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Adaptation of construction sites to Covid-19 pandemic: Safe construction site certificate for Turkish construction sector

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Abstract

This study aims to determine the measures against the COVID-19 pandemic at construction sites, analyze the implementability of these measures at selected construction sites, and propose a Safe Construction Site Certificate to improve the health of construction sites. Within the context of these aims, a questionnaire was sent through email to 38 site chiefs at residential construction sites in 15 Turkish cities. Using open-ended, semi-structured questions, the COVID-19 pandemic measures taken in the construction work areas, administrative offices, dormitories, and dining halls of construction sites were examined. For the purposes of data collection and analysis, content analysis method and phenomenological approach were employed. It was determined that the COVID-19 pandemic measures were not implemented at certain construction sites, while they were inadequately implemented at others. In addition, it was discovered that the unity of measures could not be achieved in different facilities of the same construction sites and remained on an individual scale. Consequently, to build healthier construction sites by removing the inadequacies identified by the analysis and taking into account the dynamics of the Turkish construction sector and construction sites, a Safe Construction Site Certificate was proposed.

Highlights

- The construction sector involves longer, more strenuous work hours than many other sectors, particularly on construction sites.
- Health and safety measures are essential at Turkish construction sites, but they are not implemented adequately.
- The application of a safety certificate is crucial for ensuring healthy construction sites in the Turkish construction sector.

Keywords

Construction site; Construction worker; Covid-19; Pandemic measures; Turkish construction sector; Safe construction site certificate

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1. INTRODUCTION

The pandemic has had direct or indirect effects on people's working and social environments (Umar, 2022). The closure restrictions were implemented due to the pandemic's negative impact on all sectors, including tourism, manufacturing, agriculture, and finance. This issue caused severe economic contraction in both developing and industrialized nations (Bernstein et al., 2020; Chowdhry et al., 2020; Selvi, 2020; Wang et al., 2020). When the pandemic began to spread in 2020, according to a report published by Bloomberg, the world economy would suffer a total loss of $2.7 trillion (Bloomberg, 2020). Inflation and unemployment are the consequences of the economic slump brought on by the economic contraction. If the current trend continues, it is believed that even larger collapses may be imminent (Chakraborty & Maity, 2020). Unfortunately, it is not possible to estimate when the pandemic would end, despite the fact that the development of vaccines for the virus sparked optimism. Consequently, alternate living circumstances should be implemented based on the pandemic setting (Jamaludin et al., 2020). If necessary, sector-specific actions should be implemented in order to keep the wheels of the economy turning. However, a sector-based perspective reveals the reality of the various sector dynamics.

Globally, the construction sector contributes an estimated 10 percent of Gross Domestic Product (GDP) and 7 percent of employment on average (ILO, 2017; Murie, 2007), and its interaction with other sectors makes it a vital aspect of the economy (Giang & Pheng, 2011). Moreover, the construction sector is a locomotive industry since it is a large employer both directly and indirectly for the human resources of other sectors (Buniya et al., 2021a). Thus, in emerging countries, the sector is regarded as the economic pillar (Ebekozien & Aigbavboa, 2021). Similar circumstances pertain to Turkey, which belongs to the category of emerging and developing nations (IMF, 2020). In Turkey, the construction sector is one of the sectors that drives the expansion of other sectors and the nation's development by addressing infrastructure and superstructure inadequacies. Therefore, the pandemic's effects on Turkish construction sector can be seen as critical. In this setting, the construction sector cannot tolerate collapse and recession.

From January 3, 2020 to March 3, 2022, the total number of COVID-19 virus-confirmed cases in Turkey reached roughly 14.2 million, with over 95,000 fatalities (WHO, 2022). In Turkey and around the world, the importance of taking new measures for the current circumstances and continuing life with new norms was emphasized. However, the compatibility and applicability of the new standards for the construction sector is a major concern. Globally, numerous scientific investigations on the relationship between the COVID-19 pandemic and the construction sector have been conducted (Amoah & Simpeh, 2021; Ebekozien & Aigbavboa, 2021; Simpeh et al., 2021; Simpeh & Amoah, 2021; Ogunnusi et al., 2020; Olukolajo et al., 2021; Umar, 2022; Wang et al.,

2020). In the aforementioned investigations on the construction sector, it was concluded that the analysis and evaluation of the measures performed against the COVID-19 virus at construction sector workplaces remain superficial. Particularly, an in-depth focus was not found on residential construction sites.

This study focuses on the building construction phase of the entire construction process, which stands out in terms of labor intensity and duration. First, the construction site must be built in this phase, which involves the physical construction of the building. Construction sites contain not just the construction work areas where a structure is constructed, but also operating facilities, social facilities, and infrastructure facilities. In this context, the aim of this study is to determine the measures implemented against the COVID-19 pandemic in the construction work areas, operating facilities, and social facilities of the construction sites; to analyze the implementation status of these measures at the selected construction sites; and to present a proposal for a COVID-19 Safe Construction Site Certificate to make the construction sites healthier. Within the context of these aims, the study consists of three steps. Through a comprehensive literature review, the impact of the COVID-19 pandemic on construction sites, related measures, and the implementability of the measures on construction sites were identified in the first step. In the second step, a questionnaire was delivered via email to the construction site chiefs and employer representatives at 38 residential construction sites from 15 Turkish cities. The questionnaire consisted of two sections that outline the demographics of the participants and the measures against the COVID-19 pandemic at construction sites. Along with the questionnaire, a situation assessment of the Turkish construction sector was conducted, as well as an analysis of the implementation status of the WHO-advised measures implemented at construction sites. In the third step, a certificate was proposed to make construction sites healthy by eliminating the deficiencies and inadequacies revealed by the analysis.

