

## The adoption of green management in Iraqi construction industry: The challenges and benefits

Ahmed Mohammed Raof Mahjoob<sup>1</sup>, Abbas M. Burhan<sup>1</sup>, Rehab Abdul Razzaq Ibraheem<sup>2</sup>, Omar Akrm Al-Juboori<sup>3</sup>, Hatim A. Rashid<sup>4</sup>

<sup>1</sup> University of Baghdad, College of Engineering, Department of Civil Engineering, Baghdad, Iraq

<sup>2</sup> Ministry of Education, General Directorate of Education in Baghdad, Rusafa II / Division of School Buildings, Baghdad, Iraq

<sup>3</sup> University of Baghdad, College of Science, Unite of Reconstruction and Projects, Baghdad, Iraq

<sup>4</sup> University of Al-Nahrain, College of Engineering, Department of Civil Engineering, Baghdad, Iraq

### ABSTRACT

Working locally acting Globally is the essential principle in the modern world, to achieve this principle all the countries should work together to protect the Natural environment and the ecosystem. The protection methods and procedures were developed and adapted to suit all fields of the life specially the industry fields, Green Management (GM) considered one of the important methods for this purpose because it provides the bases for environmental conservation. Industry of construction shares a high percentage of the world economy as well as adverse influence on the environment as natural. The current paper tries to set the challenges and benefits of adopting the GM in Iraqi industry of construction throughout exploring the important Factors (main and sub-Factors) that affect the applications of the GM as well as the motivation factors. To achieve this goal a review of literatures was performed to collect the effecting factors, then these Factors were evaluated by the experts using questionnaire survey and the questionnaire results were analyzed utilizing Process of Analytical Hierarchy (AHP). The results revealed that the main factors are the financial factors and the Project-related and technical factors with 23% and 19% of important respectively. Accordingly, the conclusions were extracted with a set of recommendations which mainly state the important role of the Iraqi government in the application of GM in the industry of construction.

**Keywords:** Green Management, Construction industry, Motivations, AHP

### Corresponding Author:

Ahmed Mohammed Raof Mahjoob

University of Baghdad, College of Engineering, Department of Civil Engineering, Baghdad, Iraq

E-mail: [ahmed.mahjoob@coeng.uobaghdad.edu.iq](mailto:ahmed.mahjoob@coeng.uobaghdad.edu.iq)

### 1. Introduction

Despite the facts that industry of construction effects positively on economic development and that infrastructure and buildings projects are essential to fulfill the growing population demands in developing countries, but it has an enormous influence on the broader environment, including the emissions of harmful gases, outdoor and indoor environmental pollution, and the influences on the ecological system [1], waste production and landfill shortages [2]. It was explained that such construction work has a myriad of concerns belonging to sustainability of a range from environmental, social, and economic problems, since projects of construction still rely mainly on conventional styles [3]. These conventional styles related to inefficiency and poor resources usage [4].

Globally, all construction companies have incorporated green through strategic plans to mitigate negative influences on the ecosystem [5]. Dasgupta et al discover beneficial GM outcomes on self-evaluated fulfillment with the regulations of the environment [6]. In the same line, Wagner defines that GM permits the improvement of strategic resources which can decidedly influence development abilities overall and hence also on technological environmental innovations [7]. While Horbach achieves a beneficial influence of various GM events on technological environmental innovations [8].

In Iraq, the environmental situation has been dependent upon various uniting pressures coming from growth of population, the effect of 3 conflicts, environmental alteration, lowly land utilizes planning, and the environmental challenges posed by the vast quantity of debris and waste resulting from re-construction and renovation projects over the country [9]. Alajeeli and Al Kaabi indicate that no applied system is there for managing waste in the Iraqi projects of construction [2]. Therefore, being environmentally friendly has becoming an importantly matter for construction companies because of the global attention about environmental requirements, as a result, stimulated the increasing heed of researchers in exploring and developing the GM [10].

Iraq has been ranked as one of the ten countries with the lowest environmental performance scores [11]. It is estimated to generate 31,000 tons/day of waste of construction per capita waste generation exceeding 1.4 kg /day [12]. In Iraq, the cost of the degradation in the environment is about 4.9 to 8.0 percentage of Gross Domestic production (GDP) (about 5.5 US billion \$ per year) [13].

Iraq involvement in green issues started since the launch of the National Environmental Strategy (2013-2017), where the main objectives of the strategy were the implementation of green technology and green economy. However, GM in Iraq industry of construction is yet in the early phases of rolling out an orderly improvement on the practical level. Laws and regulations in Iraq have not achieved a complete arrangement or execution mechanism to launch an integrated GM in planning, designing, construction and post-construction for sustainable deliver of projects of construction. In Iraq, there has been no research carried out that explore the GM implementation in projects of construction. Thus, the aim of the current work is to explore and rank the effecting factors on the applications of the GM in Iraqi projects of construction. The main research goals are: "Defining the factors affecting the GM applications in projects of construction in Iraq" as well as the motivation aspects. Secondly, evaluate these factors to realize their importance ranks. The rest of this manuscripts was arranged illustrates the review of literatures in the second section followed by the frequently cited affecting factors; section three explore the methodology, while the fourth section involve the result and discussions, finally, the conclusions presented in section five. The current study results can aid the top administration and partners to execute a powerful GM in Iraq.

### 1.1. Green management

Green Management (GM) becomes an essential part in all forms of firms. It is replacing conventional management which does not consider the environmental aspect. GM is the sustainable expansion development by the reliable management of policies, strategies, projects, and programs with the goal of attaining a friendly-environment structure. It directs green building activities such as planning, design, construction, operation, and maintenance of buildings [14]. G. M. includes improving procedures and policies that can help promote and coordinate sustainability at the project site [15].

Furthermore, Peng and Lin defined G.M. as "required practices for producing products which is environmentally friendly as well as reducing the influence on the ecosystem by green activities in (development and research, marketing and production) [16]. while Shu et al defined G.M. as" a management systematic practices of the firms for setting the issues of the ecosystem through protecting the environment and reducing the adverse influence of the firm's products on the environmental during the entire cycle life of the project" [17]. Generally, G.M. includes two main components of practice, the first is the management of the environment for preserving the natural resources and environment, while the second is the efficient use of the energy and resources.

There are a few issues relating to G.M. rehearses that incorporate the trouble in attempting to actualize GM hones within the working environment, the arrangements and method required to actualize it, the challenges watched when attempting to make workers mindful almost G.M., and the way of overcoming opposition made by representatives not willing to take an interest in the advancement of GM Hones within the work environment [18].

