



## A Brief Review on Worker and Material Planning in Constructions with BIM

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### Abstract

In this article, studies on labor and material planning in construction projects using BIM are discussed. With the development of technology, the technological needs of civil engineering have increased day by day. Especially with the growth of construction projects, problems in management and organization issues have started to arise. At this point, we come across BIM. Thanks to BIM, the technological developments needed by various departments in the projects have been met. In particular, there are different studies in the literature in order to meet the need for labor and material planning in projects. In this study, the studies on the subject have been tried to be brought together to a certain extent.

## BIM ile İnşaatlarda İşçi ve Malzeme Planlaması Üzerine Kısa İnceleme

### Anahtar Kelimeler;

BIM,  
YAPI YÖNETİMİ,  
İŞÇİ VE MALZEME  
PLANLAMASI

### Özet

Bu makalede BIM kullanılarak inşaat projelerinde işçi ve malzeme planlaması konusunda yapılan çalışmalar ele alınmıştır. Teknolojinin gelişmesiyle beraber inşaat mühendisliğinin duyduğu teknolojik ihtiyaçlarda her geçen gün artmıştır. Özellikle inşaat projelerini büyümesiyle beraber yönetsel ve organizasyon konularında sorunlar ortaya çıkmaya başlamıştır. Bu noktada karşımıza BIM çıkmaktadır. BIM sayesinde projelerdeki çeşitli departmanların ihtiyaç duydukları teknolojik gelişmeler karşılanmıştır. Özellikle de projelerdeki işçi ve malzeme planlaması konusundaki ihtiyacın karşılanması amacıyla literatürde farklı çalışmalar bulunmaktadır. Bu çalışmada konuyla ilgili olarak yapılan çalışmalar belirli bir oranda bir araya getirilmeye çalışılmıştır.

## 1 INTRODUCTION

Civil engineering practices have always existed at different levels since the dawn of mankind. The discovery of cement, the main component of concrete, was accompanied by freer building designs. The development of technology has also brought some innovations in construction practices. Keywords such as economy, workmanship, and use of materials have become the defining elements of projects. Modern construction is significantly influenced by the economics and efficiency of the industry directly or indirectly related to construction. Today, the majority of the world's population lives in cities, of which buildings are an important part [1,2]. Therefore, the development of cities, in other words, the buildings where people live, is important for both the welfare level and economic development of society. On

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the other hand, economic development causes significant damage to the environment. The CO<sub>2</sub> emission that occurs during the production and use of materials used in the construction industry seriously affects global warming in a negative way. Considering all these conditions, it becomes clear how important material planning and management is. Major construction projects require a variety of resources, including materials, personnel worker workforce, and equipment, after the initial planning and design phase. It is possible to establish a strong connection between any one resource component and other resource categories. Therefore, for construction projects to be planned effectively and proceed in an orderly manner, logistics and procurement issues need to be properly implemented, adhering to the basic principles as much as possible. In order to examine the management of construction projects, it is necessary to consider the following main topics: classification of supply projects, service activities and construction logistics, procurement and supply status of materials, transportation, and warehouse locations. Building projects, public projects, and other categories can all be used to categorize construction projects. It includes basic policies such as procurement and supply of building materials, inventory and stocking of materials, material requirement planning, and timely supply. Building Information Modelling BIM corresponds to all these needs.