2. CONSTRUCTION SITES AND THE COVID-19 PANDEMIC

Construction sites are temporary workplaces where construction works are carried out in accordance with specified characteristics and attributes, and which are expired when the building is constructed. Each construction work has different spatial and outfitting requirements, depending on the targeted characteristics and attributes (Guo, 2002; Sanad et al., 2008; Song et al., 2017). A construction site may consist of a construction work area, operating facilities (such as administrative offices, sales/rental offices, and material production/storage centers), social facilities (such as dormitories, dining halls, canteens, and sports fields), and infrastructure facilities. It is essential to prepare construction site facilities with human health in mind and improve construction site organization accordingly. The work environments at construction sites are intricate and hazardous. Many other sectors pose fewer risks than the construction sector, despite the fact that construction workers may be subjected to severe and unpleasant conditions such as inadequate lighting and ventilation. Irregular working hours and an extended culture of overtime are observed (MacDonald & Durdyev, 2021); and in addition, work patterns such as a noisy work environment cause workers to work under stress. Consequently, construction workers confront the risk of physical damage, death, and health degradation over time throughout operations (Eaves et al., 2016; Huang et al., 2021). In this regard, it is essential for human health that operating facilities such as administrative offices, sales/rental offices, material production/storage centers, and social

facilities such as dormitories, dining halls, canteens, and sports fields provide adequate comfort conditions.

It is essential that construction workers have access to healthy conditions outside of their shifts and minimum standards of welfare and comfort. This will increase the mental and physical productivity of workers and their motivation to work. It is critical to provide for the basic needs of workers, as lower motivation will result in decreased work productivity.

After the pandemic, many construction workers never returned to the sector (Alsharef et al., 2021). The decline in labor force indirectly raised unit labor expenses. Similarly, the supply chain, which has been hindered or disrupted as a result of the pandemic, has produced an increase in material costs. This is reflected in the construction expenses as a whole. Due to a chain reaction, the rise in construction expenses creates delays in the completion of projects (Umar, 2022). Prior to the pandemic, prolonged project completion times were one of the most problematic parts of the construction sector. During the pandemic, prolonged project completion times have become an even greater issue (Ogunnusi et al., 2020). Consequently, it may be argued that there is a considerable loss of efficiency in the construction sector. By adopting to the pandemic measures, it may be possible to reduce this loss. These measures in the construction sector go far beyond those concerning the use of personal protection equipments, such as steel-toed work shoes and clothing, belts, welder goggles, dust masks, and rigid hats (Sanad et al., 2008). The primary pandemic measures include wearing a face mask or face shield, using disinfectants, checking the temperature, keeping social distance, avoiding crowded places, etc. The applicability of these measures to construction sites is, however, questionable.

The building construction phase involves labor-intensive construction works that necessitate the physical presence of managers and construction workers at the construction site (Agyekum et al., 2021). Furthermore, the physically intensive nature of construction work hinders the implementation of even the most fundamental anti-pandemic measures, such as keeping social distance and wearing face masks (Avice, 2020). To illustrate, wearing face masks is a challenging measure to apply in outdoor productions conducted during humid and hot weather. Therefore, it may be stated that construction workers generally work in COVID-19-vulnerable workplaces (Alsharef et al., 2021; Subramaniam et al., 2021).

Raising awareness about pandemic measures can be one of the most effective means of fostering healthy conditions at construction sites. Indeed, lack of awareness is a significant impediment to the sustainability of pandemic measures. Several studies also support this assertion. According to the study by Buniya et al., there is an immediate need for training about the COVID-19 virus and pandemic measures (Buniya et al., 2021b). In addition to a lack of awareness, the unwillingness of construction companies to pay the higher costs of health and safety regulations is a significant obstacle to the implementation of pandemic measures at construction sites. In addition to the previous mandatory expenditures, the COVID-19 pandemic imposed additional costs at construction sites. These additional expenditures include the provision of additional personal protective equipment (face masks, gloves, etc.), the placement of washing/disinfection stations, and the provision of additional cleaning products and cleaning equipment. In an economic setting, managers believe that such costs impose an additional strain on the project. The results of Simpeh's

questionnaire research support this notion. In this study, participants were asked why pandemic prevention measures could not be implemented at construction sites. Seventy percent of the responses concerned the high implementation costs generated by the measures (Simpeh et al., 2021).

3. METHODOLOGY

Concerning the influence of the pandemic on the functioning of several sectors, there are gaps to be filled. Exploratory qualitative research methods are utilized when there are uncertainties and gaps about the issue to be explored, and there has been little prior research on the subject (Squires & Dorsen, 2018). Through qualitative research methods, participants' perspectives and experiences regarding a phenomenon in the study area can be acquired in great depth (Mohajan, 2018; Polit & Beck, 2017). This study employed phenomenological approach, one of the qualitative research methods. It is one of the most common and well-known qualitative research approaches (Groat & Wang, 2013). By internalizing their thoughts, perceptions, and experiences concerning a topic, this method enables participants to express them (Leedy & Ormrod, 2015). An in-depth understanding of the research subject enables researchers to focus on particular characteristics of the investigated phenomena (Creswell, 2007).

In each research, a target population is selected based on the objectives of the study (Creswell, 2014). Participation and assessment of the entire target population are practically impossible. Therefore, a sample population is often used to acquire the necessary data for research. However, sampling may not necessarily lead to the researcher's anticipated outcome. In this case, to prevent time loss in the data collection process and to find more target-oriented participants, participants with the necessary knowledge and qualifications are selected and purposive sampling is performed (Blumberg et al., 2014). The target population of this study consists of site chiefs working on residential construction sites in Turkey. Population growth, intra-country regional migration, immigration from abroad, the gradual decrease in household size, and the necessity to renovate non-disaster-resistant existing residential buildings cause residential buildings to account for a considerable portion of the Turkish construction sector. In this study, residential construction sites, which are anticipated to account for the largest part of the sector for many years, were chosen for sampling.

