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Workplace Disaster and Emergency Plans, Risk Analysis and Implementation*

Murat Can DURUEL[1], Ahmet ÇELEBİ[2]
ORCID: 0000-0003-2306-4405, 0000-0002-3508-2590

Abstract

Disasters and emergencies are situations that can be encountered anytime and anywhere. These situations may be faced while at workplace as well as at school or at home. Considering the time spent at work, the importance of being prepared for this situations in the workplaces becomes apparent. To be prepared, it is necessary to make and implement a plan. In this study, it is aimed to reveal and implement how to prepare the most effective workplace disaster and emergency plan. To this aim, document analysis, one of the qualitative research methods, was used. As a result of the analysis, four steps have been identified for the preparation process of the plan: the planning team, risk analysis, developing and implementing. A disaster and emergency plan has been prepared for a workplace in line with the determined steps and other findings. First, a planning team was formed from the relevant. Then, the hazards were determined, risk analysis was performed with the method created and the correct measures were determined. After, procedures were prepared to detail what needs to be done and the issue of communication. The details of the training and drills to be carried out for the implementation of the plan are specified. Finally, the documentation of the plan was completed by stating how often the plan should be renewed. A well-prepared and implemented plan is very important as it will ensure that both employees and the workplace are prepared for all kinds of incidents.

Keywords: Disaster Management, Workplace, Emergency Plan, Planning, Risk Analysis

İş Yeri Afet ve Acil Durum Planları, Risk Analizi ve Uygulaması

Öz

Afet ve acil durumlar, her zaman ve her yerde karşılaşılabilecek durumlardır. Okulda veya evdeyken olabileceği gibi iş yerindeyken de afet ve acil durumlar ile karşı karşıya kalınabilmektedir. Geçirilen süre dikkate alındığında iş yerlerinde bu durumlara hazırlıklı olmanın önemi ortaya çıkmaktadır. Bunun için de bir plan hazırlamak ve uygulamak gerekmektedir. Bu çalışmada, en etkili iş yeri afet ve acil durum planının nasıl hazırlanacağının ortaya koyulması ve uygulanması amaçlanmaktadır. Bu amaç için, nitel araştırma yöntemlerinden biri olan doküman analizi kullanılmıştır. Analiz sonucunda planın hazırlanma süreci için dört adım belirlenmiştir: Planlama ekibi, risk analizi, geliştirme ve uygulama. Belirlenen adımlar ve diğer bulgular doğrultusunda bir iş yeri için afet ve acil durum planı hazırlanmıştır. Öncelikle ilgililerden bir planlama ekibi oluşturulmuştur. Ardından tehlikeler belirlenmiş, oluşturulan yöntemle risk analizi yapılmış ve alınması gereken önlemler

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[1] Lecturer, Kahramanmaraş Istiklal University, Elbistan Vocational School, Property Protection and Security Department, Kahramanmaraş, Türkiye
[2] Associate Professor, Sakarya University, Engineering Faculty, Environmental Engineering Department, Sakarya, Türkiye
Corresponding author e-mail: muratcan.duruel@istiklal.edu.tr

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belirlenmiştir. Daha sonra yapılması gerekenlerin ve iletişim konusunun detaylandırıldığı prosedürler hazırlanmıştır. Planın uygulanmasına yönelik yapılacak eğitim ve tatbikatların detayları belirtilmiştir. Son olarak planın ne sıklıkta yenilenmesi gerektiği belirtilerek planın dokümantasyonu tamamlanmıştır. İyi hazırlanan ve uygulanan bir plan, hem çalışanların hem de iş yerinin her türlü olaya hazırlıklı olmasını sağlayacağından oldukça önemlidir.

Anahtar Kelimeler: Afet Yönetimi, İş Yeri, Acil Durum Planı, Planlama, Risk Analizi

1. Introduction

1.1 Emergency and disaster

An emergency can be defined as any situation that causes or may cause significant damage to people or structures (Shen and Shaw, 2004). Another source defines events that can be intervened locally and require urgent intervention as emergencies, even though their impact is great (AFAD, 2014). Because they are unexpected situations, they will cause various damages. In addition to the loss of life, they can cause physical and environmental damage. The most effective response method is to be prepared before an emergency occurs. This is only possible with the measures to be taken (ÇSGB, 2017). This preparation allows the creation of plans to respond to situations that disrupt normal life (Vaughn, 2023).

Natural or man-made events that affect the whole or a certain segment of the society, stop or disrupt normal life, cause losses in every field, exceed the coping capacity of the affected are defined as disaster (AFAD, 2014). The fact that it affects all living things, that capacities are exceeded, that it is associated with vulnerability and that social processes are effective can be counted as the common characteristics of all disasters. If we talk about the types of disasters; basically, it can be divided into natural disasters and man-made disasters. It should be understood from the concept of natural disaster that it is not a part of daily life but is related to nature. Earthquakes, storms, floods, tsunamis and volcano eruptions are examples of common natural disasters. On the other hand, man-made disasters are events that are generally caused by careless and imprudent behavior and where humanitarian factors are effective. Dam failures, industrial fires, air pollution, global climate change and wars are examples of man-made disasters (Kadıoğlu, 2011).

Disaster management is the process of struggle to prevent disasters, reduce possible damages, respond in a timely and effective manner when disasters occur, provide a safe and developed life for the affected community (AFAD, 2014). In disaster management, four phases are generally considered: Risk and harm mitigation, preparation, response and recovery. These four phases are also composed of the processes in Table 1 (Kadıoğlu, 2011).