Additionally, construction firms look for, through G.M., to minimize energy waste, water, and materials all through the project life cycle. Throughout the phase of construction, one of the goals should be to minimize the landfills materials quantity. By gathering waste of human at the source and changing it to a semi-unified biogas along with other waste as biological, liquid compost can be formed [19]. Another point of view suggests that G.M. is a device to survive and relieve the government's difficulties coming across the community services' demands and agencies of security. Finally, it is vital that the associations have an unmistakable degree of mindfulness and comprehension to accomplish authoritative sustainability [10].

A study by Leonidou et al posited that G.M. adds to stronger company execution by reducing expenses and expanding likely income [20]. Ambec and Lanoie argued that G.M. should improve company income through

“well right of entry to definite markets; distinguishing products, and technology of selling pollution-control” in addition to reducing costs in four types: “risk relations and management with external stakeholders; capital expense cost of material, energy, and services; capital cost; and labor cost” [21]. As well as GM can diminish the of by giving more straightforward admittance to capital business sectors, simpler credit from banks, and surer investor responses. It likewise diminishes the expense of work by reducing the expenses related to diseases, truancy, enlistment, and turnover [17]. Accordingly, it can be concluded that G.M. refers to all management actions under which construction firms take to enhance and improve environmental management. This could be done by engaging entities such as the founding of environmentally responsible work procedures, expansion of environmental management system, provision of human capital management for the design and development of sensible works practices, etc.

## 1.2. Green management motivations

Motivations for adopting G.M. differ. Bansal and Roth recommended four components for stimulating green adoption which are the pressures of stakeholder, legal considerations, ethical consideration and economic chances [22]. Chabowski et al. likewise hypothesized that ethical, legal, and discretionary intentions are 3 key chauffeurs of applying GM in firms. The intention being legal indicates the rule of law in business activities. The ethical intention is signified by the ethical matters linked to stakeholders i.e., the government, public, and employees. The intention as discretionary shows that firms positively espouse green notions further than ethical and legal expectations [23].

## 1.3. Factors affecting GM

GM activities can be improved by investigating the aspects influencing the enhancement of the environmental performance of projects. These aspects differ based on the project specifications, but they are all essential for reaching a specific planned goal. The industry of construction is filled with risk, and therefore the possibility of failure is present; thus, construction firms should consider aspects that may influence their success in a construction project [24]. To develop G.M., the organization requests surveying its environmental influences, set emphases to diminish such influences, and plan the way for accomplishing the aims. Many previous studies have been led to evaluate the significant drivers of G.M. execution. Frank stated that social responsibility in the performance of the firm is necessary for applying GM [25]. Likewise, Hosseini characterized the main aspects for developing GM which are: “policy of environment, environmental influence recognition, targets and objectives, consultation, management plan of the environment, responsibilities, review audits, and reporting structure, and monitoring compliance, constant improvement”. Furthermore, it is illustrious that support of high-ranking managers is a vital driver for the effective implementation of most technology, innovations, activities, and programs [26]. Therefore, to guarantee the full environmental quality, top management should be dedicated [27]. Also, communication between environmental-professionals and firm managers is significant for an effective project and environment relationship [28]. According to Wagner, G.M. programs may contain a chain of actions such as the publication of an environmental strategy, and the invention of improved environmental training programs [7].

Hosseini developed two models that identify aspects that can help in applying a GM system in the Iranian transportation industry. The study's suggested theoretical framework that links to two parts: environmental systems (process model) and management systems (goal-oriented model) [26]. Moreover, Ziegler and Sejas suggested that if firms realized certified environmental management systems, products environmental labeling, life cycle activities assessment, and waste measures disposal, GM would not need public support [29]. Goyal tried to converse the numerous initiatives which might be taken by organizations for promoting GM. The study states 14 important actions for GM, some of them are: “save power and energy; measuring performance with the standards; organizations should start using the (reduce, recycle & reuse); encourage the employees to buy sustainable; make utilize of renewable energy sources; Save energy and improve the environment” [18].

Similarly, Mathiyazhagan et al stated that government category, supplier, market, internal drivers, customer, and lastly environment are the main drivers for GM implementation for the fund chain in the Indian construction industries [30]. Cronstam and Grönberg studied the influencing aspects in the GM implementation in Swedish SMEs in logistics [31].

Results showed that the most effective factors are categorized into 2 criteria: external and internal aspects. Internal aspects are engagement of managers, orientation of goal, commercial situation, and EMS. External aspects are relationships between the company, suppliers, customers, and other cooperative companies.

Although Wibowo et al., suggested framework as conceptual for green fund chain management implementation in the Indonesian industry of construction. The results showed that green supply chain management involves 5

concepts (design of green product, green initiation, management of green material, construction as green and green maintenance, and operation), 86 elements and 22 dimensions [32]. Alqadami et al shed light on the key achievement aspects for implementing green procurement in Malaysian infra-structure projects. Results showed that there is outstanding consistency in the examined aspects. The aspects are classified into themes called, regulative, perception, logistical, organizational management, contractual, strategic, technical, and financial aspects [33]. In addition, Taghavi et al prioritize and identified the main factors that apply green supply chain management in the Iranian industry of construction. The findings showed that the most active aspects categorize into 2 criteria and ten sub-criteria; internal factors that relied on the organization itself and external aspects linked to outside the organization i.e., customers suppliers, institutions as governmental and non-governmental [34].

## **2. Research methodology**

This study generally depends on three phases. The first phase covers identifying the affecting factors of G.M. implementation through the review of literature. The 2<sup>nd</sup> phase involves a quantitative method for determining the weight of the specified factors using the expert's survey through questionnaire. The third phase employs the Super Decisions software (SDS), which uses Hierarchy Process (AHP) technique to categorize the priority factors involved in the G.M. implementation process in Iraq. In the end, the results of this work are straightforward for enhancing the awareness of the decisions makers about the GM and help the managers in preparing an effective G.M. plan.

### **2.1. Data collection**

A literature review is used to take out the G.M. success aspects derived from related literature including journal articles, handbooks, PhD and MSc theses, research reports, and conference papers. Investigations were done using Scopus and Clarivate databases.

### **2.2. Survey design and administration**

According to the review of literature, a few workers are there on such topics. Particularly in Iraq, there was a deficiency or less considered research on the G.M. implementation in the industry of construction. For solving such difficulty, an empirical questionnaire survey according to the pairwise comparing was compiled derived from literature review findings, which were 29 dimensions. The questionnaires were formed utilizing an Analytical Hierarchy Design Process AHP and pairwise comparisons for determining the loads of the chief criteria, sub-criteria, and alternatives. Before that, a pilot study with 7 construction experts was carried out to develop the phrasing and boost the reliability of the questions. Such specialists have extra than 10 years of involvement and work in the industry of construction in Iraq.

