Sampling of questionnaire and AHP

The overall number of construction companies in Wuhan city was determined to be 414 with the help of the directory of construction foundation engineering companies in Wuhan. A sample of 200 construction companies was selected in the construction industry from the total population by reference to the *Krejcie and Morgan table* (Table 6) and purposive sampling method. Key influencing factors can be analyzed by descriptive analysis. Experts of AHP came from senior managers and senior engineers in the field of housing construction in Wuhan building foundation construction companies, and Table 3 shows the scoring criteria for expert scoring. Key influencing factors can be analyzed by AHP.

Table 6 Table for Determining Sample Size of a Known Population

N	S	N	S
360	186	440	205
380	191	460	210
400	196	480	214
420	201	500	217

Note: N is a population. S is a sample size. Source: Krejcie & Morgan, 1970

3.5 Data Analysis Method

First of all, when data collection is done using purposeful sampling. Data is labelled and summarized in excel sheets. Secondly, this study will use descriptive analysis and inferential analysis by SPSS software. The study will be based on a design questionnaire, using Excel to label the survey data with individual numbers. Data will also be pooled and analyzed using SPSS.

4. Findings

The results of the study confirm the importance of the key factors of the SSCM for construction materials. In general, the study was carried out through a questionnaire collected from employees in different departments of 200 different construction companies. The population

(Table 7) was drawn from different departments and groups of people in construction companies, including purchasing, quality inspection, construction and management departments, involving executives, department managers, assistant managers and employees.

Table 7: Classification of the questionnaire population

Criteria	Category	Number	Percentage
Gender	Male	124	62%
	Female	76	38%
Position	Executives	16	8%
	Department managers	25	12.5%
	Assistant managers	29	14.5%
	Employees	112	56%
Type of department	Purchasing department	51	25.5%
	Quality inspection department	53	26.5%
	Construction department	58	29%
	Management department	38	19%

The theoretical significance of this study lies in the use of a mixed research approach, which combines descriptive analysis and AHP, and most importantly, two research methods are interrelated. The practical significance of this study is that construction companies can gain a better understanding of construction material SSCM and also identify the key factors of SSCM to facilitate construction material management and improve the competitiveness of construction companies.

The following results are obtained through data collection and analysis: The key factor in the influencing factors of the first layer construction material SSCM is government regulation. The key factor in the influencing factors of the second layer construction material SSCM is waste management. Therefore, the result we found is that construction companies should firmly grasp the two key factors of government regulation and waste management when carrying out SSCM for construction materials.

5. Discussion

5.1 Analysis of the literature review

In the literature review, Yu et al. (2022) argue that SSCG is more sustainable than SCG for construction materials and Mojumder and Singh (2021) also identify SSCG as an important part of housing construction, which can help companies to reduce operational costs. The study found that government regulation and waste management are key factors in SSCG, and they also confirm that SSCG can help construction companies reduce waste and save money on construction materials.5.1 Questionnaire Analysis of Sustainable Supply Chain Management

5.2 Questionnaire Analysis of Sustainable Supply Chain Management

5.2.1 Summary of the Questionnaire Collection

This research collects data on the influencing factors of SSCM of construction materials by means of a questionnaire survey. The questionnaires were distributed to 231 employees of different companies in Wuhan city. The number of returned questionnaires was 202, and the recovery rate of the questionnaires was 87.46%. Within the normal range, the obtained questionnaire data is valid.

5.2.2 Descriptive Analysis

According to the data on the influencing factors of SSCM of construction materials in Wuhan city in this study, the results show that among the influencing factors of waste management, energy savings, green materials and reverse logistics, 79 people agree with waste management, accounting for 39.1%. is considered to be the most influential factor. The number of people who agree with Reverse logistics is only 24, accounting for 11.9%, which is considered to be the least influential factor. It is not difficult to see from the data that construction companies in housing construction projects often encounter a large amount of material waste in the process of sustainable management of the supply chain, so the most important thing for them is to save resources and reduce costs.