Researchers have differing opinions regarding the number of participants or data required for qualitative research. A previous study using the qualitative research method by Safman and Sobal suggested that 10-25 participants are considered ideal (Safman & Sobal, 2004). The pioneer of qualitative research methods, Creswell, has various suggestions over time. The author stated that 5 to 25 participants were sufficient for accurate data analysis in 1998, 20 to 30 participants in 2007, and 15 to 30 participants in 2014. (Creswell, 1998; Creswell, 2007; Creswell, 2014). In accordance with the principles of purposive sampling, 47 construction site chiefs from 20 different cities were contacted in advance for this study. 38 construction site chiefs provided positive responses, which could be examined using convenient sampling. In the scope of this study, a questionnaire was sent through email to 38 construction site chiefs working on residential construction sites in 15 different Turkish cities. On a map of Turkey, the spread of these construction sites is illustrated in Figure 1.

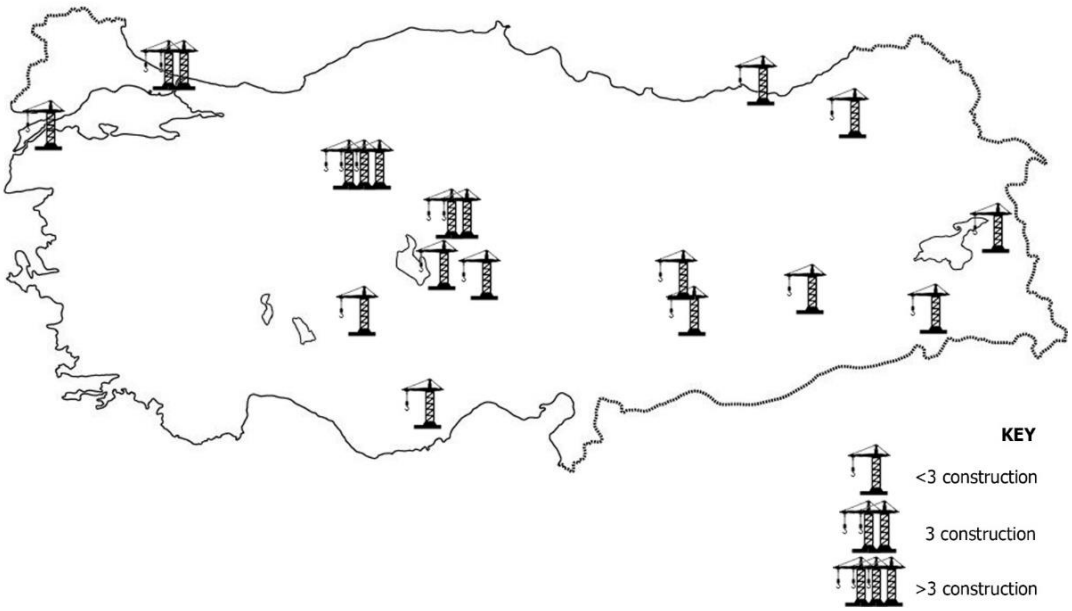

Figure 1 - Distribution of the evaluated residential construction sites.

Open-ended and semi-structured questions are preferred when the author lacks sufficient knowledge of the subject and needs extensive information on the investigated phenomenon (Saunders et al., 2019). In this specific study, the first section of the questionnaire consisted of the participants' demographic information. The second section detailed the measures taken against the COVID-19 virus at the construction sites. Open-ended semi-structured questions were used to investigate the construction site, the operating facilities (administrative offices), and the social facilities (dormitories and dining halls). At the construction sites addressed by the questionnaire, there were no sales/rental offices or material production/storage centers within the operating facilities, nor are there any canteens or sports areas within the social facilities. Therefore, these facilities were excluded from this study's limitations.

Content analysis, a qualitative data analysis method, was utilized in the data analysis regarding the questionnaire results. Apart from quantitative research data, content analysis is more prevalent in studies that emphasize meaning and expression and contains specific information rather than categories (Schutt, 2018). This method involves a preliminary examination of the data, the formatting of the codes based on the data, the development of similarities and classifications based on the created codes, and the determination of the size of the established themes (Creswell, 2014).

In light of the gaps in pandemic measures at construction sites, a safety certificate was developed for Turkish construction sites based on the findings of the content analysis. The certification process has been designed to reflect the unique dynamics of the Turkish construction sector and construction sites.

4. EVALUATION OF THE COVID-19 PANDEMIC MEASURES AT CONSTRUCTION SITES: A CASE STUDY IN THE TURKISH CONSTRUCTION SECTOR

4.1. Properties of Participants and Projects

The first section of the questionnaire is designed to collect information about the participants and the projects they represent. As seen in Table 1, all but except one of the participants are male. In some sectors, such as the construction sector, it is common knowledge that males predominate, particularly in the construction phase, for a variety of reasons, such as the tough image of the sector (MacDonald & Durdyev, 2021). The questionnaire directly reflected this.

Table 1 - Properties of the participants and the projects.

