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Review Article

Determination of significant factors affecting on-site tracking process efficiency in the Turkish construction industry

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ABSTRACT

The construction industry is a vital sector in the development of infrastructure and buildings. The efficiency of tracking processes at construction sites plays a crucial role in determining the success of projects and overall productivity levels. To address this issue, this study aimed to provide valuable insights into the factors affecting the efficiency of tracking processes in the construction industry and to support initiatives aimed at improving productivity and project outcomes. The research methodology of this study involved conducting a comprehensive literature review of articles published in the last 20 years, resulting in the identification of 44 potential factors under six main categories that could impact on-site tracking efficiency. These factors were then evaluated and validated through a survey of experts working in the construction industry. The survey results were then analyzed using Relative Importance Index (RII) analysis which is commonly used for determining the significance level of identified factors. The results of the survey emphasized the critical role of resource allocation, technology utilization, and communication in determining productivity levels at construction sites. The findings highlight the importance of considering these factors in the implementation of strategies aimed at improving productivity in the construction industry. The survey also revealed that factors such as low fees and payment delays, lack of construction management skills, and the use of inappropriate equipment were among the most critical issues affecting the efficiency of tracking processes. In conclusion, this study sheds light on the complexities of the construction industry and the need to address the key efficiency factors affecting the tracking processes at construction sites. The results of the survey could guide future efforts aimed at enhancing efficiency in the construction industry and improving project outcomes.

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INTRODUCTION

Construction projects involve complex processes that require efficient coordination and management to ensure successful completion within the allocated time and budget [1]. On-site tracking is a crucial aspect of construction management that involves monitoring and recording progress, resources, and costs in real-time. However, achieving efficient on-site tracking is a challenge in the Turkish construction industry due to various factors such as limited resources, technological limitations, and inadequate training [2]. To enhance project management techniques and guarantee good project results, it is crucial to identify the important aspects that have a substantial impact on the effectiveness of the on-site tracking process in the Turkish construction industry. Therefore, by being aware of the main variables that affect the effectiveness of on-site tracking, construction professionals may put the right strategies and solutions in place to address these problems and enhance project performance [3].

Additionally, effective on-site tracking may aid building enterprises in maximizing resource usage, reducing waste, and guaranteeing the timely completion of projects, enhancing their competitiveness in the industry. In order to flourish sustainably of Turkish construction industry and for the overall development of the country's infrastructure, it is necessary to comprehend the significance of monitoring on-site efficiency [2].

The main purpose of this study is to determine the factors that negatively affect the on-site follow-up process efficiency in the Turkish construction industry. With the aim of contributing to the sustainable growth and development of the construction industry through the integration of factors obtained through the literature review and insights from the survey, the study is intended to help construction professionals and stakeholders develop effective strategies and solutions to overcome the challenges hindering onsite monitoring process efficiency in the Turkish construction industry.

LITERATURE REVIEW

To achieve the aim of identifying significant factors affecting on-site tracking process efficiency in the Turkish construction industry, firstly, a comprehensive literature review was conducted by scanning the studies that have a focus on "on-site tracking" and "on-site efficiency" between 2012-2022. As a result, a total number of 29 studies were identified.

A systematic literature review was conducted utilizing the Web of Science (WoS) database. Identified keywords and associated search terms were input into the WoS search engine to generate a comprehensive list of potential sources. The resultant pool of articles was then subjected to a rigorous filtering process, guided by predetermined criteria such as article type, publication date, among others. This meticulous approach ensured the inclusion of the most current and relevant studies, thereby providing a comprehensive overview of the existing body of knowledge on the subject.

Afterward, in the light of identified 29 studies, the prominent factors that affect the productivity of on-site tracking processes were evaluated by frequency analysis. For literature reviews, frequency analysis can be used to identify the most commonly used words and topics related to a specific research area. This can help identify key terms in the literature and narrow down the search for particular keywords or topics. Additionally, frequency analysis can be used to determine the periods and fields in which a particular topic has been studied more extensively. For example, [4] conducted a study in which they analyzed the frequency of key terms in environmental ethics literature to determine the areas of focus and debates in this field. As a result, a total of 44 factors affecting on-site tracking process efficiency were determined and classified under six main categories which are namely Labor factors, Management factors, Material and equipment factors, Technical factors, External factors and Motivational factors. The result of the frequency analysis is presented in Table 1.