Table 1. Disaster management phases and processes (Kadıoğlu, 2011)

Risk and Harm Mitigation	**Preparation**	**Response**	**Recovery**
Hazard Analysis	Incident Command System	Impact and Needs Analysis	Medium-Long Term Recovery
Risk Analysis	Planning	Field Management	Rebuilding
Risk Mitigation	Forecast and Early Warning	Early Recovery	
Risk Communication	Drill		
	Training		

1.2 Workplaces' risks in emergencies and disasters

In a booklet prepared by the United States of America Occupational Safety and Health Administration (USA-OSHA); situations that threaten employees, customers and the public, interrupt or halt production/service, cause physical or environmental damages are defined as emergencies that a workplace will encounter. Fires, floods, hurricanes, hoses, toxic gas emissions, radiological accidents, explosions, chemical sprinkles, workplace violence and social events are defined as disasters and emergencies that can be seen in workplaces (USA-OSHA, 2001).

According to the guide prepared by the Turkish Ministry of Labor and Social Security (ÇSGB), in addition to these situations, it is necessary to consider emergencies that may occur specific to the nature of the work done (ÇSGB, 2017). For example, organizations that provide mass nutrition services face the most job-specific emergencies such as foodborne diseases, wastewater contamination, water shortage and biologically contaminated water (Mortaş and Bilici, 2016). Job-specific emergencies that industrial divers may encounter as high-risk in the work area can be listed as the operation of the ship's propeller, the use of winches and capstan, gas compression and explosion, and the diver's air cut off during diving from the surface (Akagündüz, 2015). Occupational emergencies that may occur at airports can be counted as aircraft accidents, illegal acts and hazardous material incidents (SHGM, 2012). In ships, the most common examples of job-specific emergencies are rudder failure, abandonment of the ship, falling over the sea, grounding and water intake (Taçyıldız, 2014).

1.3 The importance and purpose of the study

Working people spend a significant part of the day in their workplaces. During this time at their workplaces, they encounter disasters and emergencies. As in all segments of society, workplaces must be prepared for disasters and emergencies that may affect the area and surroundings of their facilities and take necessary precautions (URL 1). Also, when an emergency occurs, it will be very difficult to find an effective solution at that moment. For this reason, it is very important to know who should do what for which situation. The material and moral losses experienced until today in the event of disasters and emergencies also reveal the necessity of a good plan for every workplace (Kadıoğlu, 2011).

The purpose of this study is to reveal what steps should be followed in the preparation of the most effective disaster and emergency plan for workplaces, after examining and evaluating the legislation, guides and resources in force, and to implement these steps in a production field.

2. Methodology

This study was conducted in two steps. In the first step, document analysis was carried out. Guidelines, legislation and academic studies for the preparation of workplace disaster and emergency plans of both national and other countries were investigated. It was checked whether the documents on the websites of the authorised institutions were original or not. After the documents were examined and analysed, a scheme was created to reveal the most effective plan preparation steps. In the second step, a disaster and emergency plan of a workplace was prepared and implemented with the obtained scheme and findings.

2.1 Disaster and emergency plan preparation process

It is the workplace disaster and emergency plan, which includes all the information about disasters and emergencies that may occur in the workplace and all the steps to be taken. An emergency plan must be prepared and implemented to prevent injuries and accidents, to protect the workplace and surrounding structures from possible damages, to overcome the damage caused by incidents to the workplace with the least damage, to protect the society

and the environment from possible effects, and then to ensure a fast and effective transition to normal working order (ÇSGB, 2017).

For an overview of disaster and emergency management, we can refer to the United Kingdom Cabinet Office's emergency preparedness document under the Civil Contingencies Act Enhancement Program. It shows emergency planning in 5 steps: Risk profile, goals, role and resources, organization, responsibilities (UK, 2011). According to the Emergency Management System of British Columbia, Canada, an emergency plan can be prepared in 10 steps. These steps are; determination of the planning context, identification and roles of stakeholders, hazard and risk analysis, purpose and scope of the plan, meeting with stakeholders and data collection, plan formulation, feedback and approval, compliance and training, implementation, maintenance and continuous improvement of the plan (Canada, 2016).

If we examine more specifically for workplace disaster and emergency planning, the United States of America Federal Emergency Management Agency (US-FEMA) shows the preparation of an emergency plan in 4 steps in its guide for workplaces. These steps are; establish a planning team, analyze capabilities and hazards, develop the plan and implement the plan (USA-FEMA, 1993). In another guide prepared by the Canadian Vancouver Office of Emergency Management for workplaces, it is shown in 6 steps. These steps are; It has been stated as forming the planning team, identifying the risks and determining their effects, risk mitigation and preparation, creating a response plan, creating a recovery plan, drill and updating (Canada, 2017).

In the legislation and guides of Türkiye regarding workplace emergency plans, steps to be applied in different numbers and the emergency plan preparation process are described. Examined legislation and guides: Regulation on Emergency Situations in Workplaces, ÇSGB guide, Istanbul Provincial Disaster and Emergency Directorate (IAADM) guide, Istanbul Chamber of Industry (ISO) Guide. The steps in them are shown in Table 2.