Background Information	Response	Frequency	Percentage
Gender	Male	37	97.37%
	Female	1	2.63%
Age	18-29 years	11	28.95%
	30-39 years	11	28.95%
	40-49 years	6	15.79%
	50-59 years	8	21.05%
	60+ years	2	5.26%
Location	Adıyaman	1	2.63%
	Aksaray	1	2.63%
	Ankara	19	50.00%
	Çanakkale	1	2.63%
	Diyarbakır	1	2.63%
	Erzurum	1	2.63%
	İstanbul	3	7.90%
	Kırşehir	3	7.90%
	Konya	2	5.27%
	Malatya	1	2.63%
	Mersin	1	2.63%
	Nevşehir	1	2.63%
	Şırnak	1	2.63%
	Trabzon	1	2.63%
	Van	1	2.63%
Highest level of education	High school degree and below	5	13.16%
	Bachelor's degree	28	73.68%
	Master's degree	5	13.16%
Profession	Construction technician	5	13.16%
	Civil engineer	17	44.74%
	Architect	4	10.52%
	Other	12	31.58%
Project Size	< 5.000 m^2	15	39.47%
	5.000 m^2 < … < 30.000 m^2	12	31.58%
	> 30.000 m^2	11	28.95%

The fact that the majority of project participants (86.84 %) hold at least a bachelor's degree and the majority of them (68.42 %) are construction-trained specialists (civil engineers, construction technicians, and architects) demonstrates the dependability of the collected data. On the assumption that the size of the construction site will be comparable to the size of the building to be constructed, information on the size of the projects in which the respondents participated was also requested. In order to draw broad conclusions from the analyses to be conducted, a construction site size range of 400 m2 to 1,000,000 m2 has been determined. The majority of construction sites evaluated (78.95 %) are located within metropolitan municipalities. Due to the dense population in metropolitan municipalities, construction demands are also higher. The information gathered from the construction sites in these cities will aid in the generalization of the analysis's conclusions.

4.2. Impact Level of the COVID-19 Pandemic on the Construction Sites

As in Table 2, all of the questionnaire participants (100%) stated that they had knowledge about the COVID-19 pandemic. Despite awareness of the health and safety procedures to be taken on construction sites, it is recognized that these measures are not properly executed. Furthermore, it can be argued that knowledge of the COVID-19 pandemic will not constitute as sufficient data. The second section of the questionnaire begins with the inquiry, "Did construction works at the construction site continue throughout the days/times of the curfew, which is one of the measures taken during the COVID-19 pandemic?". While 32 site chiefs responded affirmatively to this question, it was discovered that six construction sites had ceased operations. In addition, the questionnaire asked individuals to estimate the severity of the COVID-19 pandemic at construction sites. The responses of the construction site chiefs on this question form a bell curve. While 18 respondents (47.37 %) described the impact level as "moderate", 31.58 percent described the impact level as "high". In addition, 7.89 percent of construction site chiefs classified it as "low" and 13.16 percent as "very high".

Table 2 - Awareness level of the construction site chiefs on the COVID-19 pandemic.

Question	Answer	Frequency	Percentage
Do you know about the COVID-19 pandemic?	Yes	38	100%
	No	0	0%
Did the construction works at the construction site continue throughout the days/times of the curfew, which is one of the measures taken during the COVID-19 pandemic?	Yes	32	84.21%
	No	6	15.79%
What is the impact level of the COVID-19 pandemic at the construction sites?	Very high	5	13.16%
	High	12	31.58%
	Moderate	18	47.37%
	Low	3	7.89%
	None	0	0%

It is observed that the majority of participants are aware of the dangers that the COVID-19 virus poses to human life. It was found, however, that the majority of construction sites continue to operate due to the requirement of maintaining works in the construction sector, as in all sectors. At construction sites, continuity can be ensured by implementing pandemic measures in accordance with the new norms. The new norms have material and moral effects on the management and workers of the construction site. This impact varies in intensity based on the environmental and project dynamics of construction sites.

4.3. COVID-19 Pandemic Measures Implemented at the Construction Sites

To restrict the spread of the COVID-19 virus, governments impose numerous regulations, particularly in public spaces. Nonetheless, sectoral dynamics may impede the application of the guidelines. Such locations include construction sites, where the majority of employees have a low level of education. The matter should not be evaluated solely from a personal standpoint. Daily pay construction workers cannot earn money when they are not working. Therefore, despite feeling ill, people continue working since they are unaware that they can transmit the infection to the environment. It is inevitable that construction workers who are unconcerned with their own health and have no qualms about causing harm to others will disregard several rules at the construction site. There are also administrative mistakes in this regard. Failure to provide the appropriate materials and equipment for the implementation of the rules or failure to attempt to apply the rules by conducting the necessary inspections notwithstanding the availability of the necessary materials and equipment can be regarded direct manager deficiencies.

In contrast to other facilities, the measures adopted against the COVID-19 virus in the construction work areas of construction sites are distinct. However, in the construction site-focused analysis, it was claimed that 9 out of 38 construction sites (23.68 %) would continue to operate as they did prior to the pandemic without taking any further measures until there is an official restriction or disease. As shown in Table 3, the intensity of the measures adopted in construction work areas of construction sites was relatively low. This obviously demonstrates that very few measures were taken in the construction work areas. On almost half of the analyzed construction sites, workers keep social distance between one another, according to the findings (52.63 %). Managers required extensive planning to ensure social distance at construction sites. First, every effort was made to avoid workers from operating in the same location. In circumstances when it could not be avoided, a shift system allowed construction workers to work at the same location during various time periods. In addition, it has been reported that 47.37 percent of construction sites require workers to wear face masks. Although at low rates, 26.32 percent of the examined construction sites had disinfectants at the entrances of the construction work areas or in specific sections within the area. Checking the temperature of workers at the entrance to the construction work area, with a rate of 15.79 percent, and providing training on what to do during a pandemic, with a rate of 10.53 percent, are respectively determined as the measures adopted.

Table 3 - Pandemic measures at the construction work areas of the construction sites.

Pandemic Measures	Frequency	Percentage	Rank
Complying with social distancing rules *	20	52.63%	1
Wearing a face mask	18	47.37%	2
Placing disinfectants at certain areas	10	26.32%	3
Checking temperature at the entrances to the construction work area	6	15.79%	4
Providing training on what to do during the pandemic	4	10.53%	5

* Side-by-side works in the same location were avoided. A shift system was organized.

