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Investigating the Use of Building Information Modeling (BMI) in Facilitating Construction Management and Sustainable Development in Supply Chain Management (SCM) in the Construction Industry

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Abstract

This research aims to create new ways to create information about architecture, and then, according to the things presented above, it describes and examines the main and secondary indicators. The purpose of this study is to investigate the concept, advantages, limitations, and challenges of public-private collaboration of BIM and SCM. The main indicators in this research are management factors and project beneficiaries, technical and infrastructure factors, financial factors, and safety and quality factors . After identifying the small signs and symptoms, first, by placing the big signs, the ranking of the two comparisons related to the big signs is entered into the Selection Expert program. Then, their weight is determined based on the AHP algorithm. The findings of the research show that the criterion of managerial factors and project stakeholders with a weight of (0.449) is the most important in examining the use of Building Information Modeling (BIM) in facilitating construction management and sustainable development in Supply Chain Management (SCM) in the construction industry. and the criteria of technical and infrastructural factors, economic factors and security and quality factors are ranked second to fourth with weights of 0.288, 0.152, 0.138 and 0.126 respectively. On the other hand, among the five objectives investigated, the option of reducing cost and time wastage with a weight of 0.279 is the best effect of using BIM in facilitating construction management and sustainable development in SCM. The selected construction industry, as well as the goals of improving operational efficiency, quality, and productivity, are ranked second and third with a difference of 4.66% and 17.20%, respectively.

Keywords: Supply chain management, Production models, Production, Sustainable development.

1 | Introduction

In recent years, a lot of research has been done in the field of Supply Chain Management (SCM) in the construction industry. The application of SCM in the construction industry still focuses on the internal level,

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which is the management of materials and resources. Meanwhile, Building Information Modeling (BIM) has been used as a new technology in the construction industry. BIM helps designers visualize the planning of the structure in an integrated automatic drawing, coding, and sequencing to become a model of the building that realistically provides information [1].

The concept of SCM basically integrates stakeholders to collaborate from upstream to downstream. But, the problem that occurs in the construction project is how to establish good communication between the stakeholders in the supply chain flow. There are still many lost communications and a lack of information between contractor and supplier, contractor and subcontractor, and contractor and owner. In fact, these problems and challenges affect the promotion and improvement of the quality level of the project. BIM with integrated technology from design to construction and monitoring has the opportunity to be a suitable bridge between project stakeholders [2].

Currently, many people understand BIM and are aware of the importance of SCM in construction projects but have not implemented it together. Therefore, the main goal of this study is to fill this gap and identify and prioritize performance indicators of the supply chain of the construction industry based on the application of BIM technology and provide suggested solutions in the field of sustainable performance of the sustainable supply chain in order to benefit from information modeling. It is a building.

2|Supply Chain Management

In general, the supply chain includes all activities related to the flow of goods from the supply phase of materials and raw materials to the final stage, as well as the flow of information related to it. In this regard, SCM is the optimal and efficient management of all processes that begin with the design of a product or service and end with its sale to the final consumer. In other words, SCM can be defined as the coordination and integration of activities related to the flow of materials and information by improving the chain in order to achieve a competitive position [3].

As stated, the supply chain includes all matters related to the flow of goods and the transformation of materials, from the initial procurement phase to reaching the end consumer, but in relation to the flow of goods, there are two other flows: the flow of information. There is also a flow of financial and credit resources. Also, the supply chain does not only consist of manufacturers and suppliers but also includes transporters, warehouses, retailers, and even customers [4].

Various definitions of the supply chain have been presented; in the first view, some consider the supply chain limited to the relationship between the buyer and the seller. So, in this view, there is emphasis only on the first-level purchasing operations in an organization. If it is looked at from the point of view of the second approach, which has a broader view of the supply chain, the supply chain includes all sources of supply for an organization. In this definition, the supply chain includes all the suppliers of the first, second, third, etc. In this definition, only the analysis of the supply network has been discussed.

However, in the third view, Porter's value chain, the supply chain includes all the activities necessary to provide the product or service to the final consumer. From this point of view, manufacturing and distribution functions are added to the supply chain as part of the flow of goods. In other words, in this view, the supply chain includes three parts: procurement, production, and distribution [5].

In general, a supply chain consists of two or more organizations that are separate from each other and are connected through the flow of materials, information, and financial management. Instead, these organizations are companies that produce materials, parts, and finished products or provide services such as distribution, storage, sales, and marketing. Currently, one of these organizations may be consumers [6].

Therefore, the optimal performance and efficiency of the supply chain require a coherent and dynamic structure that can prepare and provide goods or services for consumption. Meanwhile, there are challenges, such as designing and supplying specialized parts, which add to the complexity of the supply chain [7].

Today, due to population growth and the need for communities to build housing, recreation centers, hospitals, sports halls, roads, bridges, etc., the construction industry has become very important. In this regard, the construction industry is one of the huge mother industries that has a wide supply chain [8].

In total, there are six basic elements in the supply chain process, including production, supply, inventory, location, transportation, and information. The production element emphasizes the supply chain process in the strategic phase on customers and consumers and market demands as well as the schedule in order to meet the immediate needs of consumers in the market. The supply element in the supply chain process creates the conditions for economical and efficient production to meet the needs of the final consumers; therefore, organizations and companies are forced to use suppliers to keep costs low and flexibility high.

Choose more carefully. In this process, the element of warehouse inventory is related to the company's stored level of inventory. In fact, a large amount of stock increases storage costs, and a small and insufficient amount of stock causes a lack of response to market demands and loss of income and customers. The location element in the supply chain process emphasizes the location of production machinery, distribution, and warehousing facilities in the market. The transportation element is related to the quick and economical delivery of goods and services to the customer. The information element also deals with the connection of information sources throughout the supply chain process.

