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Effect of Project Types on Business Health and Safety Practices in the Construction Sector: Focusing on Ankara Province

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Abstract

Today, the concept of occupational health and safety emerges from technical, legal, and socioeconomic aspects at every point of life. This study discusses the work accidents that have occurred at construction sites, the perspectives of employees in the sector toward these accidents, and what can be done after such work accidents occur. A survey was conducted with 384 construction project employees in Ankara (employers, technical staff, and workers). The interactions between parameters that are thought to cause workplace accidents have been evaluated. The study concludes that in large size projects, OHS measures were increased and that measures against occupational accidents in public housing areas were more effective than other project types. It has been found that occupational health and safety training is provided in 49.2% of the projects in build-and-sell sector and in 100% of turn-key projects. Some of the striking points that have emerged from the study are that the distance to danger has been increased by all the infrastructure companies within the context of collective protection against a present danger and that 90.5% of danger sources have been isolated by the mass housing developers. The results of the study are expected to positively contribute to the development of occupational health and safety training in the construction sector.

Keywords: Occupational health and safety, work accidents, use of personal protective equipment, OHS trainings

1. Introduction

The construction sector has been one of the most determining factors in the growth of economies all over the world. Throughout history, one of the most imperative needs of humankind, shelter, has made the sector important. This vital sector has shown steady progress and development. Because the construction sector affects 200 sub-sectors, it has direct or indirect effect on the development of other sectors. Therefore, the construction sector, being an extremely large sector, naturally has a large share in employment. Especially in Turkey, the construction sector is a large field of employment for unskilled workers. As it is the case all over the world, one of the most dangerous sectors to work for in Turkey is also the construction sector. Due to the close proximity of the sector to danger and majority of the employees being unskilled and untrained workers, in Turkey and all over the world, the probability of work accident is 3–5 times higher in the construction sector than that in other sectors (Web Message 1).

One of the fundamental reasons for the high frequency of work accidents is the perception of the safety precautions as an economic burden by employers and the failure to take work safety precautions in working environments (Web Message 2).

When the workplace accidents data of Turkey is examined, according to the Social Security Institution that includes only compulsory and still working insured persons, the number of work accidents in 2013 was 191,389 and that of deaths caused by occupational accidents or illnesses was 1,360. Due to these work accidents, the workers were exposed to 2,357,505 days of temporary incapacity. When the distribution of work accidents in 2013 is examined by sector, base metal industry and factory metal industry (when considered together with sub-sectors) take the first place with 27,760 accidents representing 14.5% of all the accidents. The second place is occupied by the building construction and private construction sectors (when considered together with sub-sectors) with 26,967 accidents representing 14.09% of all the accidents. The sectors of coal and lignite extraction, metal ore mining, other mining, and quarrying and mining support services follow in the third place with 14,186 accidents representing 7.41% of all the accidents. When the sectors with fatal occupational accidents were investigated for the same year, the building construction sector was in the first place with 296 people and 21.8%; the land and pipeline transport sector was second with 183 people and 13.5%; the construction of non-building structures sector was third with 121 people and 8.9%; and the private construction sector was fourth with 104 people and 7.6%. An analysis of this data reveals that the construction sector has the highest number of fatal occupational accidents with 1.360 incidents representing 38.30% of all accidents involving death (Web Message 3).

The time and low cost pressure of the construction sector and the managing difficulty with regard to the chaos at the construction site caused by subcontracting are two factors that increase the number of workplace accidents. Especially in Turkey, the large number of unregistered works in this sector and the temporary and seasonal workers that constitute the vast majority of employees increase the likelihood of accidents because of various reasons. Furthermore, there are other important factors such as working conditions, long and intensive work hours, workers' lack of capability to refuse to work in insecure environments, and the lack of safety training to prevent accidents. Disrespect toward employers with regard to the right of organization of their employees and the low ratio of unionization in the construction sector can be listed as other factors that raise the probability of accident and prevent the applicability of the work safety and health regulations (Web Message 4).