The questionnaire consisted of three sections; section 1 enquires personal information of respondents. Section 2 includes a pairwise comparison matrix of the main GM factors. Section 3 presents pairwise comparison matrices of G.M. Sub-criteria. The participants were asked to weigh each pairwise comparison between factor categories and specific factor on a numerical scale from 1 to 9, where 1 = no significant influence and 9 = high influence on project success. The questionnaire survey was performed from April 1, 2022, and June 31, 2022. The objective respondents to the questionnaire were the experts and managers at middle or higher management levels in the industry of construction. The forms were delivered to construction specialists working at the Education Ministry, Planning Ministry, Construction and Housing Ministry, Municipalities and Public Works Ministry of, Higher education and scientific research Ministry, and to local construction companies working in Iraq.

### **2.3. Data analysis, and AHP structure**

In this study, the Super Decisions software SDS version 3.2.0 will be used to analyze the data of AHP survey. Thomas L. Saaty developed the software of SDS for (AHP) implements for resolution-making with feedback and dependence. AHP is a multi-model resolution-making process launched by Saaty (1980) [35]. This process has been generally applied throughout the previous two decades [36]. Darko et al. reviewed more than 70 AHP-papers published to help decision-making within the field of construction management which indicate the wide applicability of this method in construction management [37]. Conceptually, AHP is the concept of measurement throughout pairwise comparisons, it involves separating (hierarchical) a problem into its choice

components, organizing them in a progressive construction, making decisions on the general significance of sets of components, and blending the outcomes. Specifically, the correlations are made utilizing a scale of expert decisions that shows the predominance of one model over another thinking about a given other option [38]. In current study, once the AHP model was constructed, a pairwise comparison questionnaire was shaped. After that, the geometric ways of all paired comparing decisions were computed for every question. The researchers afterward ordered such group decisions in paired comparing matrices utilizing the assess/compare Super Decisions software module. Utilizing the Super Decisions software, the imports are gained from the paired comparing matrices. Furthermore, the weight of priority was automatically calculated via the software. The inconsistency ratio was  $< 0.1$  in all paired comparing matrices.

### 3. Results and discussion

#### 3.1. Analysis of literature

Based on the literature review, 29 factors that influencing the GM in projects of construction were collected, classified, and clustered into seven main classes as presented in Table 1. Figure 1 illustrates the main examined groups and their sub- factors in a hierarchical structure.

Table 1. Factors affecting the GM Projects initiated from the literature

Categories	Factor	References
Company Factors	Global orientation towards sustainability and GM	[39]
	The company ability for competition in the global markets	[40]
	Value added for the company assets	[41]
	The willingness and orientation of the company top management toward GM	[30], [31], [33]
Project-Related and technical Factors	Facilitating problems settling	[26], [33]
	Acquisitions of modern and high technology	[42], [43]
	New management techniques /Alternative procurement methods or materials	[7]. [18]
	Adopting reduce, recycle & reuse methods	[7]. [32]
	Rising alertness on sustainability matters and promoting green policy	[33]
	Competency of project team	[31], [33], [44]
	Supporting and adopting goal orientation policy	[26], [31]
	Adopting the principle of sustainability in the design process	[45]
Financial Factors	Well-defined scope of work	[46]
	Cost-optimization by green procurement / Save power and energy	[20], [21], [33]
	Whole life costing consideration and money analysis value	[33]
Environmental Factors	Project's adequate funds/resources	[18]
	Develop new environmental training programs	[7]. [18]
	Applying measures of site precaution for mitigating pollution of environment	[33]
Governmental Factors	Environmental management systems /GM policy - ISO 14001	[18], [26]' [30],[32]
	Government support	[30], [34], [47]
	Government regulation and legislation	[32], [48], [49]
Customer-supplier Factors	Economic and political stability	[39], [42]
	Availability for green procurement and green manufacturing in market	[50]
	Demand from customers in environmental protection requirements	[51], [52]
External Factors	Customers - supplier pressure and commitment	[31], [33], [34]
	Society or public pressure	[30], [33]

Categories	Factor	References
	Effective communication channels between government, consultants and suppliers	[33], [50]
	Improve the image of the construction company	[30], [33]
	Social responsibility	[53]