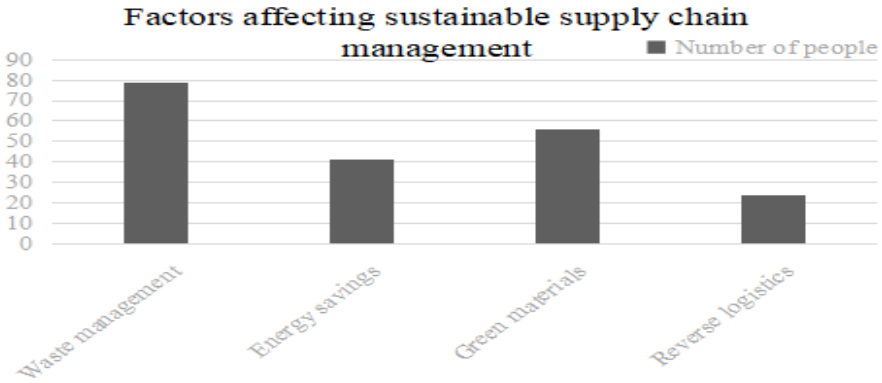

Figure 5 Factors affecting sustainable supply chain management

5.3 Multilevel Analytical Process Method of Sustainable Supply Chain Management

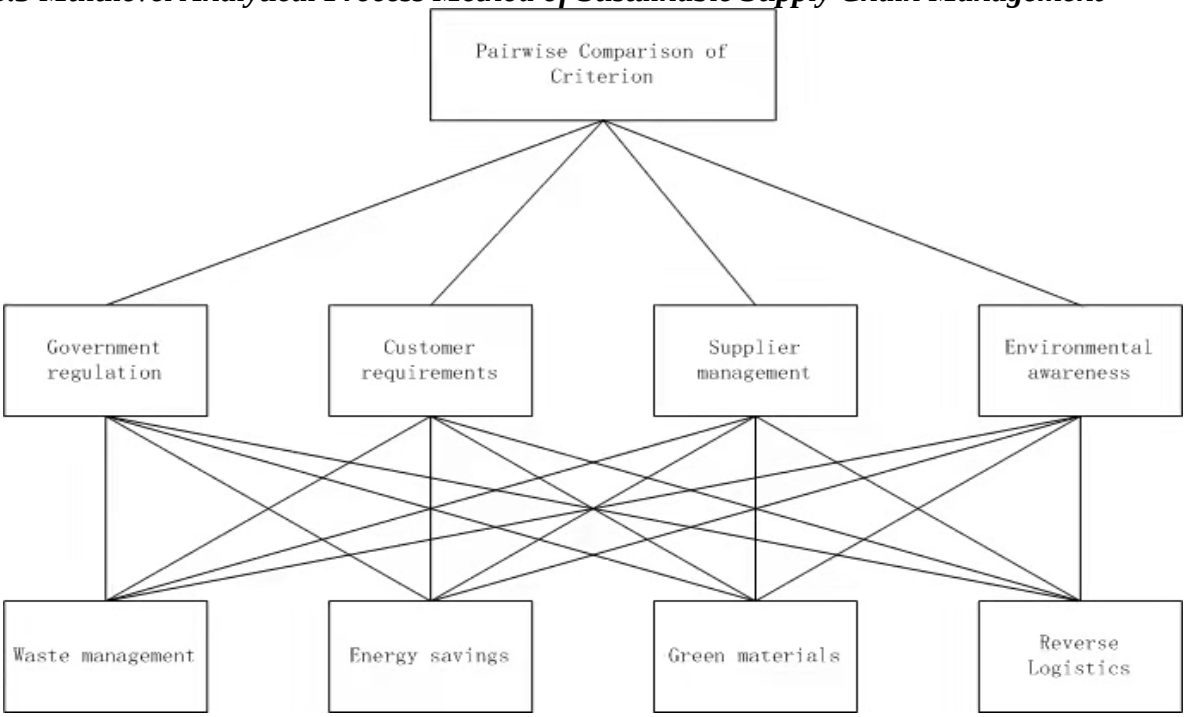

Figure 6 Hierarchical Structure Diagram

AHP is a simple and clear analytical method for analyzing qualitative and quantitative data. This research make use of AHP to model the priority index of the influencing factors of SSCM of construction materials, and AHP will calculate the views of construction enterprises in

Wuhan on SSCM, including how to ensure the sustainable development and profitability of construction enterprises in the future. The AHP method in this study was applied to the influencing factors of SSCM of two-layer construction materials in Figure 6.

5.2.1 Step 1: Building a Hierarchical Model

AHP first divides complex multi-criteria decision-making situations in the form of relevant decision-making criteria and decision-making choice levels, and divides decision-making goals, factors to be considered, and objects that need to be decided into the highest level, the middle level, and the lowest level according to the relationship between the factors. layer to draw a hierarchy diagram. Figure 6 shows the AHP. AHP can stratify the problem to be analyzed; according to the nature of the problem and the overall goal to be achieved, the problem is decomposed into different components.