Table 2. Disaster and Emergency Plan Preparation Processes According to National Legislation and Guides (TOG, 2013; ÇSGB, 2017; IAADM, 2009; ISO, 2008)

Legislation	**ÇSGB Guide**	**IAADM Guide**	**ISO Guide**
Identification of emergencies	Identification of emergencies	Team building	Policy and team building
Measures	Measures	Hazard and risk analysis	Mission and authorization
Determination of officers	Determination of officers	Harm reduction planning	Risk analysis
Response and evacuation	Response and evacuation	Command and services	Completion and confirmation
Documentation	Documentation	Procedures	
Drill	Drill	Training and drill	
Renewal	Renewal	Solidarity	
		Emergency supplies	

When the legislation and guides are examined, it is seen that although the titles of the plan preparation process change, the procedures to be done are almost the same. In this study, the preparation of the plan will be examined in four steps, but within each step, the processes specified in Table 2 will also be examined. These steps will be; creating the planning team, making hazard and risk analysis, developing the plan and implementation of the plan.

2.2 Hazard and risk analysis method

Hazard is defined as a physical condition that has the potential to cause human injury, property and environment damage, or a combination of these. Risk, on the other hand, refers to the probability of an undesirable event occurring within a certain time or under certain conditions, that causes certain results (Alli, 2008). Risks have a dynamic nature. How the workplace uses resources and its capacity to act will determine its ability to respond to these risks (ILO, 2011). If there are disaster hazard and risk maps of the region where the workplace is located, taking advantage of these will enable the workplace risk analysis to be evaluated with clearer information (ÇSGB, 2017).

First of all, the hazards that the workplace may encounter should be determined. Both disasters that may occur in the region and emergencies specific to the workplace should be determined. Once determined, risk analysis can now be performed using the matrix. The sample risk analysis table presented in the guide prepared by USA-FEMA is given in Figure 1. For each identified hazard, a total score is obtained by scoring the probability of occurrence, effective factors and resources, and with this score, the size of the risk is digitized (USA-FEMA, 1993). A similar sample evaluation presented in the guide prepared by the Canadian Vancouver Office of Emergency Management can be found in Figure 2. The sample table presented in the guide prepared by IAADM is shown in Figure 3. In addition to these, in the guide prepared by the ISO, it is recommended to perform risk analysis using four separate tables. After the hazard is selected from the first table, the probability of the hazard is determined from the second table. After selecting the result category from the third table, the risk level appears in the fourth table (ISO, 2008).

TYPE OF EMERGENCY	Probability	Human Impact	Property Impact	Business Impact	Internal Resources	External Resources	Total
	High 5 ↔ 1 Low	High Impact 5 ↔ 1 Low Impact			Weak Resources 5 ↔ 1 Strong Resources		

Figure 1. Sample risk analysis in FEMA guide (USA-FEMA, 1993)

Sample Risk Analysis

ASSET	HAZARD	PROBABILITY SCORE	POTENTIAL IMPACT/SCENARIOS	IMPACT SCORE	RISK RATING
Employees	Earthquake	Likely (4)	• Injury • Damage to homes/schools • Disruption to transportation network	Severe (5)	Extreme (20)
	Flood	Possible (3)	• Damage to homes/schools • Disruption to transportation network	Moderate (3)	Medium (9)
	Wind Storm	Possible (3)	• Damage to homes/schools • Disruption to transportation network	Moderate (3)	Medium (9)
Refrigerated Inventory	Earthquake	Unlikely (4)	• Damage to refrigerators/freezers (From impact to displacement) • Power outage	Significant (4)	High (16)
	Flood	Possible (3)	• Damage to refrigerators/freezers (From impact to displacement) • Power outage	Significant (4)	High (12)
	Wind Storm	Possible (3)	•Power outage	Moderate (3)	Medium (9)

Figure 2. Sample risk analysis in Vancouver guide (Canada, 2017)

HAZARD AND RISK ANALYSIS													
	HAZARD									RISK			
	Damage					Probability							
	0	1	2	3		0	1	2	3		0	1	2	3
Human														
Property					x					=				
Business														

Figure 3. Sample risk analysis in IAADM guide (IAADM, 2009)

Contagion impact should also be evaluated separately. Risks of neighboring workplaces are indirectly hazardous. It is important that neighboring workplaces come together and share their risks. If the risks of neighboring workplaces are known, preparations can be made against the hazards that may come from there. With risk sharing, there will be a chance to act together for common risks. It will be possible to prevent the domino effect especially in natural disasters and major accidents (ISO, 2008).

Although risk assessment in workplaces is required in national legislation, there is no detail on the method that should be used. This provides the opportunity to choose different applications depending on the sector of the workplace and the risks it poses. In the guides prepared for the workplace emergency plans, it is seen that L-type matrix is generally used for risk analysis (Figure 1,2,3). Matrices are used to rate the magnitude of risk. With this simple technique, it can be determined which risks should be taken against first (Özkılıç, 2014). In the L-type matrix, the relationship between the probability of occurrence of hazards and the damages that may occur when they occur is analysed. The method is one of the most frequently used quantitative methods because it is easy to apply and can be performed by one person (Koltan, 2010). Quantitative methods other than L-type matrix are Fine-Kinney method and X-type matrix. There are also qualitative methods such as fault tree analysis, what if analysis, cause and effect analysis, hierarchical task analysis (Selçuk and Selim, 2018).