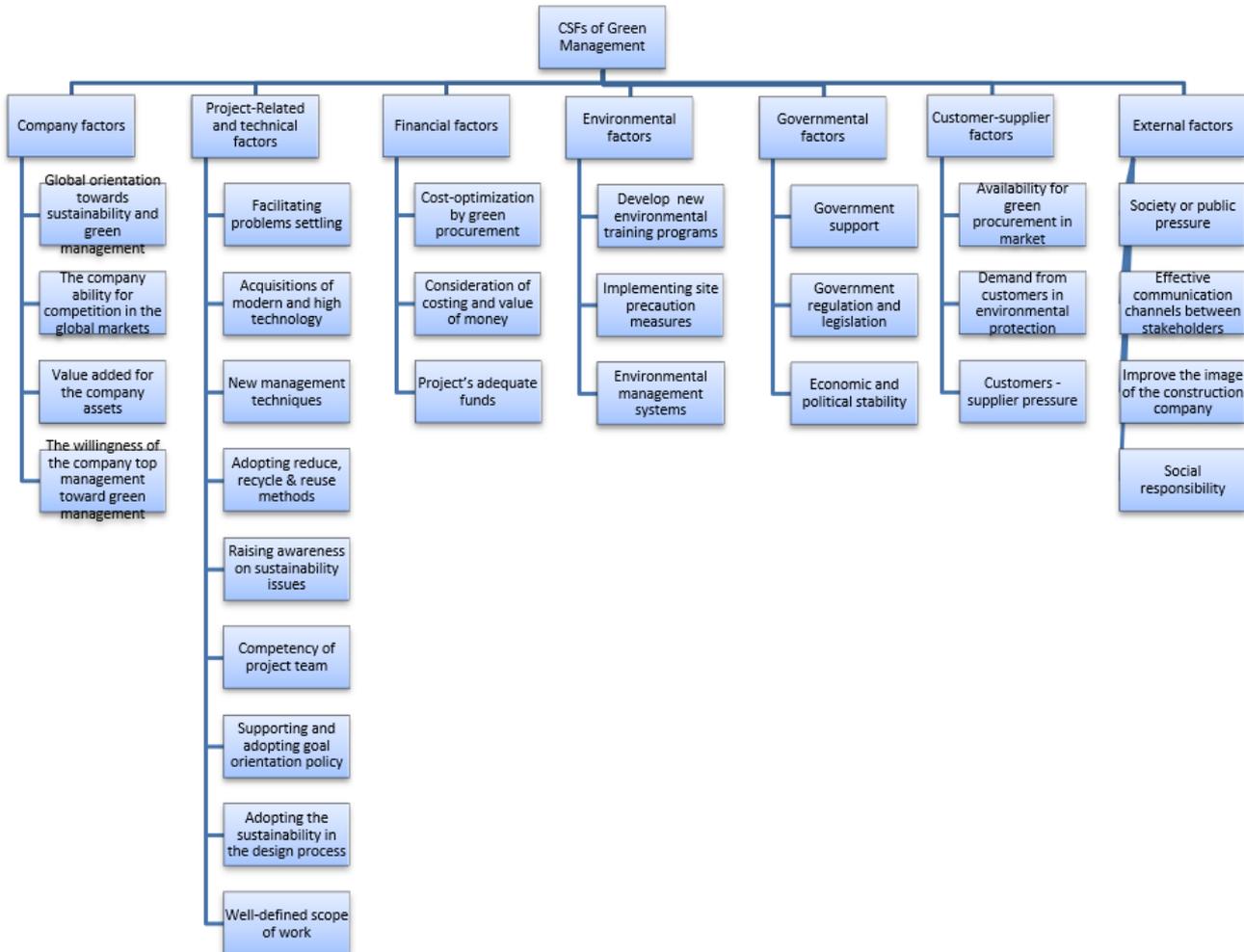


Figure1. AHP Framework for recognizing Factors affecting G M in Iraqi industry of construction.

### 3.2. Questionnaire survey

The questionnaire form was designed in clear manner to be easy to understand and answered by the respondents, it consists of 2 main axes, the first axis related to the personal characteristics of the respondent, while the second axis involve the factors affecting the GM. 50 questionnaire forms were distributed but only 23 were re-turned, where 17 were finished. The rate of active reply was 34 %, that fairly indicator for the aims of further analysis.

#### 3.2.1. Respondents' characteristics

Table 2 addresses the demographic respondent's characteristics. Results indicate that in relations to respondents' experience there were 6% with 5 years or below, 18% with (6–10) years, 12% with (11–15) years and 24% with (16-20) years, and 41% with 21 years or above. Thus, about 77% of respondents had extra than 10 experience years in projects delivery. Among the respondents, 41% had a degree as bachelor, MSc, and Ph.D. holders form 35 %, and 24 % respectively. It is apparent from Figure 2 that the respondent's majority holds official management ranks. Administrative area directors produced 35 % of the search sample, whereas 18% of the respondents worked in advisor positions. Moreover, 24 % served as deputy general manager, and general director positions comprised 18%, whereas 6% held an engineer position. Consequently, respondents were adequately deemed knowledgeable on the investigation topic. Furthermore, Figs. 2 and 3 show the public sector respondents' organizations and working sector.

Table 2. Characteristics of Respondents

Variable	Type	Frequency	Percent
Years of career	5 years or below	1	6%
	(6-10) years	3	18%
	(11-15) years	2	12%
	(16-20) years	4	24%
	21 years or above	7	41%
Educational level	B.Sc.	7	41%
	M.Sc.	6	35%
	Ph.D.	4	24%
Sector	Public sector	12	71%
	Private sector	1	6%
	Both	4	24%

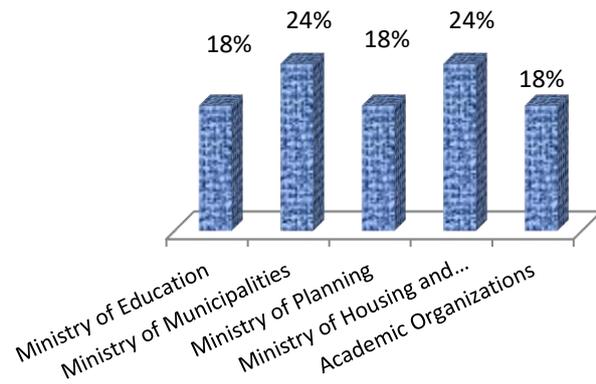
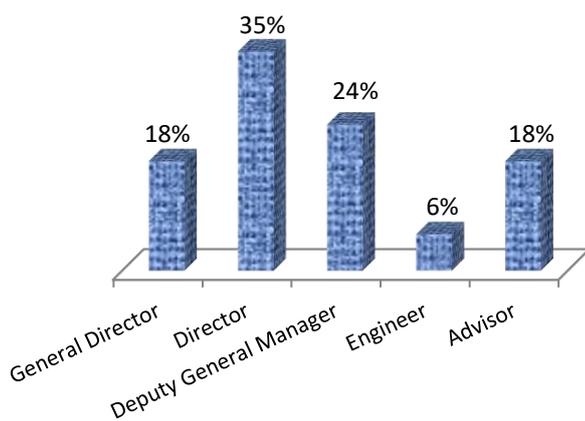


Figure 2. The respondents based on title job.

Figure 3. The public sector respondents' organizations.

**3.3. The motivation factors**

The results of the survey illustrate that 41% of participants argued that legislation is the main reason for involving in GM, while 29% of participants see it is to improve the image of the construction company. 12% of participants declare it is the ethical concerns related to stakeholders, or government and to reducing pollution and waste. While 6% of participants think it is to reduce expenses as presented in fig 4. The above results give an indicator about the main motivations aspects in Iraqi industry of construction which can be used by the decision maker to encourage the adoption of GM.

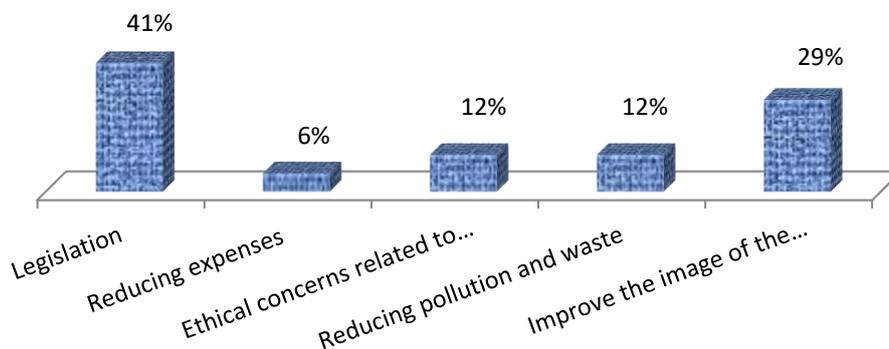


Figure 4: Motivations for involving in GM

**3.4. Importance of effective aspects for GM projects**

For this study, as the entireties of specialists' viewpoints were viewed as of similar significance, the geometric mean, eq (1), were utilized to merge group assessments. Also, to stay away from confusion, responding to incorporated decisions should be identical to combining their reciprocals [54].

$$GM = \sqrt[\sum_{i=1}^{i=n} f]{(x1^{f1})(x2^{f2})(x3^{f3})(xn^{fn})} \quad (1)$$

In which: GM = Geometric Mean, f = frequency, i = iteration order, n = last iteration, and x = the risk factor.