5.2.2 Step 2: Constructing judgment matrix

Next, in the AHP, it is necessary to construct the judgment matrix of different influencing factors, and then put all the matrices and all the factors together and compare them with each other. In the process of comparison, this study invites senior managers of construction companies with more than 10 years of work experience to score the factors for the comparison between the two projects. The detailed score table has been described in Table 3. The influencing factors of this AHP are government regulation, customer requirements, supplier management and environmental awareness (Zhu & Xu,2019), through pairwise comparison, to minimize the nature of different factors to compare with each other difficulty to improve accuracy, meaning government regulation, customer requirements, supplier management and environmental awareness will be compared against their importance in promoting the adoption of SSCM by construction companies. Through pairwise comparisons of the standards, scoring according to participating experts A comparison matrix (see Table 8) is derived from the answer of In the weighted decision matrix, the average value of each row is calculated on the weighted decision matrix. The average value of each row is the weighted importance value of the construction company's construction material SSCM influencing factors (see Table 9).

Table 8 Pairwise comparison of criterion

Pairwise Comparison of Criterion				
Criterion	Numerical Rating			
	Government regulation	Customer requirements	Supplier management	Environmental awareness
Government regulation	1	5.00	3.00	7.00
Customer requirements	0.20	1	0.33	3.00
Supplier management	0.33	3.00	1	5.00
Environmental awareness	0.14	0.33	0.20	1
Sum	2.01	10.33	5.53	16.14

Table 9 Sum-product method to calculate the weight of influencing factors

Criterion	Government regulation	Customer requirements	Supplier management	Environmental awareness
Government regulation	0.50	0.48	0.54	0.43
Customer requirements	0.10	0.10	0.06	0.19
Supplier management	0.17	0.29	0.18	0.31
Environmental awareness	0.07	0.03	0.04	0.06

By calculating the average number of each row of the four influencing factors of government regulation, customer requirements, supplier management and environmental awareness, the weights are 0.49, 0.11,
0.24 and 0.05 respectively. It can be seen from the data that government regulation has the highest score. important factors that influence factors.

5.2.3 Step 3: Comparison of two-by-two matrix

The analysis and comparison of the second-level influencing factors will be carried out. This time, four types of factors, government regulation, customer requirements, supplier management and environmental awareness, will be used as the main standards, and they will be taken out and compared with the second-level influencing factors waste management, energy savings, green materials and reverse logistics comparison (Table 10), in the next decision-making scheme, the "government regulation" first comparison matrix will be developed, followed by a weighted decision matrix. After taking the row average in the weighted decision matrix, the weighted importance of each influencer is derived. In this way, the individual importance of the influencing factors of each construction material can be assessed, and the potential to drive SSCM for construction materials can be identified (Table 11). As can be seen from the matrix table in the table below, experts have scored and aggregated different influencing factors in pairs.

Table 10 Criteria 1: Government regulation

Criteria 1: Government regulation				
Alternative	Waste management	Energy savings	Green materials	Reverse logistics
Waste management	1.00	3.00	5.00	7.00
Energy savings	0.33	1.00	3.00	3.00
Green materials	0.20	0.33	1.00	3.00
Reverse logistics	0.14	0.33	0.33	1.00
Sum	2	5	9	14

Table 11 Sum-product method to calculate the weight of influencing factors

Alternative	Waste management	Energy savings	Green materials	Reverse logistics	Weight
Waste management	0.60	0.64	0.54	0.50	0.57
Energy savings	0.20	0.21	0.32	0.21	0.24
Green materials	0.12	0.07	0.11	0.21	0.13
Reverse logistics	0.09	0.07	0.04	0.07	0.07

By calculating the average number of each row of the four influencing factors of waste management, energy savings, green materials and reverse logistics comparison, the weights are 0.57, 0.24, 0.13 and 0.07 respectively. It can be seen from the data that waste management has the highest score. important factors that influence factors. This is also consistent with the descriptive analysis of the previous questionnaire, reaffirming that the influence of waste management relative to government regulation is the key factor.