## **2 BIM**

Nowadays, as a result of the advancement of technology, technical techniques such as In an effort to satisfy the expectations of the construction sector, BIM, automation, artificial intelligence, machine learning, deep learning, robotic blockchain, etc. are gaining popularity [3]. The concept of BIM is basically a term that aims to better represent the geometric and non-geometric properties of building elements as well as the relationship between all elements [4]. BIM has gained popularity in the construction sector, notably during the past ten years, thanks to the benefits it provides for the service life of construction projects [5]. This approach has advanced to the point where any promising innovation in the building sector must be appropriate for and compatible with BIM [6]. The adoption of BIM in the construction industry improves the collaboration between the people or organizations involved in the project as well as the advantages it provides in design, construction, maintenance, and operation. While the history of CAD, which is used in 2D design for sharing architectural plans, dates to the 1970s, the concept of BIM only appeared in the early 2000s. [5]. BIM includes every stage of a building project, from the planning stage to project completion. Basically, it stores all the information it produces and has in the process from the first project to the last project and allows this information to interact and communicate with each other [6]. At the same time, it is also possible to define it as a technology that has rules, processes, and interactions within itself, where the project and design data required for the service process of the building can be managed [7]. Thanks to BIM, it is a model that reduces fragmentation in the construction industry, increases efficiency, increases efficiency and reduces costs by working together in harmony [8]. BIM enables projects in the construction industry to be designed and managed in an environmentally friendly, economical, and more efficient way. One of the most promising techniques for evaluating the sustainability of construction projects that have benefited from engineering and architectural services is BIM [9]. It allows the digital management of projects such as buildings, infrastructure, etc. throughout their entire service life and facilitates the relationship and collaboration between all those involved in the project (engineers, architects, contractors, owners, etc.) [10]. Due to the various advantages obtained by using BIM, its use is encouraged in different countries of the world. It draws attention throughout the whole service term, not just during the design phase but also during the operations and maintenance procedures of completed projects [11]. Thanks to the BIM database, improvements have been achieved in drinking water and

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sewerage design processes. A traffic study methodology for highway intersection design based on BIM was developed by Casta neda et al. [12]. By fabricating a common virtual data environment that allows for any alterations during and after construction, BIM can be utilized to replicate project design, construction, and demolition stages [13]. BIM makes it simpler to gather, classify, modify, update, and analyze project information, and it connects readily to the criteria required for decision-making by various branches [14–15]. In the simplest terms, BIM facilitates information management and interchange amongst the many project branches.

### **2.1 Property of BIM**

#### **2.1.1. Visualization**

In the construction industry, visualization is crucial. Relying on the human brain to imagine and solve problems has been less and less effective in recent years due to the variety of architectural forms in the construction sector and the growth of more sophisticated models. BIM technology meets the need at this point [18-19].

#### **2.1.2. Coordination**

In construction projects, business owners and construction-related units need to work in coordination and coordination with each other. In case of any problem or work delay in the project, it is easy to find out from which unit the error is caused by coordination, which is one of the basic features provided by BIM. However, since there is not enough coordination between the units during the design phase of the project, it causes delayed communication between the units on some issues.

#### **2.1.3. Simulation**

Simulation studies on several subjects, including emergency evacuation, sunlight, energy conservation, and heat conduction of construction projects, can be conveniently carried out during the design phase of BIM. In addition, simulations of real construction can be easily realized during the construction and tender process. In addition to these, simulations that are needed can be easily realized [18,20].

### **2.2. Worker and Material Planning in Construction with BIM**

In essence, BIM is an innovation and concept that is ideal for managing and digitally simulating the planning, design, construction, and operation phases of construction projects. In particular, it allows the deficiencies in worker and material planning in the construction sector to be solved within a plan and design. The integration of information such as the number of workers, working time, worker skills, and material procurement and planning into the BIM model is an important issue. In this way, worker and material planning in construction becomes more logical, accurate, and consistent. The project's schedule and resource management must now incorporate worker and material planning because of BIM. Issues such as at which stage of the project workers and materials will be needed, at which stage and when they will be used in the project, and how important they are in which line of work are of importance. In this way, it is easier to identify key workers and material items. It significantly helps the project to be completed on time. As a result, thanks to BIM, worker and material planning, like other plans, is integrated into the system, allowing the project to be better organized and resources to be used more effectively. In this way, construction projects become more economical, more efficient, and more sustainable organizations.

### **2.2.1. Material Planning and Management**

The cost of project materials makes up about 70% of the entire cost of building in the construction sector. Therefore, material planning and management directly affect the costs of projects. Especially with the developments in technology, different technological approaches such as BIM, Internet of Things, etc. are adopted in the design, planning, management, and operation of the construction industry [21]. In this way, the necessary optimizations in issues such as worker and material planning in construction can be easily made. Xie et al. [22] stated that material planning and arrangement before the start of construction projects is important in terms of project durations and work organization. A BIM project management system based on 5D was reportedly developed in 2014 for the integration of cost material information with the progress of project works, according to Cao et al. [23]. Xiong et al. [24] stated that the best material management plan would be more appropriate to model the criteria such as procurement time of materials, material properties, and quantities with BIM. Hashim et al. [25] stated that by finding a specific way to optimize material procurement and management, companies have achieved significant advantages in the costs of projects.