According to Table 1, it is seen that the factors affecting the on-site tracking processes in the construction industry are concentrated in the technical factors group whereas external factors are less concentrated. The other four groups (management, labor, motivational, and material and equipment factor groups) have been mentioned in the literature with similar intensity.

METHODOLOGY

Responses of survey participants were analyzed using the Relative Importance Index (RII) method. The "Relative Importance Index" (RII) is a method used to measure the importance of a subject or factor. RII is often used to analyze results from data collected through surveys or survey-like methods. The RII can be used to determine the overall ranking of factors or characteristics, and this ranking can then assist a decision-maker or a team manager in determining their priorities [5].

In the endeavor to enhance job tracking processes at construction sites, the selection of an appropriate method to prioritize productivity factors is of utmost importance. The Relative Importance Index (RII) method was chosen for this task over multi-criteria decision-making methods. The primary reason for this choice is the simplicity and straightforwardness of the RII method [6]. Unlike multi-criteria decision-making methods, which often require complex mathematical computations and a deep understanding of the criteria and their interrelationships, the RII method provides a clear and easy-to-understand ranking of factors based on their relative importance [7]. This makes it an accessible tool for practi-

Table 1. Frequency analysis of literature related to factors affecting on-site tracking process efficiency

Factor group	Factor	[9]	[10]	[11]	[12]	[13]	[14]	[15]	[6]	[16]	[17]	[18]	[19]	[20]	[21]	[22]	[23]	[24]	[25]	[26]	[27]	[28]	[29]	[30]	[31]	[32]	[33]	[34]	[35]	[36]	Total
Labor Factors	Lack of experience and skills	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		X	X	X	X	X	X	X	28
	Overtime and overwork	X	X	X	X	X	X	X	X	X	X		X	X	X	X	X	X	X	X		X	X	X	X				X	X	24
	Absenteeism	X	X		X	X	X	X				X	X	X		X		X	X		X	X		X		X	X	X	X	X	20
	Lack of communication between workers	X	X		X	X							X	X	X	X		X	X	X		X		X				X	X	X	16
	Lack of periodic training	X	X	X	X			X			X		X	X					X			X	X			X	X	X	X	X	16
	Irregular break times	X			X		X				X		X	X	X														X	X	9
	Disloyalty					X								X												X			X	X	5
	Implementation of strict control			X														X	X	X	X										5
	Lack of team spirit													X		X		X											X		4
Management Factors	Lack of monitoring of worker performance and lack of workforce control	X		X	X	X		X	X	X	X	X	X	X	X	X	X	X		X	X	X		X		X		X	X	X	23
	Lack of communication	X		X	X	X	X	X		X	X	X	X	X		X		X	X	X		X			X	X		X	X		20
	Lack of construction management skills	X	X					X	X	X	X		X		X				X	X	X	X	X	X		X	X	X		X	18
	Lack of experience of site engineers	X	X			X		X	X	X			X			X	X	X		X		X		X				X		X	15

Table 1. CONT.

Factor group	Factor	[9]	[10]	[11]	[12]	[13]	[14]	[15]	[6]	[16]	[17]	[18]	[19]	[20]	[21]	[22]	[23]	[24]	[25]	[26]	[27]	[28]	[29]	[30]	[31]	[32]	[33]	[34]	[35]	[36]	Total
	Lack of periodic meetings/reports				X		X		X		X					X		X	X			X	X						X	10
	Intervention of the company owner or customer in field management				X						X			X			X				X					X	X			X	8
	Lack of coordination									X	X					X	X													X	5
Material and	Lack of materials	X	X	X		X		X	X	X	X	X	X	X	X	X	X	X		X	X	X	X		X				X		21
Equipment Factors	Lack of equipment	X	X			X		X	X	X	X	X	X	X		X	X	X			X	X		X			X	X	X		19
	Lack of storage management	X		X	X	X		X	X							X		X				X	X	X				X	X		13
	Material and equipment supply issues		X				X		X			X	X			X			X		X			X	X				X		11
	Using old, poor quality and inefficient equipment and materials					X	X						X			X		X				X					X	X	X	X	10
	Lack of material and equipment management		X		X	X	X									X									X					X	7
	Use of incorrect equipment		X			X																						X	X	X	5
Technical Factors	Rework	X	X	X		X	X	X	X	X	X			X		X	X	X	X	X	X	X	X	X	X	X			X	X	23
	Frequent revision in project and design	X	X	X			X	X	X	X	X		X	X	X		X			X	X	X	X	X	X	X	X	X		X	22
	Project and design quality	X	X	X	X		X	X	X	X	X	X	X			X	X	X	X	X	X	X				X		X		X	21