2. Method

This work aims to determine the way in which the occupational health and safety (OHS) measures are applied according to Law No. 6331 by the firms operating in the construction sector in Ankara and the approach of the employees toward OHS. The study puts forth the existing situation by using a descriptive method, and the investigation has been explained in the following paragraphs (Büyüköztürk, 2005).

2.1 Universe and Sample

This research focuses on firms operating in the construction sector in Ankara and the personnel working at these firms. The sample comprises 384 randomly selected construction sites in Ankara. Among them, 165 have an OHS Board. The distribution of the respondents who participated in the study is as follows: 29.2% civil engineers, 4.7% architects, 1.6% engineers, 7.6% university graduates, and 57% employees with undergraduate or lower level of education. Of these personnel, 8.3% are project managers, 27.1% are site chiefs, and 64.6% are company owners. The project type distribution of the study is as follows: 70.8% single buildings, 16.4% mass housing projects, 1.6% industrial buildings, 1.6% shopping malls, 4.4% infrastructure works, 1.6% tunnel-metro constructions, and 3.7% other structures.

2.2. Data Collection and Analysis

The OHS scale developed by Akkaş (2006) was used in the study. In addition, a scale with 58 questions was prepared by making additions on the basis of the OHS Law No. 6331 and the OHS Regulations in the Construction Works, and a face-to-face interview was conducted at 165 construction sites. The study was analyzed using SPSS 22.0 version. The Cronbach's alpha reliability coefficient of the scale was found to be 0.728, indicating that the measurements are reliable. It has been determined in analyses that the group is not parametrically distributed. Thus, a chi-square test was conducted to determine the relationship between the construction sites.

3. Findings

The data obtained in the study were transformed into tables after processing in the SPSS application. The table below describes the demographics of the profiles of the firms.

Table 1. Distribution of employees participating in the project by project types and characteristics

Variable		Number	%
Total construction cost of the project	600,001–1,500,000	221	57.6
	1,500,001–5,000,000	35	9.1
	5,000,001 and above	128	33.3
	Total	384	100.0
Total completion time of the project	0–18 Months	243	63.3
	19–36 Months	135	35.2
	37–60 Months	6	1.6
	Total	384	100.0
Total number of employees in the project	0–10 Persons	237	61.7
	11–50 Persons	58	15.1
	51–100 Persons	12	3.1
	101 Persons and above	77	20.1
	Total	384	100.0
Total duration of work in a single shift of the project	0–8 hours	68	17.7
	9–12 hours	316	82.3
	Total	384	100.0
Project type	Single building	272	70.8
	Mass housing	63	16.4
	Industrial structure	6	1.6
	Shopping mall leisure Center	6	1.6
	Infrastructure	17	4.4
	Tunnel-metro	6	1.6
	Other	8	2.1
	Complex structure	6	1.6
	Total	384	100.0
Project implementation stage	Rough construction stage	59	15.4
	Fine construction stage	20	5.2
	Rough and fine at the same time	305	79.4
	Total	384	100.0
Determination of the project implementation type	Contract	23	6.0
	Build-and-sell	290	75.5
	Own investment	12	3.1
	Build-operate-transfer	6	1.6
	Turn-key	53	13.8
	Total	384	100.0

When the construction costs of the projects are examined according to Table 1, it can be seen that 57.6% of the projects are between 600.001 and 1.500.000 teraliter, 9.1% are between 1.500.001 and 5.000.000

teraliter, and 33.3% are 5.000.001 teraliter and above. When the total completion time of the projects is examined, it is seen that it is 0–18 months for 63.3% of the projects, 19–36 months for 35.2% projects, and 37–60 months for 1.6% projects. When the total number of employees of the project is examined, 61.7% projects are found to have 0–10 persons, 15.1% to have 11–50 persons, 3.1% to have 51–100 persons, and 20.1% to have 101 persons or more. When the duration of work in a single shift of the project is examined, 17.7% projects are found to have 0–8 hours and 82.3% to have 9–12 hours. Furthermore, when project types are examined, it is seen that 70.8% are single buildings, 16.4% are mass housing projects, 1.6% are industrial structures, 1.6% are shopping malls, 4.4% are infrastructure, 1.6% are tunnels and metro works, and 3.7% are other constructions. When the project implementation stage is examined, it is seen that 15.4% of the projects are in a rough construction stage, 5.2% are in a fine construction stage, and 79.4% are in a rough and fine construction stage at the same time. When the projects are examined according to the project implementation type, 75.5% are found to be build-and-sell, 6% to be contract, and 3.1% to be own investment, 1.6% to be build-operate-transfer, and 13.8% to be turn-key.