### 3.4.1. Main factors analysis

Table 3 shows the main Factors prioritization based on experts' judgments by AHP. The responses were examined for inconsistency and the findings display an outstanding inconsistency of 0.0181, the analysis revealed that financial Factors were the most important factor and it obtained weight of (0.23428); this reflects the excessive worries assumed by the respondents concerning the great challenge for balancing the essential green technologies cost and the profit of making as such. At the same time, project-related and technical Factors were considered at second high priority with a weight of (0.19483). This might be related to the fact that GM necessities might pose an influence on the schedule of construction and such necessities are required to be pointed out in the schedule for preventing any crisis producing delay in the project. Thus, Iraqi construction companies should maintain a good management system and it is mostly dependent on project performance and the effectiveness of management billing activities and claims. Furthermore, Environmental aspects are placed at the third level with a weight of (0.17844), this may be due to international organizations formulating various acts, such as ISO 14001; and reaching agreements that may influence the construction companies directly or indirectly.

Table 3. AHP Weights for Main G.M. factor

The Main Factors	Sorted weight value	Rank
Financial Factors	0.23428	1
Project-related and technical Factors	0.19483	2
Environmental Factors	0.17844	3
Company Factors	0.10897	4
Customer-supplier Factors	0.10350	5
Governmental Factors	0.09742	6
External Factors	0.08255	7
<b>Inconsistency of 0.0181</b>		

### 3.4.2. Sub-factors analysis

#### 3.4.2.1. Company factors

Table 4 shows sub-Factors prioritization based on respondents' judgments. The company Factors category was divided into four sub-Factors. With an inconsistency of 0.00388, it was noted that global orientation towards sustainability and GM was the most important factor in the company Factors category with a weight of (0.45541), Iraqi contracting companies should benefit from the evidence presented by this research that successful management must take into account complying with the global trends towards sustainability and GM. Achieving this goal will certainly lead to the realization of the second sub-factor, which is the company's ability to compete in global markets with a weight of (0.26283). The company's environmental commitment should be a mission, not a goal. Value added for the company assets graded 3<sup>rd</sup> with a weight of (0.14088), and the willingness and the company's top management orientation toward GM graded 4<sup>th</sup> with a weight of (0.14088).

Table 4. Company category Sub-factor

Company Factors	Sorted weight value	Rank
Global orientation towards sustainability and GM	0.45541	1
The company ability for competition in the global markets	0.26283	2
Value added for the company assets	0.14088	3
The willingness and orientation of the company top management toward GM	0.14088	4
<b>Inconsistency: 0.0038</b>		

### 3.4.2.2. Financial factors

Table 5 shows sub- Factors prioritization of the financial aspects category. Financial Factors were divided into three sub- Factors. With an inconsistency of 0.05156, the current study results proposes that cost-optimization by green procurement was the most important factor in this category with a weight of (0.52784), Cost optimization will reduce the total project cost base on green procurement which has recently gained notable interest by workers in the project management field. This concern resulted from environmental and competitive aspects, in Iraq, there are almost no regulations regarding environmental compliance, but companies have recognized the competitive advantages globally. In general, green procurement will reduce waste and increase the recycling of used materials which has a significant influence on project cost as well as environmental requirements. The common tool to analyze the cost- optimization is the whole life costing and value of money analysis which appears in the second rank as a sub-factor with a weight of (0.33252) and reflects a good indicator of the awareness of the Iraqi construction companies in using such analysis. Furthermore, the Project's adequate funds/resources ranked third with a weight of (0.13965).

Table 5. Financial category Sub-factor

Financial Factors	Sorted weight value	Rank
Cost-optimization by green procurement	0.52784	1
Consideration of whole life costing and value of money analysis	0.33252	2
Project's adequate funds/resources	0.13965	3
<b>Inconsistency: 0.05156</b>		

### 3.4.2.3. Project-related and technical factors

Project-related and technical Factors category was divided into nine sub- Factors. With an inconsistency of 0.09198, the study highlights acquisitions of modern and high technology as the most important factor in this category with a weight of (0.19033). Acquisition of advanced and modern technology is a valuable tool to enhance the competitiveness of construction companies. The rapid technology development has a tremendous influence on achieving the requirements of green and sustainable principles for construction companies as well as completing projects in an efficient and more productive manner. Thus, contracting firms must be up to date about acquiring high and modern technology to ensure competitiveness and productivity. On the other hand, adopting the new management techniques will enhance the management practice and make the green policy useful for the company. New management techniques ranked number two with a weight of (0.14996). Furthermore, facilitating problems settling ranked third with a weight of (0.12425), table 6 shows sub- aspects prioritization based on respondents' judgments.

Table 6. Project-related and technical Sub-factor

Project-related and technical Factors	Sorted weight value	Rank
Facilitating problems settling	0.12425	3
Acquisitions of modern and high technology	0.19033	1
New management techniques	0.14996	2
Adopting reduce, recycle & reuse methods	0.12098	4
Rising alertness on sustainability subjects and promoting green policy	0.10641	5
Competency of project team	0.10611	6
Supporting and adopting goal orientation policy	0.07509	7
Adopting the principle of sustainability in the design process	0.07072	8
Well-defined scope of work	0.05614	9
<b>Inconsistency: 0.09198</b>		

### 3.4.2.4. Environmental factors

The environmental Factors category was split into three sub- Factors. With an inconsistency of 0.00885, this study indicates that developing new environmental training programs was the most important factor in this category with a weight of (0.53961). The competitive nature of construction companies has been raised above building high-quality products at a low price and limited time. Social and corporate responsibility issues are becoming more important to organizational competitiveness at both the operational and strategic levels.

Preserving the natural environment is at the core of the new competitive argument for green and sustainable corporate education. Such corporate education could be evolved by depending on practical training programs at both strategic and operational levels to be set as a mission for the construction companies. The practical training should include the implementation of preventive measures at the site to mitigate or reduce environmental pollution. The training program should also include the consequences of neglecting such measures in site management. With a weight of (0.29696), applying measures of site precaution for mitigating pollution of the environment ranked two, followed by Environmental management systems /GM policy -ISO 14001 with a weight of (0.16342). Table 7 indicates sub- aspects prioritization of the environmental Factors category.