Table 1. CONT.

Factor group	Factor	[9]	[10]	[11]	[12]	[13]	[14]	[15]	[6]	[16]	[17]	[18]	[19]	[20]	[21]	[22]	[23]	[24]	[25]	[26]	[27]	[28]	[29]	[30]	[31]	[32]	[33]	[34]	[35]	[36]	Total
	Lack of proper planning and scheduling		X	X		X	X			X	X		X	X	X	X	X	X			X	X		X	X	X	X	X	X	X	21
	Wrong construction methods	X	X		X	X		X	X	X	X		X	X	X	X		X	X		X						X	X	X	X	19
	Construction site and facility layout	X	X	X	X	X			X	X	X	X		X		X	X	X								X	X	X		X	17
	Late or incorrect inspection and control		X	X	X				X	X	X						X			X		X	X				X	X		X	13
	Delay and lack of response to information requests			X	X					X	X				X		X			X				X			X			X	10
Motivational Factors	Low fees and payment delays	X		X	X	X	X		X	X	X	X	X	X		X	X	X	X	X	X	X		X	X	X		X	X	X	24
	Lack of work safety and accidents	X	X		X	X			X		X	X		X		X		X	X	X		X	X	X				X	X	X	18
	Personal problems	X	X			X		X				X				X		X	X							X	X	X	X	X	13
	Lack of competition	X					X						X			X		X	X									X		X	8
	Incentive policies and lack of opportunities	X	X			X									X				X									X	X		7
	Lack of consideration of employees' suggestions or ideas						X									X			X	X	X										5
External Factors	Extreme weather conditions	X	X	X	X	X		X		X	X			X	X	X	X	X	X	X	X	X				X	X	X	X	X	22
	Geological and hydrological conditions	X			X			X		X							X		X		X					X	X	X	X		11

Table 1. CONT.

Factor group	Factor	[9]	[10]	[11]	[12]	[13]	[14]	[15]	[6]	[16]	[17]	[18]	[19]	[20]	[21]	[22]	[23]	[24]	[25]	[26]	[27]	[28]	[29]	[30]	[31]	[32]	[33]	[34]	[35]	[36]	Total
	Regulation and law	X	X					X	X	X							X													X	6
	Economic conditions	X	X					X					X								X						X				6
	Government policies												X			X									X	X		X			5
	Social culture	X						X					X																		3
	Environmental issues			X									X																		2

tioners in the field, who may not have extensive training in complex decision-making methodologies. Furthermore, the RII method is particularly well-suited to situations where data is ordinal and subjective, as is often the case with productivity factors in construction [8]. It allows for the direct comparison and ranking of factors based on their perceived importance, without the need for intricate calculations or assumptions about the nature of the data. This makes it a robust and reliable tool for prioritizing productivity factors, even in the face of uncertainty or ambiguity [6]. The RII method, therefore, offers a practical and effective solution for prioritizing productivity factors in job tracking processes at construction sites.

RII is calculated using a rating scale such as the Likert scale. The Likert scale usually uses a scale of 1 to 7 and presents participants with a series of statements or questions. These statements or questions are "for each statement or question. These numbers are then used for the RII calculation.

The formula used by the method to analyze the numerical information obtained as a result of the survey is given below.

$$RII=\Sigma W/(A^*N) \quad (1)$$

In the equation, W is the weight value given to each criterion by the participants. A is the highest weight value (7) and N is the total number of participants. The higher the RII value found according to the equation result, the more important the criterion.