Table 2. Protection measures and personal protective equipment (PPE) usage at construction sites

Variable		Number	%
Which protection measures are taken against an existing danger?	Increasing distance to danger	250	65.1
	Isolation from danger is provided	122	31.8
	Danger is eliminated	12	3.1
	Total	384	100.0
If collective protection is not possible, is personal protective equipment (PPE) provided?	Everybody receives it	355	92.4
	Provided according to the quantity of PPE	29	7.6
	Total	384	100.0
Whether or not the given PPE is used?	Yes	83	21.6
	No	225	58.6
	Partially	76	19.8
	Total	384	100.0
Why the given PPE is used?	Compulsory	243	63.3
	We think it provides protection	2	0.5
	Because the employer requires it	46	12.0
	1. and 2. together	18	4.7
	1, 2, 3, and 4 all together	75	19.5
	Total	384	100.0
Why the given PPE is not used?	Uncomfortable	231	60.2
	Do not think it provides protection	29	7.6
	Do not think it is necessary	6	1.6
	Inexperience	6	1.6
	Uncomfortable and decreases work efficiency	112	29.2
	Total	384	100.0
What sanctions are imposed by the employer when PPE is not used?	Verbal warning	266	69.3
	Fine	8	2.1
	1 and 2	12	3.1
	1, 2, and 3	98	25.5
	Total	384	100.0

According to Table 2, the answers given by the respondents to the question "Which protection measures are taken against an existing danger?" are as follows: 65.1% said "Increasing distance to danger"; 31.8% said "Isolation from danger is provided"; 3.1% said "Danger is eliminated." To the question "If collective protection is not possible, is personal protective equipment (PPE) provided?" 92.4% of the respondents said "everybody receives it"; 7.6% said "Provided according to the quantity of PPE." The question "Whether or not the given PPE is used?" received the following answers: 21.6% "Yes," 58.6% "No," and 19.8% "Partially." The question "Why is the given PPE used?" received the following answers: 63.3% "Compulsory," 0.5% "We thinks it provides protection," and 12% "Because the employer requires it." To the question "Why is the given PPE not used?" received the following answers: 60.2% "Uncomfortable," 7.6% "Do not think it provides protection," 1.6% "Do not think it is necessary," 1.6% "Inexperience," 29.2% "Uncomfortable and decreases work efficiency." To the question "What sanctions are imposed by the employer when PPE is not used" received the following answers: 69.3% "Verbal warning," 2.1% "Fine," and 3.1% "Both verbal warning and fine."

Table 3. Existence of OHS regulations and if OHS training is given

Variable		Number	%
Whether an internal OSH regulation exists?	Yes	113	29.4
	No	52	13.5
	Total	165	43.0
	Those who do not have an OSH Board	219	57.0
	Total	384	100.0
Whether personnel are provided OSH training?	Yes	119	31.0
	No	46	12.0
	Total	165	43.0
	Those who do not have an OSH Board	219	57.0
	Total	384	100.0

According to Table 3, to the question "whether an internal OSH regulation exists?" 29.4% of the respondents said "yes" and 13.5% said "no." To the question "whether personnel are provided OSH training?" 31% of the respondents said "yes" and 12% said "no." In addition, 57% of the projects do not have an OSH committee.