#### **2.2.1.1 Material Management**

In the construction sector, "materials planning and management" refers to a broad range of organizing, controlling, planning, and other management activities for the management, supply and procurement, purchasing, distribution and storage, utilization, and saving of various materials required by the enterprises during the service [26,27]. In addition to organizing and overseeing the interactions between functional divisions in building projects, materials management also makes sure that businesses run efficiently by taking into account the financial advantages of low consumption, plentiful supply, and affordable labor. Basically, materials management is carried out through 4 main activities. The first is the estimation of the quantity of materials required for the procurement and supply of materials. The second is the arrangement of the goods to be received, including purchasing. The third is the acceptance, storage, and distribution of purchased materials. The last step is the statistical study of inventory and materials [18,28,29]. In addition to these, another important stage of materials planning and management is the quality control of materials [18].

## **3 BIM APPLICATIONS IN CONSTRUCTION**

BIM technology can be used at every stage of construction projects, especially in the architectural design phase. Thanks to this feature, it enables the use of design projects and models belonging to different disciplines within the same platform. In this way, it makes it possible to facilitate cooperation between different participants.

BIM also offers significant advantages in cost management. Unlike the old classical methods, cost management has become more difficult with the development of technology and the need for precise cost calculations has increased even more. With BIM, all kinds of accounting accounts within the scope of the project can be easily made and managed. In addition, BIM can be used in all activity areas of the project and is also useful in the operation of the projects after the end of the project. Some of the studies on BIM are given below.

There is a sufficient amount of research and literature on construction management in the literature. Numerous writers [30-34] have offered various methods for planning and design in building projects. The details of the models are shown in table 1. Planning modeling used in projects is basically the method followed during the realization of the activities and processes

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required to complete the project. Design can be summarized as the prescription and optimized values that will ultimately achieve the best performance.

**Table 1.** Some studies on Planning and Design [30]

<b>Writers</b>	<b>A sort of Model</b>	<b>Specefic</b>
Brucher et al. [31]	Project scheduling	Contrasting project scheduling models and methods when resources are limited
Herroelen et al. [32]	Project scheduling	Review of the significant flaws in the Brucker et al. [17] project scheduling categorization
de Treville et al. [33]	Supply chain management	Examining whether reducing lead times might improve supply chain efficiency
Ala-Risku and Kärkkäinen [34]	Material delivery	In effect material delivery for urgent project deadlines

Studies on automation in the construction sector are available, in addition to planning and design models. Studies have been done by different authors [35-38] related to this topic. Inventory and management of materials used in construction projects have been studied by different authors [39-44], who have done different studies. These studies have advantages and disadvantages among themselves. Table 2 displays the studies' specifics.

**Table 2.** Some studies on material inventory and management [30]

<b>Authors</b>	<b>Type of Model</b>	<b>Specefic</b>
Pheng and Chuan [39]	Inventory and logistics management	An empirical investigation of JIT delivery for components made of precast concrete with the idea of cost sharing
Wang et al. [40]	Supply chain management	A genetic algorithm with fuzzy logic that is based for choosing subcontractors
Kapuscinski et al. [41]	Inventory management	The supply chain for Dell makes decisions about positioning its global inventories.
McCrary et al. [42]	Quality management	Analysis of quality management systems in manufacturing and construction in comparison
Missbauer and Hauber [42]	Contract management	A unit price-based contract's suitable overhead costs and activities should be allocated and projected for maximum contract payout.
Marshall and Marsh [44]	Demand management	Conceptualizing and quantitatively evaluating manufactured housing investment and demand

## **4 CONCLUSION**

The building business is constantly growing with technological advancement. Today, as the number of building projects increases, it is getting harder to manage and organize projects. At this point, the issue of worker and material planning draws attention. Since the issue of worker and material planning in construction is critical for projects, there are different studies on these issues in the literature. Each study brings a different approach to the issue of worker and material planning. At this point, BIM appears. BIM is a management program that has an information pool and rules within itself. The information in the system interacts and communicates with each other. In this way, projects turn into a more economical, more efficient, and more sustainable organization.

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