Demographic Structure of Experts

With the aim of identification of the importance level of determined factors for the Turkish construction industry, the study adopts Relative Importance Index (RII) method. In order to implement RII, firstly a survey was prepared and sent to a total number of 134 experts working in the construction industry. These experts consist of engineers, architects, academicians, and technicians. The survey was responded to by 43 experts.

In this survey, experts were asked to validate the suitability of the previously determined 44 factors for the Turkish construction industry. There was a consensus on determined factors were valid for the Turkish construction industry and experts did not suggest to add additional factor or delete any of identified factors. After getting the validation of determined 44 factors for the Turkish construction industry, experts were asked to rate factors by using 1-7 Likert Scale.

Demographic structure of 43 participants is presented in Table 2.

FINDINGS

RII analysis findings are presented in Table 3 below. As seen in Table 3, "Material and Equipment", "Management", and "Technical" Factors are seen as the most important fac-

Table 2. Demographics of participants

No	Demographic Feature	Category	%	Number of people
1	Job	Engineer	69.77%	30
		Technician	13.95%	6
		Architect	11.63%	5
		Academician	4.65%	2
2	Professional Experience	1-3	44.19%	19
		4-6	6.98%	3
		7-9	11.63%	5
		10-15	18.60%	8
		16+	18.60%	8
3	Number of Employees in the Company	0-50	30.23%	13
		51-250	30.23%	13
		251+	39.53%	17
4	Main Field of Activity of the Company	Construction and contracting	58.14%	25
		Project management	13.95%	6
		Energy	11.63%	5
		Engineering and Design	9.30%	4
		Education	6.98%	3
5	Education Background	Graduate	44.19%	19
		Undergraduate	41.86%	18
		Associate degree	9.30%	4
		High school	4.65%	2
6	Title	Site chief	27.91%	12
		Section chief	20.93%	9
		Site Engineer	18.60%	8
		Project Manager	13.95%	6
		Academician	6.98%	3
		planning engineer	4.65%	2
		Journeyman/Master	2.33%	1
		Architect	2.33%	1
		Contract Engineer	2.33%	1

tor groups among the factors affecting on-site tracking process efficiency in the Turkish construction industry whereas "Labor", "Motivation" and "External Factors" are in the last place in terms of importance.

Within labor factors, "Lack of experience and skills", "Disloyalty" and "Lack of communication between labors" were determined as the factors with the highest importance. The RII values of these factors were measured as 0.804, 0.804 and 0.794, respectively. The factors that have the lowest importance level were determined as "Absenteeism" and "Implementation of strict control". The RII values of these measures were found out as 0.661 and 0.452, respectively.

Within management factors group, "Lack of construction management skills", "Lack of coordination" and "Lack of communication" were determined as the factors with the highest importance. The RII values of these factors were measured as 0.854, 0.847 and 0.824, respectively. The factors that have the lowest importance level within this group were determined as "Intervention of the company owner or customer in field management" and "Lack of periodic meetings/reports". The RII values of these measures were determined as 0.764 and 0.734, respectively.

With respect to the material and equipment factors group, "Lack of equipment", "Material and equipment supply issues" and "Lack of materials" were identified as the factors with the highest importance level with the RII values of 0.854, 0.834, and 0.824, respectively. The factors that have the lowest importance level were determined as "Using old, poor quality and inefficient equipment and materials" and "Lack of storage management". The RII values of these measures were determined as 0.791 and 0.761, respectively.

Concerning the technical factors group, "Lack of proper planning and scheduling" and "Project and design quality"