In this study, it was decided to use L-type matrix because it would be suitable for the situation of the identified workplace, the risks can be expressed numerically and can be easily applied. A table was created by evaluating all the samples obtained and the risk analysis of the hazards identified for the workplace was performed according to this table. The risk level of the hazards was digitized with the created table. The risk level can be grouped and classified as low, medium, high and very high. The two-way contagion impacts have been revealed by evaluating the neighboring workplaces.

2.3 Risk and harm mitigation program

After the risk analysis, the measures to be taken should be determined and implemented to reduce the risk and harm. Some of these measures are: To take measures to prevent loss of life and property caused by hazards, to work to prevent or reduce damage that may occur, to organize precautions and activities for teams to come into action when a disaster or emergency occurs, to take structural measures to limit the impact of the hazard (Kadıoğlu, 2011). These processes need to be studied within a program. To create the program, priorities should be determined and the risks should be resolved in order by writing them accordingly. A sample of this program is as in Figure 4. However, this is just a sample study and may vary depending on the specific features of the workplace and the formats it uses (ISO, 2008).

Risk Number: Special number to risk	**Classification:** Risk category	**Report date:** the date the risk form was prepared
Definition: Define each risk in terms of conditions-consequences		
Probability: Probability of risk to cause problems	**Impact:** What kind of harm can cause when risk becomes a problem?	**Exposure to risk:** Predict to risk exposure by multiplying the probabilities and loses
First signs: What are the firs signs that risk will turn into a problem?		
Correction approaches: State the practices made to reduce the risk, prevent it from occuring or control it.		
Starting date: Start date of risk reduction efforts	**Due date:** The targeted completion date of risk reduction efforts	**Responsible:** Identify a responsible person for each risk risk reduction
Current status: State the status of risk reduction efforts at the time this report was prepared		
Contingency plan: Explain the action plan to be implemented in case the risk occurs at an unexpected time		
Implementation of the contingency plan: Specify the conditions under which this plan will be implemented		

Figure 4. Sample of risk mitigation program (ISO, 2008)

It is also possible to create the program differently, by defining preventive-restrictive measures. First of all, it is necessary to pay attention to the separation of these measures. Preventive measures refer to measures and actions to be taken before a disaster or emergency occurs. Restrictive measures are the measures that should be taken when an emergency occurs to reduce the damage it will cause. For example, the preventive measure to be taken to prevent a fire in the boiler room will be periodic controls. The restrictive measure that can be applied here can be determined as the establishment of a fire extinguishing system. This program can be created by determining preventive and restrictive measures for each of the emergencies determined as a result of the hazard and risk analysis (ÇSGB, 2017).

In this study, a risk-harm mitigation program was created for each item evaluated in the risk analysis. The title of the program was created to show risk, risk assessment and potential impact, and under it, preventive and restrictive measures were put forward. Information such as who is responsible for each measure, what will be the frequency with which it will be implemented are stated in the instruction section.

3. Results and Dıscussion

3.1 Disaster and emergency plan

In human life, disasters and emergencies are possibilities that can appear anytime, anywhere and will make living conditions difficult with their effects. Predictive studies to be carried out according to the geography and environment in which we live are the only method of getting rid of disasters and emergencies with the least damage. For this reason, it is essential to prepare and implement an effective disaster and emergency plan for situations to be encountered in workplaces.

In line with the purpose of this study, legislation, guidelines and other studies were examined, the findings were compared, and the process of preparing the disaster and emergency plan was revealed. Then, these steps were implemented in a stationery production area in Kocaeli/Türkiye and the plan was created. The factory where the product is made also includes facilities such as offices, sports halls and dining halls within its borders. The four steps of the plan preparation process are as follows: Creating the planning team, making hazard and risk analysis, developing the plan and implementation of the plan (Figure 5).

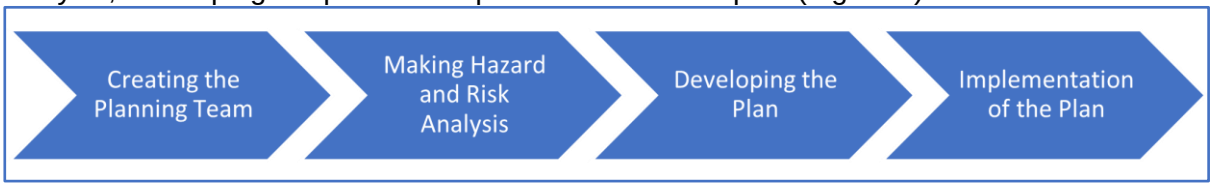

Figure 5. Workplace disaster and emergency plan preparation process

The size of the planning team varies according to the work, needs and resources of the workplace. The team should be led by an elected manager or by the current facility manager. Often one or two people will take the load, but it is very important to be able to get data input from all areas (USA-FEMA, 1993). The benefits of conducting the process as a team will be as follows: It enables more employees to adopt the plan, increases the time and energy that team members can devote to this work, and provides a broader perspective on the steps of plan preparation (IAADM, 2009).

The members of the planning team are designated as factory operations director, occupational safety specialist, occupational physician, healthcare personnel, administrative affairs manager, auxiliary facilities manager and employee representative. The operations director is responsible for the management and coordination of the team. In addition, since he is an emergency manager, the fact that the plan is in the management from the preparation stage

will provide great convenience during the applications. Occupational safety specialist, occupational physician and healthcare personnel have been included as mandatory members of the team due to their job. The administrative affairs manager was also included in the team as he was responsible for basic services such as dining hall services and cleaning services. The auxiliary facilities manager was included for the duties to be carried out by the boiler room and maintenance and repair team within its structure. The employee representative, on the other hand, is in the team to ensure the participation of the employees and to protect their rights during and after the plan preparation.