Participant-11 reported the measures implemented at the construction work area as follows;

> "Rather than collective studies, individual studies were arranged. Attempts were made to limit the number of contacts by inserting breaks between workers. There was attention paid to the issue of wearing a face mask."

As shown in Table 4, "Complying with social distancing rules" is the most frequently implemented measure at the administrative offices of construction sites, with a rate of 57.89%. Attempts are made to ensure social distance by increasing the distance between tables, creating an environment conducive to social distance by planning meetings, and limiting the number of guests allowed in offices. Additionally, the number of employees in the offices was reduced. Appointments were found to host individuals who came from outside the office. It was reported that slightly less than half (44.74 %) of the examined construction sites paid attention to the wearing of face masks in administrative offices. Administrative offices are typically where managers work, and they employ individuals with graduate degrees. Therefore, it may be assumed that face masks, social distance, and cleanliness norms receive more attention than in social facilities. It is stated that in 34.21 percent of the selected projects, "frequent ventilation and disinfection" and 26.32 percent "placing disinfectants at certain areas" were implemented, respectively. In addition, actions such as "organizing a new work schedule," "checking temperature at the entrances," and "placing informative posters and signboards" were implemented at rates of 10.53 percent, 10.53 percent, and 5.26 percent, respectively. In terms of developing a new work schedule, initiatives such as reducing the office hours of workers, alternating break times, and allowing some employees to work from home stand out as considerably more significant modifications. However, these measures were only applied at four construction sites (10.53 %).

Participant-20's explanation of the measures performed in the administrative offices is as follows:

> "The area was routinely disinfected. We attempted to meet with as few visitors as possible. The use of face masks was required throughout the day. There was a thermometer and cologne provided."

Table 4 - Pandemic measures in the administrative office area of the construction sites.

Pandemic Measures	Frequency	Percentage	Rank
Complying with social distancing rules *	22	57.89%	1
Wearing a face mask	17	44.74%	2
Frequent ventilation and disinfection	13	34.21%	3
Placing disinfectants at certain area	10	26.32%	4
Organizing a new work schedule	4	10.53%	5
Checking temperature at the entrances to the office area	4	10.53%	5
Placing informative posters and signboards	2	5.26%	7

* The distances between tables and chairs were increased. The number of workers in the office was reduced. Interviews with the visitors were held through appointments.

Dormitories are the private areas where workers spend the majority of their time after work hours. Due to the enclosed nature of dormitories, it was assumed that extra measures would be taken, but this assumption proved incorrect. As shown in Table 5, the majority (63.16 %) of the dormitory areas of the examined construction sites paid attention to social distance. To preserve social distance, the overall number of dormitories in certain projects was increased, while the number of residents per unit dormitory was decreased. In some projects, the number of dormitory beds, and thus the number of workers accommodated, has been lowered. Some of the existing workers were not permitted to stay at the construction site, therefore they were provided with lodgings and hotels outside of the construction site. With a frequency of 36.84 percent, "frequent ventilation and disinfection" is the second most frequent measure. "Placing disinfectants at certain areas" and "wearing a face mask" are the third most common measures with a low rate of 21.05 percent. This is followed by measures with very small percentages, such as "checking temperature at the entrances to the dormitory areas", "checking COVID-19 test results", and "providing training on what to do during the pandemic".

Participant-14 described the measures taken against the COVID-19 virus at the dormitory area of the construction site he manages as follows:

> "The number of beds in the dormitories was decreased, and the top and bottom bunk beds were transformed into single beds. The distance between workers was increased. Each dormitory was disinfected once per week, and greater attention was devoted to the dormitory's hygiene conditions. In every dormitory, hand disinfectants and face masks were offered."

Although there are efforts to adopt a basic measure against the spread of the COVID-19 virus by increasing the distance between employees on construction sites, it is clear that additional recommended measures cannot be widely applied. In spite of the fact that face masks used to prevent the spread of the COVID-19 virus to different employees and surfaces must be replaced frequently, it was discovered that there was a deficiency in supply of these materials. In addition, despite the fact that it is recognized that the virus may be avoided with proper hand-face and environmental hygiene, it has been discovered that these measures are implemented in relatively few projects at low rates.

Analyzing the measures obtained in the dining hall areas of construction sites revealed significantly greater percentages than in other facilities. According to Table 5, social distancing was achieved in 30 of 38 projects (78.95 %) through a variety of methods, including increasing the distance between tables and chairs, reducing the total number of tables and chairs, and directing individuals with multiple informative posters and signboards. Mealtime organizations are another method for reducing interaction between employees. On 42.11 percent of construction sites, meal hours were altered. In the shift eating system, each work team had a designated mealtime. These periods can be lengthened or shortened to reduce interaction. Basic measures such as "frequent ventilation and disinfection" and "placing disinfectants at specific areas" are applied in 26.32 percent and 21.05 percent of the dining halls, respectively, for the hygiene of the employees and the environment. The "distribution of packaged meals" measure has a comparable rate of 21.05 percent. Lower rate measures employed at construction sites include "distribution of disposable cutlery with each meal", "wearing a face mask", "checking temperature at the entrances of the dining hall area", and "prohibition of smoking in and around the dining hall". However, just 18.42 percent of the dining halls implemented these measures.

Participant-3 described the measures implemented in the dining hall area of the construction site as follows:

> "Each meal is uniquely packaged and distributed to individuals in a contactless way. Meals were eaten at distinct periods, and public meals were avoided. When entering and exiting the dining hall, everyone utilized disinfectants. The wearing of face masks was emphasized, and distance was maintained. Disinfection processes were performed in the morning and evening."