Table 3. RII analysis results

Factor group	Factor	Likert Scale								Mean	RII	Rank
		1	2	3	4	5	6	7	N/A			In Total
Labor Factors	Lack of experience and skills	0	2	3	3	6	9	19	0	5,76	0,804	9
	Disloyalty	0	0	3	6	6	10	17	0	5,76	0,804	9
	Lack of communication between workers	0	0	3	7	5	12	15	0	5,69	0,794	12
	Overtime and overwork	0	2	2	5	8	12	13	0	5,55	0,774	16
	Lack of team spirit	0	2	3	6	6	10	15	0	5,52	0,771	17
	Lack of periodic training	0	1	2	9	9	8	13	0	5,43	0,757	21
	Irregular break times	0	3	5	6	12	10	6	0	4,93	0,688	29
	Absenteeism	1	2	7	6	9	8	8	1	4,85	0,661	30
	Implementation of strict control	4	9	15	6	4	3	1	0	3,24	0,452	34
Management Factors	Lack of construction management skills	0	1	2	3	3	9	24	0	6,12	0,854	2
	Lack of coordination	0	0	2	5	4	11	20	0	6,00	0,837	3
	Lack of communication	0	1	2	4	6	9	20	0	5,90	0,824	6
	Lack of experience of site engineers	0	1	3	3	11	8	16	0	5,67	0,791	13
	Lack of monitoring of worker performance and lack of workforce control	1	0	4	4	5	16	12	0	5,57	0,777	15
	Lack of periodic meetings/reports	1	1	2	5	10	10	13	0	5,48	0,764	19
	Intervention of the company owner or customer in field management	0	2	6	6	6	9	13	0	5,26	0,734	23
Material and Equipment Factors	Lack of equipment	0	0	3	3	3	10	23	0	6,12	0,854	2
	Material and equipment supply issues	0	0	2	5	4	12	19	0	5,98	0,834	4
	Lack of materials	0	2	4	1	5	7	23	0	5,90	0,824	6
	Use of incorrect equipment	0	0	4	3	5	11	19	0	5,90	0,824	6
	Lack of material and equipment management	0	0	4	3	5	20	10	0	5,69	0,794	12
	Using old, poor quality and inefficient equipment and materials	0	0	4	4	5	18	11	0	5,67	0,791	13
	Lack of storage management	0	1	4	6	7	12	12	0	5,45	0,761	20
Technical Factors	Lack of proper planning and scheduling	0	0	1	6	5	13	17	0	5,93	0,827	5
	Project and design quality	0	0	3	4	6	12	17	0	5,86	0,817	7
	Absenteeism	0	1	3	3	4	15	16	0	5,83	0,814	8
	Rework	0	1	6	2	1	16	16	0	5,74	0,801	10
	Wrong construction methods	0	1	2	5	6	13	15	0	5,74	0,801	10

were determined as the prominent factors with RII values of 0.827 and 0.817, respectively. The factors with the lowest importance level within this group were found to as "Construction site and facility layout" and "Delay and lack of response to information requests" with RII values of 0.781 and 0.774, respectively.

For the motivation factors group, "Low fees and payment delays" was determined as the factor that has the highest importance level. The RII value of this factor was measured as 0.860. The factors that have the lowest importance level were determined as "Incentive policies and lack of opportunities" and "Lack of competition". The RII values of these measures were determined as 0.625 and 0.615, respectively.

Within the external factors group, "Economic conditions" and "Extreme weather conditions" were determined as the two factors with the highest importance. The RII values of these factors were measured as 0.797 and 0.767. The factors that have the lowest importance level were determined as "Regulation and law" and "Social culture". The RII values of these measures are 0.691 and 0.502, respectively.

DISCUSSION

The construction industry is a complex and challenging sector that requires the coordination and management of numerous factors to ensure success in on-site tracking processes. Therefore, it is crucial to determine and classify sig-

Table 3. CONT.

Factor group	Factor	Likert Scale								Mean	RII	Rank
		1	2	3	4	5	6	7	N/A			In Total
	Frequent revision in project and design	0	0	6	1	9	10	16	0	5,69	0,794	12
	Construction site and facility layout	0	2	1	5	10	10	14	0	5,60	0,781	14
	Delay and lack of response to information requests	0	1	3	7	7	9	15	0	5,55	0,774	16
Motivation	Low wages and payment delays	0	0	3	3	2	10	24	0	6,17	0,86	1
Factors	Lack of work safety and accidents	1	1	4	5	6	8	16	1	5,49	0,748	22
	Personal problems	0	2	5	8	9	6	12	0	5,14	0,718	25
	Lack of consideration of employees' suggestions or ideas	0	3	8	7	6	7	11	0	4,93	0,688	29
	Incentive policies and lack of opportunities	2	5	7	7	5	10	6	0	4,48	0,625	31
	Lack of competition	3	3	6	10	8	6	6	0	4,40	0,615	32
External	Economic conditions	0	3	3	3	4	10	19	0	5,71	0,797	11
Factors	Extreme weather conditions	0	1	3	5	9	13	11	0	5,50	0,767	18
	Geological and hydrological conditions	0	3	3	5	10	6	14	1	5,34	0,728	24
	Environmental issues	0	3	5	4	12	9	9	0	5,10	0,711	26
	Government policies	0	3	2	12	5	12	8	0	5,07	0,708	27
	Regulation and law	0	4	4	5	12	11	6	0	4,95	0,691	28
	Social culture	3	6	10	11	7	1	3	1	3,68	0,502	33

nificant factors affecting on-site tracking process efficiency in the construction industry.