The hazard and risk analysis in the second step of the plan was started by determining the hazards that would cause disasters and emergencies in the factory and the risk levels were revealed with the risk analysis method created. Due to the detailed scope of this hazard and risk analysis step, it has been examined as a separate title (3.2 Hazard and risk analysis).

In the "developing the plan" step, a risk and harm mitigation program was prepared according to the risk levels determined first. Preventive and restrictive measures for each risk are determined and specified in this program. Then, when a disaster or emergency occurs, the management and operation organization on how to handle the command of the incident was determined. The management group includes an emergency manager, operation manager, meeting place manager, fire team leader, rescue team leader, protection team leader, first aid team leader, logistics leader and evacuation leader. In the operation group, there is the operation manager and the personnel of the mentioned teams. The information of both the management and the operation group is listed in the plan. The emergency organization created by Atay (2016) in her master's thesis consists of the facility manager, emergency officer, technical affairs officer and public relations officer. Response teams, work under the emergency officer. Management organizations in workplace disaster and emergency plans; Establishment of workplaces with different titles and unit numbers according to their size, line of business and management structure shows that the workplaces form a unique organizational structure for the same purpose. The important thing is to create an organization that will provide the most effective disaster and emergency management for the needs of the workplace.

Afterward, the procedures to be followed in the determined disaster or emergencies were prepared. Procedures containing all the information such as how the intervention and communication will be, who the first person to notice the situation will inform, etc. (Figure 6). Workflow diagrams have been prepared to make the written procedure easier to understand and to facilitate the application (Figure 7). In these diagrams, the communication and workflow to be carried out from the person seeing the incident until the end of the response are shown. If there are steps that vary by shift, a separate diagram is created for each shift.

In the emergency preparedness and response plan created for a mining project of Dundee Precious Metals company in Bulgaria, scenarios were prepared for the identified hazards, sub-plans were prepared for the response according to the scenarios and the plan was completed (Dundee, 2014). In this study, a risk analysis was made using the existing and up-to-date data of the factory, a risk-harm mitigation program was created, and then response procedures were prepared. Although different methods such as scenarios can be used, quantitative analysis for the most understandable result and then the response phase will provide more concrete results. In the planning of the response phase, sub-plans can be prepared, as well as preparation of procedures in the same plan is among the methods in the literature and legislation.

OCCUPATIONAL ACCIDENT PROCEDURE

After an occupational accident:
- The person who sees the accident informs the section leader.
- Section leader or person seeing the accident notifies the Workplace Health Unit (7112). If the employee can walk, he / she is transferred to the Workplace Health Unit with a companion. If there is no situation to go by their own means, health personnel are expected.

- Occupational Safety Specialist is informed by the Workplace Health Unit.

- In cases where the casualty is unable to move, the accident is stabilized. First aid is provided only by people trained in first aid.

- The Workplace Physician or Other Health Personnel calls an ambulance if there is a need for outside assistance / ambulance request. (Contracted Ambulance phone number or 112 Emergency number).

- Workplace Health Unit provides companions for the casualty who is referred to the hospital in case of need.

- In cases where the casualty needs to be under observation, the Workplace Health Unit is informed to the Logistics Officer concerned with the patient. The Logistics Officer provides the necessary organization to inform the relatives of the patients.

- In serious accidents, the accident scene is isolated by the department leader / manager so that the Occupational Safety Specialist and Workplace Physician can investigate the accident. In cases where this is not possible, the department leader / manager is obliged to make detailed photographs and to take the records of the witnesses.

- If there is a fatal accident, the accident area is surrounded by a safety strip. Emergency Manager informs law enforcement and employee family. Until the research is done, arrangement and work are not carried out at the accident site.

- OHS staff conducts an incident investigation with the help of the department leader / manager and eyewitnesses and the necessary measures are taken.

- Incident notification is made by Human Resources via SSI e-reporting system.

Figure 6. Occupational accident procedure

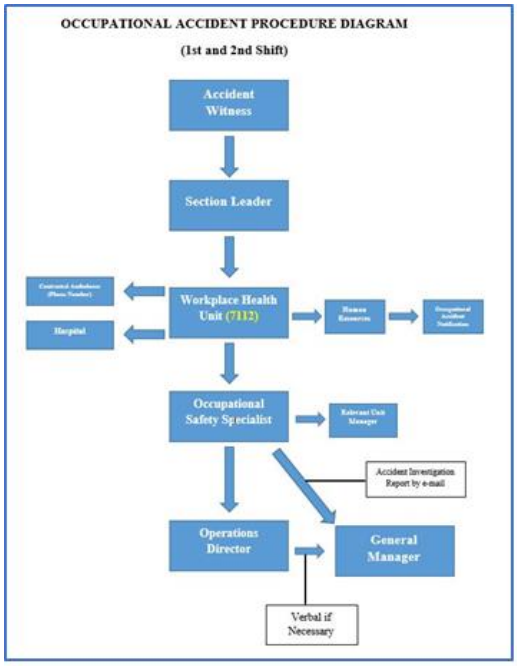

Figure 7. Occupational accident procedure diagram

After the procedures and diagrams, emergency phones required for communication, an out-of-factory communication guide, nearest hospitals and transportation information are included. Next, the facility layout and evacuation plans of all sections (Figure 8) are included.