Table 7. Environmental Sub-factor

<b>Environmental Factors</b>	<b>Sorted weight value</b>	<b>Rank</b>
Develop new environmental training programs	0.53961	1
Applying measures of site precaution for mitigating pollution of the environment	0.29696	2
Environmental management systems /GM policy -ISO 14001	0.16342	3
<b>Inconsistency: 0.00885</b>		

### 3.4.2.5. Governmental factors

Table 8 shows sub- Factors prioritization of the governmental aspects category. Three sub- Factors represent the governmental Factors category. With an inconsistency of (0.00000), the present findings suggest that government support and government regulation and the legislation both had the same weight of (0.40000) and ranked first and second respectively. Also, Economic and political stability was ranked third with a weight of (0.20000). The government is a critical factor in approving sustainability and green activities, as the government has a direct and indirect role in adopting, promoting, and implementing sustainability and green actions. Recently, the companies being under increasing pressure from many diverse parties i.e., government legislation and regulation, non-governmental Agencies, and market competition, to take part in environmental initiatives. The government legislation and regulation represent the main driver's aspects for the companies to adopt and comply with the environmental commitment. Therefore, the government should move forward with the enactment of laws that ensure that the companies will improve their environmental procedures according to the local level within the framework of the global vision of sustainability.

Table 8. Governmental Sub-factor

<b>Governmental Factors</b>	<b>Sorted weight value</b>	<b>Rank</b>
Government support	0.40000	1
Government regulation and legislation	0.40000	2
Economic and political stability	0.20000	3
<b>Inconsistency: 0.00000</b>		

### 3.4.2.6. Customer-supplier factors

The customer-supplier Factors category was divided into three sub- Factors. With an inconsistency of (0.05156), the study highlights that availability for green procurement and green manufacturing in the market was the most important factor in this category with a weight of (0.59363). With a weight of (0.24931), demand from customers for environmental protection requirements was ranked second, Moreover, Customers - supplier pressure and commitment ranked third with a weight of (0.15706). Construction project procurements play an important role as a driver for the development of the economy. However, Iraq, as a developing country, must take into consideration the preservation of the environment during the development process to prevent the degradation of the environment. So, the issue of degradation in the environment must be diagnosed and treated to prevent more damage to the environment. One of the initiative treatments that can be applied is green procurement. However, there is no regulation or legislation concerned with adopting green procurement in the public or private projects of construction. Thus, governmental motivation, market competition and knowledge increment about the green products benefits represent the main aspects for the adoption of green procurement which will lead the way for converting traditional manufacturing to green manufacturing. On the other hand, the customers demand for the environmental protection requirements will also represent a critical factor for adopting GM, whether related to the green product or environmental preservation, since the construction

companies always seek to satisfy the customer requirements. Table 9 demonstrates sub- Factors prioritization of the Customers - supplier Factors category.

Table 9. Customer-Supplier Sub-factor

Customer-supplier Factors	Sorted weight value	Rank
Availability for green procurement and green manufacturing in market	0.59363	1
Demand from customers in environmental protection requirements	0.24931	2
Customers - supplier pressure and commitment	0.15706	3
<b>Inconsistency: 0.05156</b>		

### 3.4.2.7. External factors

Four sub- Factors represent the external Factors category. At an inconsistency of (0.04544), our finding revealed that, with a weight of (0.59363); effective communication channels between government, consultants, and suppliers were the most important factor in this category. Society or public pressure was graded 2<sup>nd</sup> with (0.24264) weight. Also, improving the image of the construction company was graded 3<sup>rd</sup> with (0.24264) weight. Finally, social responsibility was ranked 4<sup>th</sup> with (0.17157) weight. Since there are many parties involved in any construction project graded (i.e. owner, consultant, contractor, and supplier), communication between these parties and the government is very important to the success of GM. Appropriate channels of communication between the various parties and the government should be established in the manner of two-way communications which will facilitate understanding the obstacles, requirements, and regulations necessary for applying GM. Lack of coordination and communication between the parties may lead to many adverse aspects influencing the GM implementation.

Alternatively, companies of construction are willing to adopt GM to enhance their image and comply with the community or public pressure by showing environmental issues primarily of construction companies' interest. Table 10 demonstrates sub- Factors prioritization of the external Factors category.

Table 10. External Sub-factor

External Factors	Sorted weight value	Rank
Society or public pressure	0.24264	2
Effective communication channels between government, consultants, and suppliers	0.34315	1
Improve the image of the construction company	0.24264	3
Social responsibility	0.17157	4
<b>Inconsistency: 0.04544</b>		

## 4. Conclusions and recommendations

GM has been viewed as an essential foundation for contraction organizations striving to make their performance better. Today, pretty much every significant business in the world has perceived the cases of GM not similarly as a protective component to hold authenticity and the option to work, however as a focal point of an association's continuous mission and justification behind being. This paper identified 29 serious achievement Factors for GM projects in Iraq, the geometric mean response values of data from survey respondents and super decisions software SDS with process of analytic hierarchy were utilized for ranking the aspects based on the perceptions judgments. These aspects were categorized into 7 chief groups. The Financial Factors appears as the most important main Factors, while Global orientation towards sustainability and GM, Cost-optimization by green procurement, Acquisitions of modern and high technology, develop new environmental training programs, Government support, Availability for green procurement and green manufacturing in market and Effective communication channels between government, consultants and suppliers are the most important sub-aspects. This paper shows the legislation represents the main motivation aspects for adopting GM.

Accordingly, the current paper extracted the following recommendations:

- The government should state a motivation system to encourage the construction companies to adopt GM.
- Establishing the necessary managerial framework for the companies that willing to adopt the GM

- The government will need to establish an environmental accounting and auditing system. Environmental reporting includes a lot of accounting techniques and should be consistent with auditing techniques.
- The government should enact the necessary regulations and legislation to comply with the global trend toward adopting the preservation of the environment.
- Training the top management in the construction companies on the advantages and requirements of GM, as well as the, preparing the strategic plans for the competition requirement at the global level.

### Competing Interest Declaration

The authors declare that they have no recognized non-financial or financial competing interests in any materials conversed in the current work.

### Funding

No funding was gained from any financial organization for conducting the current work.