One critical factor that significantly impacts on-site tracking processes in the Turkish construction industry is found as the material and equipment factor group. This group includes the timely and efficient procurement, delivery, and utilization of materials and equipment necessary for project execution. The inadequate availability or quality of materials and equipment can lead to delays, cost overruns, and safety issues, which can negatively impact the project's overall success. The material and equipment factor group are followed closely by the management and technical factor groups. The management group is essential for effective planning, communication, and coordination of project activities. The technical factor group includes factors such as planning and scheduling deficiencies, project and design quality, and delayed or faulty inspection and control processes. Therefore, ensuring the efficient management and utilization of materials and equipment is crucial for the successful execution of construction projects in Türkiye.

Labor factors are considered crucial for project success, and the two most important factors were found to as "Lack of experience and skills", and "Disloyalty". These factors can have significant impacts on the quality, productivity, and overall success of construction projects. Lack of experience and skills can be a major issue in the Turkish construction industry due to inadequate vocational education and training programs for construction laborers. This can result in laborers lacking the necessary technical skills and knowledge to perform their tasks effectively, leading to poor quality workmanship and increased rework. In addition, it can lead to higher costs and longer project durations due to delays caused by the need for additional training and supervision. According to a study by [37], the lack of skilled labor is one of the main challenges facing the Turkish construction industry, and it is expected to become even more critical in the future. Disloyalty is another significant factor that can affect the success of construction projects in Türkiye. Disloyal laborers may not be committed to completing their tasks on time or to the required quality standards, which can lead to project delays and additional costs. According to a study by [38], disloyalty among construction laborers is a common issue in the Turkish construction industry, and it is often related to low wages, poor working conditions, and lack of job security. However, it is worth noting that some researchers argue that the importance of these factors may vary depending on the context and project characteristics. For example, a study by [39] found that lack of experience and skills was not considered a critical issue in small-scale construction projects in Türkiye, as laborers in these projects were often familiar with the work requirements and had learned the necessary skills through on-the-job training. Additionally, some researchers argue that disloyalty can be mitigated by implementing effective human resource management practices, such as providing adequate compensation and benefits, offering training and development opportunities, and creating a positive work environment [40].

The two most important factors in the Management Factors group are "Lack of construction management skills" and "Lack of coordination". These factors can have significant negative impacts on construction projects, leading to delays, increased costs, and decreased project efficiency. Lack of construction management skills can result in inadequate planning and execution of construction projects, which can lead to delays and increased costs. Additionally, it can negatively impact the quality of the construction work and increase the risk of accidents and errors. A study by [41] found that construction management skills are essential for successful construction project delivery, and a lack of such skills can result in project failure. A lack of coordination among various project stakeholders is another major factor affecting the construction industry in Türkiye. Coordination is essential for ensuring smooth project progress and effective communication among team members. A study by [42] found that a lack of coordination can lead to delays, increased costs, and decreased quality in construction projects. This issue can arise due to poor communication among team members, conflicting objectives, and inadequate project planning.