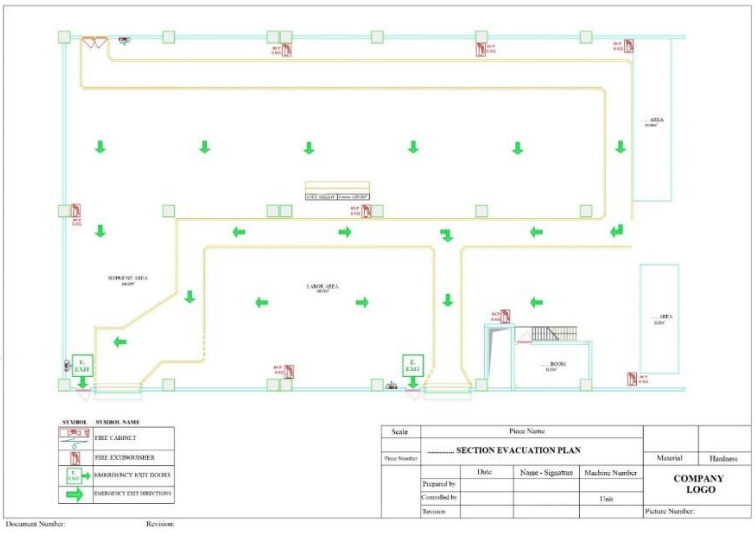

Figure 8. Evacuation plan for a section of the workplace

Relief and emergency supplies are other important issues that should be included in the plan. The factory has previously carried out insurance transactions for disasters and emergencies. It has preferred to help after disasters and emergencies in terms of relief, and has been in favor of advancing through agreements to be made with the group companies they are involved in or with other relevant companies, depending on the needs that may arise. The food and beverage needs in emergencies are provided and stored by the relevant sub-employer firm. For employees who need medication, the Workplace Health Unit assumes the responsibility.
Disaster and emergency plans must be documented in writing. A record must be created that includes all persons and institutions, all envisaged situations, all resources, and agreements and procedures (UK-HSE, 1999). In line with the findings obtained with this study, a disaster and emergency plan was prepared for the factory that produces stationery materials. The documentation of the plan, which was brought together with the content and more specified in the guide prepared by the ÇSGB, was also carried out in this study.

In the implementation of the plan, priority is given to education. In the risk-harm mitigation programs of this study, it was stated that all employees should be trained every year about disasters, emergencies and the procedures to be followed in such cases. In the content of this training that should be organized at least once a year; The duties and responsibilities of the employees/teams, hazards and measures, notification, warning and communication procedures, response procedures, evacuation, counting and asylum procedures will be found. It was stated that the operation teams should be trained within the same program. The training of the teams is carried out within the periods determined within the framework of the legislation. The training of the teams is among the most frequently asked issues by labor inspectors and other supervisory elements. After the training, a drill is carried out. It was also stated that the risk-harm reduction programs in the prepared plan should be drilled every year. The drill will be evaluated in terms of whether it is suitable for the plan or not. Necessary corrections and training will be organized for the issues that are deemed incomplete or incorrectly applied. Renewing the plan is the last step to be announced. Considering the legislation for this renewal, the mandatory periods should not be exceeded. Because the factory where the work is carried out is a "hazardous" class workplace by the local legislation, it must be renewed at least every four years. In addition, considering disasters and emergencies, when innovations that will cause a change in the hazard-risk relationship to occur, the plan should be changed partially or completely, without waiting for the necessary period. It is stated in the plan that while performing these renovation studies, the up-to-dateness of the facility information and

records, whether they include the lessons learned, in case of physical changes in the facility, this should be included in the plan, and the changes in the hazards affecting the facility should be taken into consideration.

The response procedures and diagrams prepared in this study contain information on how to report the disaster or emergency to whom, how and by whom the alarm system will be activated. In addition, evacuation plans, disaster and emergency teams and the duties of the teams are also included in the plan. In the last parts of the plan, it is emphasized that all employees should be trained on the subjects included in the plan. In a published article by Della-Giustina (2005), it was emphasized that a good emergency plan should teach employees how to report the incident, how to activate the alarm system, rescue procedures and their duties and responsibilities. It is also stated that all employees must know the plan and general evacuation procedures. The issues included in the plan prepared in this study and stated in this paragraph coincide with the points emphasized in other sources.

3.2 Hazard and risk analysis

First of all, an evaluation was made with the planning team according to the region where the factory is located, the materials produced in the facility and the work done, and the hazards were revealed. These hazards are listed as earthquake, flood, storm-tornado, epidemic diseases, fire, sabotage, explosion, occupational accident, chemical substance spread, food poisoning and heavy snowfall.

The risk status for each hazard has been assessed. However, when the sources in this study are examined, it is seen that it is usually little or no information about how to determine probability and impact scores when performing risk analysis. In some guides, it is stated that a separate table can be created showing how many points should be given for the occurrence of the hazard or what the effect will be when it occurs. While evaluating probability and impact scores; Issues such as previous disasters and emergencies in the factory, the physical conditions of the facility, the situation of the region in terms of disasters, business processes, occupational health and safety practices, and measures taken were taken into consideration. The probability and impact of disasters and emergencies will vary greatly depending on the geographical location of the factory, the structure of the facility, security measures and many other factors related to the facility. The workplace, which has been producing stationery materials for many years, moved to its new facility a few years ago. For this reason, in the risk analysis, disasters and emergencies that occur after moving to the new facility are taken into consideration, not the situations that occurred at the previous facility.