Examining the tables as a whole reveals that pandemic measures are adopted at relatively low rates. 11 construction sites (28.95%) within the scope of the administrative office-oriented evaluation, 12 construction sites (31.58%) within the scope of the dormitory-oriented evaluation, and 5 construction sites (13.16%) within the scope of the dining hall-oriented evaluation had a slightly different situation. It was stated that unless there is an official restriction or the case of COVID-19 disease in these certain areas, work will proceed under pre-pandemic conditions.

Table 5 - Pandemic measures in the dormitory and the dining hall areas of the construction sites.

Location	Pandemic Measures	Frequency	Percentage	Rank
Dormitory Area	Complying with social distancing rules *	24	63.16%	1
	Frequent ventilation and disinfection	14	36.84%	2
	Placing disinfectants at certain areas	8	21.05%	3
	Wearing a face mask	8	21.05%	3
	Checking temperature at the entrances to the dormitory area	5	13.16%	5
	Checking COVID-19 test results	3	7.89%	6
	Providing training on what to do during the pandemic	1	2.63%	7
	Complying with social distancing rules **	30	78.95%	1
	Organizing a new mealtime schedule	16	42.11%	2
	Frequent ventilation and disinfection	10	26.32%	3

Table 5 continues

Location	Pandemic Measures	Frequency	Percentage	Rank
Dining Hall Area	Placing disinfectants at certain area	8	21.05%	4
	Distribution of packaged meals	8	21.05%	4
	Distribution of disposable cutlery with each meal	7	18.42%	6
	Wearing a face mask	5	13.16%	7
	Checking temperature at the entrances to the dining hall area	2	5.26%	8
	Prevention of smoking in and around the dining hall	1	2.63%	9

* The number of workers staying in a dormitory was reduced by increasing the total number of dormitories.
** The distances between tables and chairs were increased. Warnings and markings were placed in certain areas to comply with social distancing.

5. PROPOSAL OF A SAFE CONSTRUCTION SITE CERTIFICATE FOR THE TURKISH CONSTRUCTION SECTOR

5.1. Safe Service Certificates for COVID-19 Pandemic in the World

In order to sustain life in the face of the reality of the COVID-19 pandemic, governments and various institutions implement numerous individual- or location-based applications (Awan et al., 2020). One of the most prevalent of these applications is the EU Digital COVID Certificate for individuals (DCC). Individuals' vaccination status, disease status, and PCR test results are digitally encoded and may be accessed with this certificate, which is utilized by all EU member states and 33 non-EU nations (EC, 2022). Within the purview of place-based applications, numerous certificates created by organizations such as the World Health Organization (WHO) and the Centers for Disease Control and Prevention (CDC) for airports, business facilities, and particularly accommodation facilities are utilized (CDC, 2021; WHO, 2020). Highlights of these certifications include those produced for the tourism sector and service sector (AHLA, 2022; Hanafiah et al., 2021; SG; TSE, 2022a), which are the economic drivers of countries and have been profoundly impacted by the pandemic process (Foo et al., 2021). However, no effort has been made in industrial and manufacturing fields like the construction sector.

Similar circumstances exist when the subject is evaluated in relation to Turkey. COVID-19 Safe Tourism Certificate; COVID-19 Safe Service Certificate for schools, dormitories, markets, shopping malls, gas stations, campuses, electronics, and telecommunications stores; and COVID-19 Safe Production Certificate for industrial organizations were developed in Turkey by TSE (TSE, 2022b). However, an application for a regulatory mechanism, a standard, or a certificate has not been considered for the country's locomotive construction sector. The construction sector requires more physical labor over longer hours and in more challenging conditions than many other sectors. For this reason, the applicability of pandemic measures is extremely challenging, and it is equally necessary that construction site workers be in good health to keep up with these challenging conditions. In this context, it is of the utmost importance to implement a health and safety certificate for the protection of workers at construction sites that are part of the building

construction and material production segments of the construction sector. Due to the dynamic nature of the construction sector, this certification should include topics pertinent to the sector. Thus, it is possible to take preventive measures and raise health and safety standards in the construction sector.

5.2. Organization of COVID-19 Safe Construction Site Certificate Process

Numerous studies demonstrate that occupational health and safety measures are not implemented adequately, particularly on construction sites in developing nations. (Awwad et al., 2016; Boadu et al., 2020; Musonda and Smallwood, 2008); (Awwad et al., 2016; Boadu et al., 2020). Examining the frequencies and occurrences of the events revealed by the content analysis of this study has revealed that a similar situation applies to pandemic measures. The implementation of the COVID-19 Safe Construction Site Certificate is believed to boost compliance with pandemic measures at construction sites. Nonetheless, it is crucial to plan the certification procedure in accordance with the dynamics of construction sites at this time. Thus, the operability of the process in question may be ensured. TSE is responsible for all COVID-19 safe certificate applications submitted in Turkey. Due to the particular dynamics of construction sites, it is believed that the organization method of the COVID-19 Safe Construction Site Certificate proposed in this study should not be limited to TSE. In collaboration with the Ministry of Environment, Urbanization, and Climate Change, academics, construction sector representatives, and non-governmental organizations are expected to contribute to a more efficient implementation of the process. Within the context of the TS 13811 Hygiene and Sanitation Management System Standard, a self-evaluation questionnaire, application form, and roadmap have been developed for each of the abovementioned certificates (TSE, 2018). In the initial phase of the proposed certification procedure, these documents should be tailored to the construction sites in collaboration with the relevant stakeholders. Diagrammatically depicted in Figure 2 is the organizational procedure for the proposed COVID-19 Safe Construction Site Certificate. Consequently, to this flowchart;

- The certification process should be launched by the construction site's official authorities, the site chiefs. In consideration of the to-be-updated self-evaluation questionnaire particular to the construction sites, deficiencies in pandemic measures should be determined at the relevant construction site.