### References

- [1] Zuo, J., & Zhao, Z. Y. (2014). Green building research—current status and future agenda: A review. *Renewable and sustainable energy reviews*, 30, 271-281. <https://doi.org/10.1016/j.rser.2013.10.021>
- [2] Alajeeli, H. K., & Al Kaabi, S. A. (2016). A study of waste management reality in projects of construction in Iraq. *Wasit Journal of Engineering Science*, 4(1), 75-92. 3.
- [3] Ali, H. H., & Al Nsairat, S. F. (2009). Developing a green building assessment tool for developing countries—Case of Jordan. *Building and environment*, 44(5), 1053-1064. <https://doi.org/10.1016/j.buildenv.2008.07.015>
- [4] Oyebanji, A. O., Liyanage, C., & Akintoye, A. (2017). Critical Success aspects (CSFs) for achieving sustainable social housing (SSH). *International journal of sustainable built environment*, 6(1), 216-227. <https://doi.org/10.1016/j.ijsbe.2017.03.006>
- [5] Hwang, B. G., & Ng, W. J. (2013). Project management knowledge and skills for green construction: Overcoming challenges. *International journal of project management*, 31(2), 272-284. <https://doi.org/10.1016/j.ijproman.2012.05.004>
- [6] Dasgupta, S., Hettige, H., & Wheeler, D. (2000). What improves environmental compliance? Evidence from Mexican industry. *Journal of Environmental Economics and Management*, 39(1), 39-66. <https://doi.org/10.1006/jeem.1999.1090>
- [7] Wagner, M. (2007). On the relationship between environmental management, environmental innovation and patenting: Evidence from German manufacturing firms. *Research policy*, 36(10), 1587-1602. <https://doi.org/10.1016/j.respol.2007.08.004>
- [8] Horbach, J. (2008). Determinants of environmental innovation—New evidence from German panel data sources. *Research policy*, 37(1), 163-173. <https://doi.org/10.1016/j.respol.2007.08.006>
- [9] The World Bank. (2017). Iraq - Systematic Country Diagnostic (English). Washington, D.C.: World Bank Group. <http://documents.worldbank.org/curated/en/542811487277729890/Iraq-Systematic-Country-Diagnostic>
- [10] Abu Bakar, Raida & Azlan, Azwandi. (2020). GM Strategy -An Initiative Towards Sustainable Practices. *International Journal of Business and Management*. 4, pp. DOI: 10.26666/rmp.ijbm.2020.6.1
- [11] Hamad, S. H. (2014). An Assessment of Environmental Pollution and Source of Pollution in Baghdad, Iraq (Doctoral dissertation, The University of Wisconsin-Madison).
- [12] Ministry of Planning - Central Statistics organization (CSO), The Republic of Iraq, Ministry of Planning, Central Bureau of Statistics, Department of Environment Statistics, Iraq Environmental Statistics, 2022. [Internet]. Available from: [www.cosit.gov.iq/](http://www.cosit.gov.iq/)
- [13] United Nation Environment Programme (2013). The National Environmental Strategy and Action Plan (2013 – 2017) for Iraq, 2013, pp. 19, Iraq. <https://www.unep.org/resources/report/national-environmental-strategy-and-action-plan-2013-2017-iraq>
- [14] Zhang, J. (2012). Delivering environmentally sustainable economic growth: The case of China. *Asia Society Report*, 2-25. <http://www.lapres.net/asiasociety.pdf>
- [15] Wu, C., & Barnes, D. (2016). An integrated model for green partner selection and supply chain construction. *Journal of Cleaner Production*, 112, 2114-2132, <http://dx.doi.org/10.1016/j.jclepro.2015.02.023>
- [16] Peng, Y. S., & Lin, S. S. (2008). Local responsiveness pressure, subsidiary resources, GM adoption and subsidiary's performance: Evidence from Taiwanese manufactures. *Journal of Business Ethics*, 79(1), 199-212. <https://doi.org/10.1007/s10551-007-9382-8>
- [17] Shu, C., Zhou, K. Z., Xiao, Y., & Gao, S. (2016). How GM influences product innovation in China: The role of institutional benefits. *Journal of Business Ethics*, 133(3), 471-485. <http://dx.doi.org/10.1007/s10551-014-2401-7>
- [18] Goyal, Monika (2013). Future Outlook of GM Practices. *IOSR Journal of Business and Management (IOSR-JBM)* Volume 14, Issue 6 (Nov. - Dec. 2013), PP 68-72 10.9790/487X-1466872