For example, the probability and impact scores were determined by choosing from the table in Figure 9 for earthquake hazard. In this choosing, the following were taken into account: Türkiye Earthquake Hazard Map (AFAD, 2018), Distribution of Kocaeli Existing Factories According to the Earthquake Risk Map (URL 2), The fact that the facility was built to be M9 earthquake-resistant in the first construction, glass facade and roofs in some sections, shelves, high cabinets and machines in warehouses and departments, and points where work is done at height. Then, a risk score was obtained by multiplying the probability and impact scores. This risk score is checked from the matrix in Figure 10 and the level of risk is determined. Risk analysis was carried out by applying the same procedure for each hazard (Figure 11). While there was no hazard at a ‘very high-risk level’ in the analysis, four different hazards were evaluated as ‘high’.

In this study, up-to-date maps have been evaluated to obtain up-to-date information about earthquakes and to make an effective risk analysis. In the study conducted according to a published article, an assessment of the emergency plan of an underground chrome facility was made, and the "Earthquake Zones Map", which was put into effect in 1996, was used while giving information about the earthquake zone where the facility is located (Kılıç et al., 2016).

Considering the date of the study, it is seen that the information obtained is up-to-date according to that date. Up-to-date information is of great importance for the most effective analysis in the studies carried out.

PROBABILITY AND IMPACT SCORES					
	1	2	3	4	5
PROBABILITY	Very Unlikely	Unlikely	Possible	Likely	Very Likely
IMPACT	Negligible	Low	Moderate	Significant	Severe

Figure 9. Probability and impact scores

Sample Risk Matrix					
Very Likely (5)	5	10	15	20	25
Likely (4)	4	8	12	16	20
Possible (3)	3	6	9	12	15
Unlikely (2)	2	4	6	8	10
Very Unlikely (1)	1	2	3	4	5
	Negligible (1)	Low (2)	Moderate (3)	Significant (4)	Severe (5)

Risk Level
Extreme (20-25)
High (10-19)
Medium (4-9)
Low (1-3)

Figure 10. Risk matrix

THE FACTORY RISK ANALYSIS				
HAZARD	PROBABILITY SCORE	POTENTIAL IMPACT	IMPACT SCORE	RISK RATING
Earthquake	4	Worker injury, death Damage to structures, machinery and products	4	16 (High)
Flood	3	Obligation of asylum, Transportation disruption	3	9 (Medium)
Storm - Tornado	3	Worker injury, Obligation to asylum	3	9 (Medium)
Epidemic Disease	3	Employee rest, Loss of workforce	3	9 (Medium)
Fire	3	Worker injury, death Damage to structures, machinery and products	5	15 (High)
Sabotage	2	Worker injury, death	4	8 (Medium)
Explosion	3	Worker injury, death Damage to structures, machinery and products	4	12 (High)
Occupational Accident	4	Worker injury, death	3	12 (High)
Chemical Spill	2	Worker injury, Product and labor loss	3	6 (Medium)
Food Poisoning	1	Disease in employees, Loss of workforce	3	3 (Low)
Heavy Snow	3	Obligation of asylum, Transportation disruption	3	9 (Medium)

Figure 11. Workplace risk analysis

After the analysis, the contagion impact was also evaluated (Figure 12-13). As a result of the evaluation, it has been observed that after a disaster or emergency, the situation that will affect

both the factory and the surrounding workplaces will be fire and chemical inhalation. What will be done to reduce the impacts that will spread to the environmental workplaces from the factory is to properly implement the risk-harm mitigation programs and response procedures in the prepared plan. To reduce the fire impact from surrounding workplaces, it is necessary: To perform periodic controls of fire hydrants placed around the factory without interruption, communicating with the surrounding workplaces when necessary and eliminating the impact of the spread by acting together.

CONTAGION IMPACT				
WORKPLACE	**SECTOR**	**BUSINESS DETAIL**	**SIZE OF AREA**	**ITS IMPACT ON US**
.... in the east	Logistics - storage	Storage of products belonging to different companies, loading them into vehicles and distributing them for distribution are carried out.	11.500 m²	If a fire caused by the products in the warehouse area due to earthquake or work accident cannot be stopped within the boundaries of the production area and the wind factor is also activated, it may affect us.
.... in the east	Machine production	Elevator machines and parts are produced.	10.000 m²	A fire that may occur as a secondary disaster due to earthquakes and explosions can affect us.
.... in the west	Automotive sales/rental	Car rental and sales services are provided in the campus with office and parking areas.	-	Since the production site is the closest workplace to us, even a small-scale fire in the office or parking lot is likely to affect us.
.... in the north	Engine production	Engine production is made for different vehicles with an annual capacity of 20,000.	230.000 m²	A fire that may occur as a secondary disaster due to earthquakes and explosions can affect us.
.. in the northeast	Chemical production	Auxiliary and adhesive chemicals are produced for products such as furniture, paint and paper.	-	If a fire that will occur due to earthquake or work accident cannot be stopped within the boundaries of the production area, it will affect us as well. Having chemicals in the facility will make it difficult to extinguish the fire. It has the risk of inhalation of toxic gases and injury-death.
.. in the northeast	Fabric production	Fabrics for products such as roller blinds and sunshades are produced.	12.000 m²	A fire that will occur due to machine breakdown will affect us with its contribution in the wind.
.. in the northwest	Automotive production	Automotive production is made. It includes office and production facility.	300.000 m²	A fire that may occur as a secondary disaster due to earthquakes and explosions can affect us.
.... in the west	Automotive production	Automotive production is made. It includes office and production facility.	290.000 m²	A fire that may occur as a secondary disaster due to earthquakes and explosions can affect us.