Table 4. Occurrence of occupational accidents at workplaces and types of accidents

Variable		Number	%
Whether there are accidents at the workplace?	Yes	121	31.5
	No	263	68.5
	Total	384	100.0
What kind of work accident occurred at the workplace?	Falling from a high point	92	24.0
	Collapse-Downfall	17	4.4
	Construction machine crash	6	1.6
	Other (Crushing)	6	1.6
	Total	121	31.5
	Workplaces with no accidents	263	68.5
	Total	384	100.0
The cause of the work accident	Carelessness	53	13.8
	Not taking the job seriously	17	4.4
	Negligence	45	11.7
	No PPE	6	1.6
	Total	121	31.5
	Workplaces with no accidents	263	68.5
	Total	384	100.0

According to Table 4, to the question "whether there are accidents at the workplace?" 31.5% respondents said "yes" and 68.5% said "no." The distribution of the answers to the question "what kind of work accident occurred at the workplace" is as follows: 24.0% "Falling from a high point," 4.4% "Collapse-Downfall," 1.6% "Construction machine crash," and 1.6% "Other (Crushing)." The causes of the work accidents are the following: 13.8% "Carelessness," 4.4% "Not taking the job seriously," 11.7% "Negligence," and 1.6% "No PPE." Furthermore, 31.5% of the respondents mentioned that there were no accidents at their workplaces.

In this study, the relationship between the project types and the other data was examined by the chi-square test. With regard to this test, the data with significant differences are given in Table 5.

Table 5. Results of Chi-square test

Compared variables	n	sd	Chi-square χ2	P
Project type and internal OSH regulation	165	7	79,004	0,000*
Project type and OSH training on site	165	7	99,687	0,000*
Project type and measures against existing danger	384	14	535,690	0,000*
Project type and whether given PPE is used	384	14	438,145	0,000*
Project type and why provided PPE is used	384	28	707,072	0,000*
Project type and sanctions imposed by the employer when provided PPE is not used	384	21	499,067	0,000*
Project type and whether there is an accident at workplace	384	7	197,426	0,000*
Project type and what types of accidents occurred at workplace	121	21	363,000	0,000*
Project type and causes of accidents occurred at workplace	121	21	363,000	0,000*
Total construction cost of the project and whether there has been an accident at workplace	384	2	241,069	0,000*
Total completion time of the project and whether there has been an accident at workplace	384	2	277,941	0,000*

As can be seen in Table 5, there are significant differences between project type and internal OSH regulation, OSH training on the construction site, measures taken against existing danger, whether the given PPE is used, why provided PPE is not used, sanctions imposed by the employer, what types of accidents occur, and the causes of the accidents. There are significant differences between (1) the total construction cost of the project and whether there is an accident at workplace (2) and the total completion time of the project and whether there is an accident at workplace

4. Discussion and Conclusions

Working conditions in Turkey are still not at the desired level. An analysis of the working hours reveals that most of the employees work 9–12 hours as a normal work day. Working hours longer than those permitted by the law cause exhaustion and consequently attention reduction in employees, which invites work accidents to happen. Furthermore, because rough and fine construction stages continue together, employees who are experts in their field but do not have knowledge in other fields are unaware of what safety precautions are necessary as they share the same workplace.

An analysis of projects reveals that OSH boards required by the law are not created until there are certain numbers of employees. As a result, most of the construction sites (61.7%) do not have an OSH board. This situation causes job accidents to be cured when they happen and not to be prevented in advance. Another important issue is the duration of the projects. Based on project type, among the projects that have internal OSH regulations, mass housing projects have the highest ratio. In total, 50% of the single building projects do not have an internal OSH regulation. As can be seen from the data, when the projects get larger, OSH regulations are needed and implemented. In parallel to this finding, Karaosmanoğlu (2016) found that internal OSH regulations decrease accidents.

When projects were investigated on the basis of whether they provide OSH training, it was found that of the 165 companies that have OSH committees on their construction sites, 32.1% are companies producing single buildings, 38.2% are companies producing mass housings, and 10.3% are infrastructure companies. Among these companies, 45.3% of the companies producing single buildings and 100% of the companies producing mass housings provide OSH training at their construction sites, and 100% of the infrastructure companies do not provide OSH training. According to this finding, single building companies and infrastructure companies are the ones with the least amount of OSH training. The most important reason for this may be the high personnel turnover ratio at single building companies and infrastructure companies. Yanık (2017) has determined in his study that providing OSH training is important.