- [19] Ezanee, M. E., Nadarajan, S., & Norlila, M. (2013). Green business management and green supply chain practises: A case study in a manufacturing organization. *Journal of Technology and Operations Management*, 8(1), 15-33. <https://doi.org/10.32890/jtom2013.8.1.2>
- [20] Leonidou, C. N., Katsikeas, C. S., & Morgan, N. A. (2013). “Greening” the marketing mix: Do firms do it and does it pay off?. *Journal of the Academy of Marketing Science*, 41(2), 151-170. <https://doi.org/10.1007/s11747-012-0317-2>
- [21] Ambec, S., & Lanoie, P. (2008). Does it pay to be green? A systematic overview. *The Academy of Management Perspectives*, 45-62. <https://www.jstor.org/stable/27747478>
- [22] Bansal, P., & Roth, K. (2000). Why companies go green: A model of ecological responsiveness. *Academy of management journal*, 43(4), 717-736. <http://dx.doi.org/10.2307/1556363>
- [23] Chabowski, B. R., Mena, J. A., & Gonzalez-Padron, T. L. (2011). The structure of sustainability research in marketing, 1958–2008: a basis for future research opportunities. *Journal of the Academy of Marketing Science*, 39(1), 55-70. <https://doi.org/10.1007/s11747-010-0212-7>
- [24] Gudienė, N., Banaitis, A., & Banaitienė, N. (2013). Evaluation of critical success aspects for projects of construction—an empirical study in Lithuania. *International journal of strategic property management*, 17(1), 21-31. <https://doi.org/10.3846/1648715X.2013.787128>
- [25] Frank, B. (2009). The role of " GM" in the implementation of the concept of social responsibility. Available at: [www.irdo.si/skupni-cd/cdji/cd-irido-2010/images/3-4-7-frank.pdf](http://www.irdo.si/skupni-cd/cdji/cd-irido-2010/images/3-4-7-frank.pdf)
- [26] Hosseini, A. (2007). Identification of GM system’s aspects: A conceptualized model. *International Journal of Management Science and Engineering Management*, 2(3), <https://doi.org/10.1080/17509653.2007.10671022>
- [27] Zsidisin, G. A., & Siferd, S. P. (2001). Environmental purchasing: a framework for theory development. *European Journal of Purchasing & Supply Management*, 7(1), 61-73. [https://doi.org/10.1016/S0969-7012\(00\)00007-1](https://doi.org/10.1016/S0969-7012(00)00007-1)
- [28] Apsan, H. N. (2000). Running in nonconcentric circles: Why environmental management isn't being integrated into business management. *Environmental Quality Management*, 9(4), 69-75. [https://doi.org/10.1002/1520-6483\(200022\)9:4<69::AID-TQEM7>3.0.CO;2-3](https://doi.org/10.1002/1520-6483(200022)9:4<69::AID-TQEM7>3.0.CO;2-3)
- [29] Ziegler, A., & Sejas Nogareda, J. (2006). GM and green technology-exploring the causal relationship. ZEW-Centre for European Economic Research Discussion Paper, (06-040) [https://papers.ssrn.com/sol3/papers.cfm?abstract\\_id=917070](https://papers.ssrn.com/sol3/papers.cfm?abstract_id=917070)
- [30] Mathiyazhagan, K., Datta, U., Singla, A., & Krishnamoorthi, S. (2018). Identification and prioritization of motivational aspects for the green supply chain management adoption: case from Indian construction industries. *Opsearch*, 55(1), 202-219. <https://doi.org/10.1007/s12597-017-0316-7>
- [31] Cronstam, O., & Grönberg, J. (2017). Influencing aspects in the implementation of GM practices: A qualitative study regarding Swedish SMES in Logistics. <https://www.diva-portal.org/smash/get/diva2:1116776/FULLTEXT01.pdf>
- [32] Wibowo, M. A., Handayani, N. U., & Mustikasari, A. (2018). aspects for implementing green supply chain management in the industry of construction. *Journal of Industrial Engineering and Management*, 11(4), 651-679. 11. 651. 10.3926/jiem.2637.
- [33] Alqadami, A. T., Zawawi, N. A. W. A., Rahmawati, Y., Alaloul, W., & Alshalif, A. F. (2020, May). Key Success aspects of Implementing Green Procurement in Public projects of construction in Malaysia. In *IOP Conference Series: Earth and Environmental Science* (Vol. 498, No. 1, p. 012098). IOP Publishing. doi:10.1088/1755-1315/498/1/012098
- [34] Taghavi, E., Fallahpour, A., Wong, K. Y., & Hoseini, S. A. (2021). Identifying and prioritizing the effective aspects in the implementation of green supply chain management in the industry of construction. *Sustainable Operations and Computers*, 2, 97-106. <https://doi.org/10.1016/j.susoc.2021.05.003>
- [35] Saaty, T. L. (2008). Decision making with the analytic hierarchy process. *International journal of services sciences*, 1(1), 83-98.
- [36] Ho, W., & Ma, X. (2018). The state-of-the-art integrations and applications of the analytic hierarchy process. *European Journal of Operational Research*, 267(2), 399-414. <https://doi.org/10.1016/j.ejor.2017.09.007>
- [37] Darko, A., Chan, A. P. C., Ameyaw, E. E., Owusu, E. K., Pärn, E., & Edwards, D. J. (2019). Review of application of analytic hierarchy process (AHP) in construction. *International journal of construction management*, 19(5), 436-452. <https://doi.org/10.1080/15623599.2018.1452098>
- [38] Adams W. J. L. and Saaty R. (2003), “Super Decisions Software Guide,” Creative Decisions Foundation, pp. 43,
- [39] Liu, H., Skibniewski, M. J., & Wang, M. (2016). Identification and hierarchical structure of critical success aspects for innovation in projects of construction: Chinese perspective. *Journal of Civil Engineering and Management*, 22(3), 401-416. <https://doi.org/10.3846/13923730.2014.975739>
- [40] Gandhi, A. V., Shaikh, A., & Sheorey, P. A. (2017). Influence of supply chain management practices on firm performance: Empirical evidence from a developing country. *International Journal of Retail & Distribution Management*. <https://doi.org/10.1108/IJRDM-06-2015-0076>
- [41] AlKhidir, T., & Zailani, S. (2009). Going green in supply chain towards environmental sustainability. *Global Journal of Environmental Research*, 3(3), 246-251.

- [42] Gudienė, N., Banaitis, A., Banaitienė, N., & Lopes, J. (2013). Development of a conceptual critical success aspects model for projects of construction: a case of Lithuania. *Procedia Engineering*, 57, 392-397. <http://doi.org/10.1016/j.proeng.2013.04.051>
- [43] Jagarajan, R., Asmoni, M. N. A. M., Mohammed, A. H., Jaafar, M. N., Mei, J. L. Y., & Baba, M. (2017). Green retrofitting—A review of current status, implementations and challenges. *Renewable and Sustainable Energy Reviews*, 67, 1360-1368. <https://doi.org/10.1016/j.rser.2016.09.091>
- [44] Hwang, B. G., Leong, L. P., & Huh, Y. K. (2013). Sustainable green construction management: Schedule performance and improvement. *Technological and Economic Development of Economy*, 19(sup1), S43-S57., DOI: 10.3846/20294913.2013.869669
- [45] Liu, J. Y., Low, S. P., & He, X. (2012). Green practices in the Chinese building industry: drivers and impediments. *Journal of technology management in China*. <https://doi.org/10.1108/17468771211207349>.
- [46] Yong, Y. C., & Mustaffa, N. E. (2013). Critical success aspects for Malaysian projects of construction: an empirical assessment. *Construction Management and Economics*, 31(9), 959-978. <https://doi.org/10.1080/01446193.2013.828843>
- [47] Potbhare, V., Syal, M., & Korkmaz, S. (2009). Adoption of green building guidelines in developing countries based on US and India experiences. *Journal of Green Building*, 4(2), 158-174. <https://doi.org/10.3992/jgb.4.2.158>
- [48] Hafezalkotob, A. (2017). Competition, cooperation, and co-competition of green supply chains under regulations on energy saving levels. *Transportation Research Part E: Logistics and Transportation Review*, 97, 228-250. <https://doi.org/10.1016/j.tre.2016.11.004>
- [49] Min, H., & Galle, W. P. (2001). Green purchasing practices of US firms. *International journal of operations & production management*. <https://doi.org/10.1108/EUM0000000005923>
- [50] HUANG, X., TAN, B. L., & LI, D. (2012). Pressures on green supply chain management: a study on manufacturing small and medium-sized enterprises in China. *Transportation*, 500(30), 500-3000. DOI: 10.3968/j.ibm.1923842820120401.1185
- [51] Mudgal, R. K., Shankar, R., Talib, P., & Raj, T. (2010). Modelling the barriers of green supply chain practices: an Indian perspective. *International Journal of Logistics Systems and Management*, 7(1), 81-107.
- [52] Wu, G. C., Ding, J. H., & Chen, P. S. (2012). The effects of GSCM drivers and institutional pressures on GSCM practices in Taiwan's textile and apparel industry. *International Journal of Production Economics*, 135(2), 618-636. <https://doi.org/10.1016/j.ijpe.2011.05.023>
- [53] Cruz, L. B., & Pedrozo, E. A. (2009). Corporate social responsibility and GM: relation between headquarters and subsidiary in multinational corporations. *Management Decision*, 47(7), 1174-1199. 10.1108/00251740910978368.
- [54] Saaty, T. L. (2001). Fundamentals of the analytic hierarchy process. In *The analytic hierarchy process in natural resource and environmental decision making* (pp. 15-35). Springer, Dordrecht. [https://doi.org/10.1007/978-94-015-9799-9\\_2](https://doi.org/10.1007/978-94-015-9799-9_2)