3 | Major Supply Chain Processes

In general, the supply chain is classified into three processes: logistics management, relationship management, and information management, which are described below.

Logistics management

In the analysis of production systems, such as the construction industry, logistics is included in the physical part of the supply chain. This department, which includes all the physical activities from the raw material procurement phase to the final product, including activities such as transportation, warehousing, production schedule, etc., includes a huge part of the supply chain activities. On the other hand, the logistics management process is not specific to the flow of materials and goods; it is the focus of supply chain activities, where relationships and information are the supporting tools for improving efficiency and performance in activities.

Relationship management

In general, the key and perhaps the most important part of SCM due to its construction is the management of relationships in the supply chain. Relationship management has significant effects in all areas of the supply chain and its functional levels. The main point that should be noted is that despite the ease of access to information systems and new technologies in supply chain activities and the short time required for its implementation and use, many of the failures at the beginning of the supply chain are caused by the weakness in transferring the expectations and demands of the stakeholders and parties involved in the project. As stated, the most important factor in SCM is reliable communication between stakeholders in the supply chain. As a result, in order to develop and grow in an integrated and coordinated supply chain, the development of trust and confidence among the stakeholders and their reliability plan are among the main and important criteria for achieving success.

Information management

One of the main and important concerns of organizations in SCM is information management. The lack of proper circulation and proper transfer of information causes uncertainty and integration between various parts of the supply chain; therefore, it causes a lack of effectiveness and efficiency in the processes, and their management suffers from major problems. Because in the issue of information management in the supply chain, management of information systems and information transfer is of particular importance. Coordinated information management among project stakeholders and the supply chain causes significant effects on the acceleration, accuracy, and quality of final products. Therefore, information management in various parts of

the supply chain, such as logistics management, processing, and access to logistics information in order to coordinate and integrate the processes of transportation, ordering and manufacturing, manufacturing and production schedules, warehousing operations, and exchange and processing of information between stakeholders. The project is effective in collecting and processing supply and demand information, sourcing and evaluating and predicting market trends and the future of supply and demand.

4 | Explanation of Supply Chain Performance at Three Levels

In general, the supply chain is classified into three levels from the point of view of management hierarchy. Each of these levels has its own performance criteria. Performance indicators are usually classified into two categories: financial and non-financial criteria. Despite the understanding and awareness of the importance of these indicators, organizations have not yet reached the implementation phase in a balanced way. In *Fig. 1*, performance indicators of the supply chain are shown in three levels [9].

I. First level: commercial (strategic) level indicators

At this level, the achievement of the active centers in the supply chain is evaluated in relation to the planned performance. Based on quality award models, important and outstanding results are analyzed and reviewed in relation to the main elements of the policy and strategy, as well as the extent of their achievement at the commercial level.

II. Second level: process level indicators

Many researches and studies have been done in line with capabilities and process indicators. In this connection, in the surveys conducted by Lynch and Cross, performance at the process level can be evaluated from the perspective of productivity, flexibility, and customer satisfaction indicators.

III. The third level: operational level indicators

At this level, various approaches and indicators are used to check the performance of activities. He examined the performance of the activities from the external aspect with indicators such as reliability and responsiveness and from the internal point of view with factors such as cost and waste, internal delays, and delivery time.

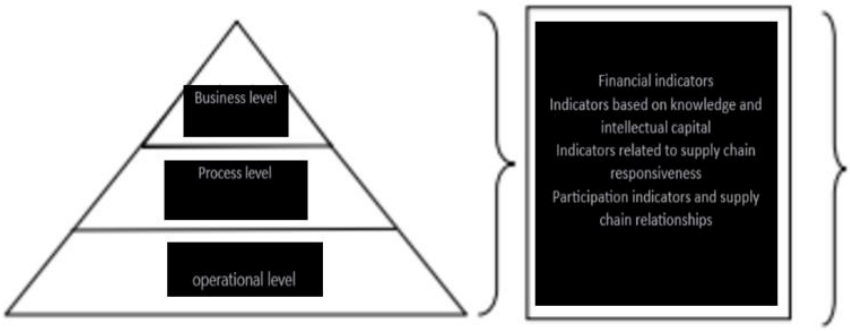

Fig. 1. Performance indicators of the supply chain at different levels of the chain.

4 | Building Information Modeling

The concept of BIM first emerged in the 1970s; however, the term BIM was used in the 1992 article by Van Nedron and Talman. However, it was not used until 10 years later and was revisited in 2002 in an article entitled BIM by Autodesk. In the meantime, various companies such as Graphisoft company under the title of virtual construction, Batley System company under the title of integrated project models, and Autodesk Vector Work company under the title of BIM, have developed a type of BIM concept in order to improve Cooperation and information exchange in the digital platform have benefited from this concept [10]. *Fig. 2* shows the integrated model of BIM.

Fig. 2. Integrated BIM model.

5 | Conclusions

The key indicators in this study are project management and stakeholders, technical and infrastructural, financial and safety, and quality. After identifying the symbols and sub-symbols, first, to preserve the main symbols, an array of pairwise comparisons that are similar to the main symbols are entered into the selector's specialized program, and then the weight is determined using the AHP algorithm.

In the field of studies conducted in this research, the following suggestions are presented for future research.

I. Identifying and evaluating factors that play a role in using Internet of Things technology in SCM

II. The feasibility of implementing blockchain technology in the sustainable supply chain in the construction industry.

III. Investigating and studying the impact of smart cities on the success of SCM and facilitating the management of construction projects.

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