Material and Equipment Factors also play a crucial role in the successful completion of construction projects. The most significant factors in this group were seen as "Lack of equipment" and "Material and equipment supply issues". The lack of equipment can lead to a decrease in labor productivity, while material and equipment supply issues can cause interruptions in the construction process. These factors can be caused by various reasons such as the limited availability of equipment in the market, inadequate planning and procurement processes, and lack of storage facilities. Therefore, it is essential for construction companies to address these factors and improve their practices to ensure successful and efficient construction projects. However, there are different views regarding the importance of material and equipment factors in the construction industry. Some argue that the advancement of technology and the increasing availability of equipment in the market have reduced the impact of material and equipment factors on construction projects [43]. Moreover, some studies suggest that innovative procurement strategies and supply chain management practices can help to mitigate material and equipment supply issues in the construction industry [44]. In the construction industry, material and equipment factors are crucial for successful project completion. According to the survey results, the most important factors in this group were equipment shortage, material and equipment procurement, and material shortage, in that order. Equipment shortage can cause delays in work processes and hinder project completion, as laborers often require different types and specifications of equipment to complete their tasks. This factor may be caused by inadequate maintenance or aging of equipment, unsuitability of equipment for the project, or unavailability of suitable rental equipment. Material and equipment procurement is also essential, and any delays or shortages in the supply chain can cause significant problems. Possible reasons for this factor include supplier capacity or production problems, logistical issues in the supply chain, or inadequate or untimely ordering of materials or equipment. Finally, the material shortage can also cause significant delays or even bring projects to a halt. This factor may be caused by incorrect calculation or estimation of required materials, supplier capacity or production problems, or logistical issues in the supply chain.

The Technical Factors group includes various factors that can impact the successful completion of construction projects. Among these factors, the two most important ones were found as "Lack of proper planning and scheduling", and "Project and design quality". Lack of proper planning and scheduling can cause delays and disruptions in the construction process, leading to increased costs and decreased project efficiency. Project and design quality issues, on the other hand, can result in construction defects and safety hazards, compromising the overall quality of the project. These factors can be caused by various reasons such as inadequate project management, lack of expertise, and insufficient quality control measures. Therefore, it is important for construction companies to prioritize these factors and implement effective measures to ensure proper planning and scheduling and high project and design quality. There are various studies that support the importance of these factors in the construction industry. For example, a study by [45] highlights the significance of proper planning and scheduling in construction project success, stating that "proper planning and scheduling of a construction project is important in ensuring that resources are efficiently utilized, and the project is completed within budget and time constraints". Similarly, a study by [46] emphasizes the importance of project and design quality, stating that "quality control measures should be implemented throughout the construction process to ensure high-quality project outcomes and minimize the risks of construction defects and safety hazards". However, some researchers argue that technical factors alone may not be sufficient to ensure successful construction projects. For example, a study by [47] emphasizes the importance of considering non-technical factors such as social and environmental factors in construction project success, stating that "social and environmental factors should be taken into account to ensure sustainable and socially responsible construction practices". Therefore, while technical factors are important, a holistic approach that considers various factors may be necessary for successful construction projects in the Turkish construction industry.

According to the findings of the study, the two most significant motivational factors affecting laborers were found out as "Low fees and payment delays", and "Lack of

work safety and accidents". These factors can negatively impact the laborers' motivation, job satisfaction, and overall well-being. Low wages and payment delays can lead to decreased motivation and job satisfaction among labors, affecting their performance and productivity on construction sites. This can result in delays, cost overruns, and decreased quality of work. Similarly, the lack of work safety and accidents can cause physical harm, injury, or even death, leading to decreased motivation and job satisfaction, as well as increased absenteeism and turnover. These factors can also have a significant impact on the construction company's reputation and bottom line. Therefore, it is crucial for construction companies to address these factors and improve their practices in order to ensure the safety and well-being of their laborers and the successful completion of construction projects. There are different perspectives on the importance of motivational factors in the construction industry. Some studies emphasize the role of financial incentives, such as bonuses and rewards, in motivating laborers and improving their job satisfaction [48]. However, other studies highlight the significance of non-financial motivational factors, such as work safety, job security, and recognition [49]. Overall, it is essential to consider both financial and non-financial motivational factors in designing effective management practices to improve labor motivation and job satisfaction in the construction industry.