- lt is assumed that the video question-answer recordings to be uploaded on the website of the ministry will be advantageous in terms of aiding the process of the elimination of the mentioned deficiencies. In addition, the question-and-answer sessions to be held at particular periods and the online support line to be developed will also contribute to the advancement of the process.

- The official application procedure begins with the completion of the deficiencies identified by the self-evaluation questionnaire, followed by the submission of the application form.

- Following the application, the audit team of the ministry conducts a preliminary evaluation of the papers. If problems are discovered, the procedure is restarted from the beginning. On authorized construction sites, the on-site audit phase is undertaken following the preliminary evaluation.

- During the on-site audit phase, it is expected that teamwork involving both construction sector representatives and healthcare professionals will contribute to a comprehensive audit with several perspectives. Instead of forming a new team, it is believed that current building inspection companies can profit from hiring healthcare workers. Using building inspection companies that employ healthcare professionals, a regional pool system can be developed. Thus, after the preliminary evaluation, building inspection companies randomly selected from this regional pool will be able to conduct on-site audits of the construction sites.

The COVID-19 Safe Construction Site Certificate is awarded to construction sites that pass on-site auditing without revealing any noncompliance. If significant nonconformities are discovered during the on-site audit, the procedure is restarted from the beginning. In the event of minor nonconformities, the site management is allowed a certain amount of time to address the shortcomings. If the deficiencies are addressed by the end of this period, the relevant construction site is eligible to acquire the COVID-19 Safe Construction Site Certificate.

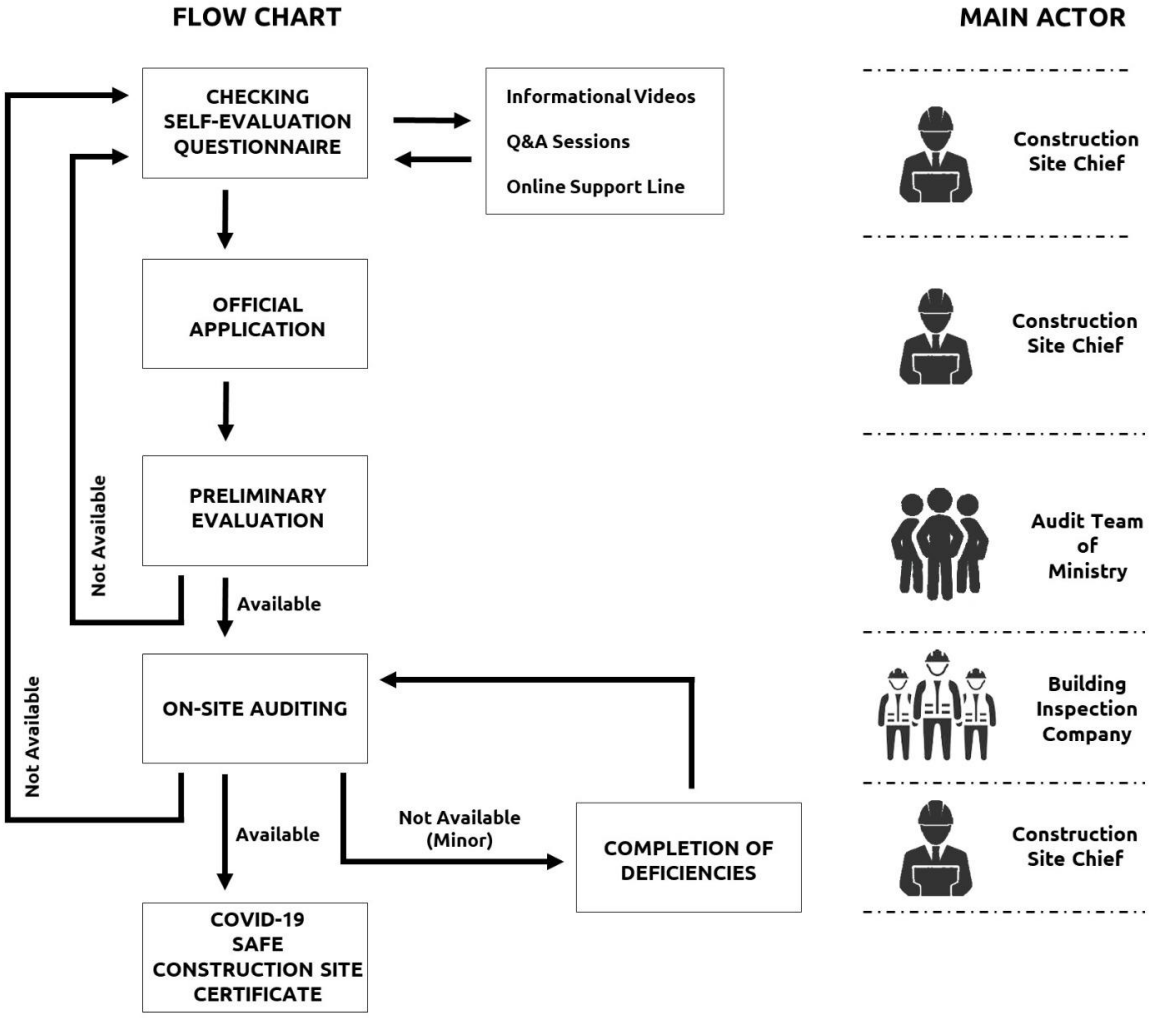

Figure 2 - Flow chart for the organization process of COVID-19 Safe Construction Site Certificate.