When collective protection precautions are required for OHS, it has been found that 80.5% of single building companies and all the infrastructure companies increase the distance to a dangerous level and 90.5% of the mass housing companies isolated the source of the danger. In cases when collective protection is not possible, it has been determined that almost everyone was provided with PPE. However, it has been found that PPE is not used by 82.7% of single building companies and 77.6% of build-and-sell companies. When PPE is not used, it has been found that 91.2% of the employers at single building companies and 89.7% of the employers in the build-and-sell sector provided verbal warnings. It has been determined that in mass housing and infrastructure sectors the employers are not satisfied by providing verbal warning and use penalties such as suspension from work. Of the companies that have answered the questions of project type and why PPE is not used, 6% responded that they undertake contract works, 75.5% responded that they make build-and-sell projects, and 13.8% responded that they make turn-key projects. Among these companies, at 100% of contract type projects, PPE was not used because they were uncomfortable and decreased work efficiency; at 79.7% of build-and-sell companies, PPE was not used because they were uncomfortable, and at 100% of turn-key companies, PPE was not used because they were uncomfortable and decreased work efficiency. Demirbilek and Çakır (2013) found in their study that if workers find themselves effective in providing safety, their use of PPE increases and the attitude of the site supervisor and the effect of the perceptions of the importance of occupational safety at workplace decreases. Contrary to the performed study, they found that the attitude of the site supervisor in unimportant.

According to the data of this study, there has been a work accident at 100% of the workplaces that do contract jobs, no work accident at 87.9% of the workplaces that make build-and-sell projects, and a work accident at 96.2% of the workplaces that make turn-key projects. It has been found that in 71.4% of the mass housing sector, all the accidents have had a “falling from a high point” accident and all accidents are declared to be caused by negligence. Similarly, it has been found that in 100% of the companies in the infrastructure sector, all the accidents involve collapse-downfall and all accidents are declared to be

caused by not taking the job seriously. Polat and Polat (2017) stated that not taking the job seriously causes problems of dangerous consequences. When work accidents are examined on the basis of the number of personnel, it has been found that there was a work accident in 89.6% of the constructions sites having 101 or more personnel. Yılmaz (2015) has found that the ratio of official inspections in construction sector is 0.83%, which is very low and not enough to prevent accidents.

About the relationship between the total construction cost of the project and workplace accidents, it has been found that there were no workplace accidents in 84% of the projects that have a total construction cost of between 600,000 and 1,500,000 teraliter, there were workplace accidents in 82.9% of the projects that have a total construction cost of between 1,500,001 and 5,000,000 teraliter, and there were no workplace accidents in 68.5% of the projects that have a total construction cost of 5,000,001 teraliter and more.

According to the relationship between the completion time of the project and workplace accidents, it has been found that there were no accidents in 97.5% of the construction sites that have completion time of 0–18 months, there were accidents in85.2% of the construction sites that have completion time of 19–36 months, and there were no accidents in 100% of the construction sites that have a completion time of 36 months and more.

As a result, when the project gets larger, an OSH board is formed and OSH trainings are provided. OSH trainings are not at a satisfactory level at sites that produce single buildings and at companies that undertake infrastructure projects. The danger is isolated at mass housing sites and the distance to danger is increased at single building sites. The usage of PPE is low at single building construction sites. When PPE is not used in mass housing sites, the employers provide verbal warnings or penalties such as suspension from work. When asked about the reasons for not using PPE, the excuses used are that PPE is uncomfortable and decreases work efficiency. In terms of construction cost of the projects, the ones between 1,500,001 and 5,000,000 teraliter have fewer accidents. However, the workplace accident ratio is high at projects that have completion time of 19–36 months. The mass housing sector has the least number of accidents.

Although OSH is considered a costly business, especially in the construction sector, many studies show that the cost incurred by a company is much higher when an accident happens (K. Van den Broek et al., 2011; M. López-Alonso et al., 2013; Mossink, 2002; Panopoulos, 2003). Therefore, it is very important to take and implement precautions.

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