5.2.4 Step 4: Hierarchical Single Sort and Its Consistency Test

The eigenvectors corresponding to the maximum eigenroots λ_{max} and lambda$_{max}$ λ_{max} of the judgment matrix are normalized, that is, the sum of all elements in all vectors is 1. This process

needs to first calculate the value of Aw, that is, multiply the weights 1 by 1 matrix and 4 by 1 matrix to obtain a 1 by 1 matrix. The test feasibility of green SSCM for construction materials of construction enterprises in Wuhan, China can be calculated by using the following formula:
$B_w=\lambda A_w = (W_1 \times W+W_2 \times W \ldots\ldots W_n \times W) +(W_2 \times W+W_2 \times W \ldots\ldots W_n \times W)$ ……
To calculate the consistency index use CI，$CI=x=\frac{\lambda-n}{n-1}$, It is necessary to first calculate the eigenvector λ. The calculation of the eigenvector λ can be obtained by dividing and adding AW and Weight two by two. The formula is as follows:
$\lambda=\frac{A_{w1}/W_1+A_{w2}/W_2+A_{w3}/W_3+A_{w4}/W_4}{n}$,
The value of λ is calculated and brought into the formula of CI to calculate the value of CI. Finally, the formula is used to calculate the test coefficient CR. To calculate CR, the random consistency index RI must first be obtained to measure the size of CI. The table of RI standard values of the random consistency index is obtained, but different standards will have different RI values. In this study, the RI is 0.89 for the fourth-order matrix (Table 12). According to the calculation formula of CR:
$CR=\frac{CI}{RI}$ *(CI versus value 0.1, if feasible if less than 0.1, and not feasible if not less than 0.1)*

Table 12 Average random consistency index RI standard value

Matrix order	1	2	3	4	5	6	7
RI	0	0	0.52	0.89	1.12	1.26	1.36

In addition, combined with the influencing factors of this case, the following matrices can be calculated to calculate A_w。

$$\begin{bmatrix} 2.1 \\ 0.44 \\ 0.98 \\ 0.2 \end{bmatrix}=A,\ \begin{bmatrix}0.5 & 0.48 & 0.54 & 0.43\end{bmatrix}=B,\ \begin{bmatrix} 0.49 \\ 0.11 \\ 0.24 \\ 0.05 \end{bmatrix}=C,\ A = B\times C$$

5.2.5 Step 5: Hierarchical Total Ranking and Its Consistency Test

Calculate the weight of the relative importance of all factors at a certain level to the highest level (total target), which is called the overall ranking of the level.

5.2.5 Step 6: Prioritization

AHP is the enabler and barrier of the weighted decision matrix and priority index. Through the analysis and comparison of data by the analytic hierarchy process, this study concluded that the priority of the factors affecting the construction company's construction materials is government regulation > customer requirements > supplier management > environmental awareness from high to low.

6. Recommendations and Conclusion

6.1 Recommendations

The key factors are government regulation and waste management in the research. Regarding the formation of these two key factors, this study gives the following suggestions. Construction enterprises often cause a lot of waste due to the frequent use of materials, and government regulation is a necessary condition for enterprises to follow sustainable supply chain management. Therefore, enterprises must always grasp the two key factors of government regulation and waste management in order to develop. For government regulation, construction

companies not only need to speed up production, but also need to keep abreast of new government policies and new requirements for a sustainable market, and strengthen direct communication with local governments. In terms of waste management, it needs to strengthen constraints from reducing material waste and the awareness and quality of enterprise personnel, and at the same time, it also needs to do a good job in the management of materials and the multiple utilization of sustainability. Through this research, construction enterprises should pay more attention to the factors affecting the sustainability of construction material supply chain in the process of material management, so that construction enterprises can reduce costs and increase profits.

6.2 Conclusion

The study will identify the influencing factors suitable for sustainable supply chain management of construction materials from literature reading, descriptively analyze the influencing factors and use the research method of analytic hierarchy process to analyze and identify the key factors in conjunction with actual engineering cases. The analysis of the key factors, combined with the company's practical situation, improves the construction company's ability to manage a sustainable supply chain.

In terms of the future direction of sustainability and supply chain management of construction materials, this research can lead to the following conclusions (1) Based on the different types and materials of construction materials, construction companies can quickly find the influencing factors and key factors in the way of sustainable supply chain management. This study found two key influencing factors for the sustainable supply chain management of many construction materials, which are government regulation and waste management. (2) Construction companies can reduce construction costs and improve their efficiency based on a combination of their internal environment and key sustainable supply chain management factors. Construction enterprises reduce the cost of construction materials and reduce the waste of construction materials while learning from the new policies of the government, the sustainable supply chain management of construction enterprise materials will be more and more successful.

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