6. CONCLUSION AND RECOMMENDATIONS

Unfortunately, it is unknown how long the latest pandemic will persist on a broad scale, despite the fact that it may seem like a long period of time to those living under suffocating restrictions. Given the implications, it is anticipated that this uncertainty will result in a number of other unfavorable outcomes. Although it was stated that measures may be taken with now available vaccines and that sick people could be treated with medicines scheduled to be released in the near future, there are also contradicting claims that should not be ignored. Assuming that the pandemic-causing COVID-19 virus will mutate over time and acquire whole new characteristics and effects, it is apparent that the current situation would deteriorate dramatically. This process has influenced the vast majority of people and, consequently, the working systems. Changes in work patterns and disruptions in global supply chains have halted activity across many sectors. Even if minor interruptions can be accepted owing to the continuance of life and vital demands, interruptions must be minimized as soon as feasible, and working systems must be made more effective and functional. This shock is attempted to be overcome in a sustainable manner at construction sites, which are the temporary workplaces of the construction sector. Adapting to the new living conditions necessitated by the pandemic required the implementation of numerous new rules, behavior patterns, and measures, which are necessary for overcoming this shock rapidly. Due to the aforementioned factors, the construction workers overlooked some crucial pandemic measures at the construction sites.

This study focuses on the construction sites of residential construction projects in several Turkish cities. An investigation was conducted into the pandemic measures implemented at the construction site to prevent the spread of the COVID-19 virus in the construction work area, administrative offices, dormitories, and dining halls. The information acquired is provided in separate tables on behalf of the construction work areas and facilities, and it was determined how much of the specified measures were implemented in total. Within the scope of the frequencies, percentages, and rankings in the tables, the following findings were obtained:

- lt was examined whether there's a pattern and/or similarities between the regulations set by governments in accordance with the World Health Organization's guidelines for pandemic measures and the rules applied in the construction work area, the operating facilities, and the social facilities. It was found out that numerous recommendations and guidelines were either not implemented or only partially applied. Prior to the COVID-19 pandemic, construction sites were not in particularly good health and safety conditions. During the pandemic, construction sites continued to score poorly on this metric.

- Even if a certain level of compliance awareness exists, it is acknowledged that there is no uniformity of measures between the construction work area, administrative offices, dormitories, and dining halls at construction sites. Additionally, it was revealed that the necessary measures vary by construction sites. This indicated that awareness of the measures remained on an individual level, that certain measures could only be applied on an individual scale by the workers in that workplace, and that collective awareness of the issue was not achieved.

- Employees in numerous sectors have adopted flexible work hours in response to government measures. Therefore, the interaction problem preventing the virus's transmission was eliminated. The vast majority of construction workers are paid on a daily basis. Accordingly, regardless of the circumstances, they must function practically. Unfortunately, this circumstance is simply the nature of the work.

The questionnaire revealed that pandemic measures are implemented at a relatively low level at construction sites in Turkey. Unless there is a legislative obligation, it is quite likely that pandemic measures will not be implemented on construction sites in the future. In this case, it is crucial to encourage the implementation of measures through various incentives and supports in order to lessen the likelihood of this happening. The COVID-19 pandemic poses a particular hazard to the health of construction workers. It is expected that the endorsement of the COVID-19 Safe Construction Site Certificate with some incentives and supports on construction sites where workers with very low levels of education are employed will result in a rapid increase in the number of construction sites in Turkey holding this certificate. Therefore, the intended application of the COVID-19 Safe Construction Site Certificate proposed in this study, as well as its benefits to the companies, must be specified in depth. In this regard, it is believed that providing the following facilities to the owners of the construction site companies who have obtained the COVID-19 Safe Construction Site Certificate will be beneficial:

- Construction companies are subject to several taxes from construction site installation to project completion. Companies that have earned a COVID-19 Safe Construction Site Certificate may be eligible for a number of exemptions or tax reductions.

- The phases of building construction and material production need considerable economic investments. In exchange of equity, many companies can carry out this process with a credit system. Companies who have obtained the COVID-19 Safe Construction Site Certificate are eligible for loans with below-average interest rates.

- Recognition and reliability are absolutely critical concerns for construction companies. Companies that have been awarded the COVID-19 Safe Construction Site Certificate can be announced on the ministry's website and advertised.

This study, which examines the COVID-19 pandemic measures that should be taken for the health of construction workers working on construction sites in the Turkish construction sector, contributes significantly to the body of literature. Recent development and economic growth rates in developing nations such as Turkey have paralleled construction sector investment levels. Therefore, the analyses and conclusions obtained at construction sites of a developing country are also highly valuable for other case studies. The results of this study may assist a prediction that resolving the concerns identified for the pandemic and on the long run will be advantageous for the resolution of chronic problems in the construction sector and at construction sites. In addition, the data will be useful for shedding light on the implications of the pandemic on construction sites for sector stakeholders who wish to gain a better understanding of these effects.

This study, which has certain limitations, constitutes due diligence for Turkish residential construction sites. After confronting the actual situation, it is essential to take the necessary steps and strengthen the existing ones. It is impractical for a single study to fill all the gaps in the literature. Therefore, it is essential to continue the investigation with further research. Studies for construction sites other than residences or nested analyses with applications in different sectors will provide the opportunity to examine the subject from several perspectives. In the future, it will be possible to analyze the entirety of the results produced from this study and to conduct research on better management of construction sites.

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There is no conflict of interest for conducting the research and/or for the preparation of the article.

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Ethical Statement

The study was conducted according to the guidelines of the Declaration of Helsinki and approved by the Institutional Review Board of Ankara Medipol University (Protocol Code: E.81477236-604.01.01-3077; Date of Approval: 17/November/2021).

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Author Contribution Statement

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D. Danışmanlık / Supervision	E. Malzeme, Kaynak Sağlama / Material, Resource Supply	F. Veri Toplama, İşleme / Data Collection, Processing
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