Factors such as "Economic conditions" and "Extreme weather conditions" have been identified as the most important external factors affecting on-site tracking process efficiency in the Turkish construction industry. Economic conditions, such as fluctuations in inflation rates, interest rates, and currency exchange rates, can have a significant impact on construction projects, affecting everything from material costs to project funding and investment decisions. Additionally, extreme weather conditions, including floods, storms, and earthquakes, can cause delays, damages, and safety hazards, ultimately affecting project schedules and budgets. Several studies have examined the impact of economic conditions on the construction industry in Türkiye. For example, in a study by [50], it was found that economic fluctuations and uncertainty were among the most significant challenges faced by construction companies in Türkiye. Similarly, a study by [51] found that fluctuations in the exchange rate and inflation rates had a significant impact on the profitability of construction projects in Türkiye. In terms of extreme weather conditions, studies have shown that Türkiye is susceptible to various types of natural disasters, including floods, landslides, and earthquakes [52]. The frequency and severity of these events have increased in recent years, affecting construction projects and causing delays, damages, and safety hazards [53]. However, some scholars argue that external factors, such as economic conditions and extreme weather conditions, may not always have a significant impact on construction project success. For example, a study by [54] found that project managers can mitigate the impact of economic fluctuations by adopting effective risk management strategies. Similarly, a study by [55] found that incorporating climate change adaptation measures into construction projects can help mitigate the impact of extreme weather conditions.

According to RII analysis results, the five least significant factors affecting on-site tracking process efficiency in the Turkish construction industry in descending order were determined as "Implementation of strict control" under the labor factor group, "Social culture" under the external factor group, "Lack of competition" under motivation factor group, "Incentive policies and lack of opportunities" under motivation factor group, and "Absenteeism" under labor factor group. The low ranking of these factors may be attributed to several reasons. Firstly, strict enforcement may be considered unnecessary by some experts who believe that the existing regulations and enforcement mechanisms are sufficient. Secondly, social culture may not be perceived as a critical factor in on-site tracking as it is difficult to quantify and may not have a direct impact on the process. Thirdly, the construction industry in Türkiye may suffer from a lack of competition, which could lead to a decreased emphasis on optimizing on-site tracking processes. Fourthly, incentive policies and lack of opportunities may not be considered important as they may not have a direct impact on on-site tracking processes, and their effects may be more long-term in nature. Finally, absenteeism may not be considered significant as it may be perceived as a management issue that can be resolved through better supervision and employee engagement. Overall, the low ranking of these factors may reflect differences in opinion among experts or a relative lack of attention paid to them in the Turkish construction industry.

CONCLUSION

This study attempts to provide valuable insights into the factors affecting the efficiency of tracking processes in the Turkish construction industry and to support initiatives aimed at improving productivity and project outcomes. Within this aim, a literature review was conducted to identify the factors affecting on-site tracking processes in the construction industry. A total number of 44 determined factors were then evaluated according to their degree of frequency by conducting a frequency analysis. The factors were classified under 6 main groups: labor factors, management factors, technical factors, material and equipment factors, motivational factors, and external factors. Lastly, the RII method was applied in order to find out the significance level of those factors in the Turkish construction industry. The results showed that "Low fees and payment delays", "Lack of equipment", Lack of construction management skills", and "Lack of coordination" were found to be the significant factors affecting on-site tracking process efficiency in the Turkish construction industry.

The findings of the study can be beneficial for construction companies in the industry working to improve on-site tracking processes in construction since survey results show that industry experts' assessments for improving existing processes. These assessments can help companies and their managers identify factors to focus on to improve on-site tracking processes. The results of the study can also be a base for technology companies working on digital transformation to direct their work on the development of on-site tracking processes. With the software to be developed, studies can be carried out to automate the processes or solve them with the support of artificial intelligence.

FUTURE STUDIES

There are several potential areas for future research in this field. One possible avenue of investigation could be to explore the impact of emerging technologies such as artificial intelligence, the internet of things, and blockchain on on-site tracking processes in the construction industry. Another potential area of inquiry could be to examine the role of government policies and regulations in improving on-site tracking practices and addressing the challenges identified in this study. Additionally, future research could focus on identifying best practices and success factors for on-site tracking processes in the construction industry and developing guidelines and frameworks to facilitate their implementation.

AUTHORSHIP CONTRIBUTIONS

Authors equally contributed to this work

DATA AVAILABILITY STATEMENT

The authors confirm that the data that supports the findings of this study are available within the article. Raw data that support the finding of this study are available from the corresponding author, upon reasonable request.

CONFLICT OF INTEREST

The author declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

ETHICS

There are no ethical issues with the publication of this manuscript.

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