Figure 12. The contagion impact to the workplace

CONTAGION IMPACT				
WORKPLACE	**SECTOR**	**BUSINESS DETAIL**	**SIZE OF AREA**	**OUR IMPACT TO THEM**
.... in the east	Logistics - storage	Storage of products belonging to different companies, loading them into vehicles and distributing them for distribution are carried out.	11.500 m²	A fire that may occur in our factory, especially in the boiler room, may affect them with the contribution of the wind.
.... in the east	Machine production	Elevator machines and parts are produced.	10.000 m²	A fire that may occur in our factory, especially in the boiler room, may affect them with the contribution of the wind.
.... in the west	Automotive sales/rental	Car rental and sales services are provided in the campus with office and parking areas.	-	If a fire that may occur in our factory cannot be extinguished in the field, it will affect them as well.
.... in the north	Engine production	Engine production is made for different vehicles with an annual capacity of 20,000.	230.000 m²	In the event of a very large and unavoidable fire, it may affect them with the contribution of wind.
.. in the northeast	Chemical production	Auxiliary and adhesive chemicals are produced for products such as furniture, paint and paper.	-	A fire that may occur in our factory, especially in the boiler room, may affect them with the contribution of the wind.
.. in the northeast	Fabric production	Fabrics for products such as roller blinds and sunshades are produced.	12.000 m²	A fire that may occur in our factory, especially in the boiler room, may affect them with the contribution of the wind.
.. in the northwest	Automotive production	Automotive production is made. It includes office and production facility.	300.000 m²	In the event of a very large and unavoidable fire, it may affect them with the contribution of wind.
.... in the west	Automotive production	Automotive production is made. It includes office and production facility.	290.000 m²	In the event of a very large and unavoidable fire, it may affect them with the contribution of wind.

Figure 13. The contagion impact to surrounding workplaces

Finally, lists containing the information of disabled-pregnant employees and their attendants were added. It is of great importance to keep the list up-to-date and the attendants to be close to the disabled-pregnant employees in every shift, for the safe evacuation of the disabled or pregnant employee in the event of a disaster or emergency.

3.3 Risk and harm mitigation

In this study, a risk-harm mitigation program was created for each hazard evaluated in the risk analysis. The title of the program was created to show the risk, risk score and potential impact. Under it, preventive and restrictive measures are put forward, respectively. Information such as who is responsible for each measure or how often it will be performed are specified in the instructions (Figure 14).

RISK AND HARM MITIGATION PROGRAM			
Risk	**Risk Point**	**Program Date**	**Potential Impact**
Fire	15 (High)	February 2020	Worker injury, death Damage to structures, machinery and products

Preventive Measures	Instructions
Periodic control of the electrical installation	It will be held once a year
Restricting smoking areas	Restrictived
Keeping a gas detector, periodic control	Available in relevant sections, once a year
Periodic control of gas cylinders and gas lines	It will be held once a year
Periodic checks of the Faraday Cage	It will be held once a year
Keeping electronic devices closed outside of working hours	Announcements to employees will be repeated
Periodic control of the boilers	It will be held once a year
Critical facilities such as boiler rooms are not entered except by authorized persons	Restrictived by security card
Proper storage of used chemicals	Raw material warehouse and departments
Careful management of waste	Under the supervision of the relevant subcontractor and OHS
Setting up an automatic gas flow shut-off system	OHS and Auxiliary Facilities will conduct research for system installation

Restrictive Measures	Instructions
Having smoke detectors and making periodic control	Available, to be checked twice a year
Establishing a firefighting team	Created, to be kept up to date
Providing / receiving the necessary trainings for the firefighting team	Training has been given, will be repeated
Periodic control of fire extinguishing installation	Will be checked twice a year
Periodic fire drills	To be held every year
Emergency exit doors suitable for quick evacuation in case of fire	Doors are conveniently positioned
Evacuation sketches hanging in a visible way	To be hung in every section
Correct positioning of fire fighting equipment	Checked, suitable
Availability of equipment according to the standard, periodic control	Available, to be checked monthly
Emergency valves	Available, manual system
Illuminated and audible alarm system	Available
When the alarm goes off, the section doors are closed and automatic doors are opened	Trial will be done every month

Figure 14. Risk and harm mitigation program for fire

A published article reported that make drills before a disaster or emergency occur will prevent the panic and confusion that can arise when the situation happens. Therefore, it is emphasized that the key to a successful plan is to conduct regular drills to evaluate employees' reactions to the process (Della-Giustina, 2005). As a result of Bostan and Yildiz (2018)'s study, it was stated that occupational health and safety trainings in workplaces should be increased and employee participation should be increased. In an article published by Kırtaş and Altundağ (2019), it is stated that the practice of the trained personnel will leave a more permanent effect and that drills should be carried out at least once a year after the training. It was stated that the plan prepared in this study should be drilled regularly in risk-harm reduction programs. In addition, in the last parts of the prepared plan, it is stated that after the disaster and emergency plan training to be carried out, a drill will be held at least once a year. After the drill, the evaluation was made and the correction of the missing and wrong matters was emphasized.

4. Conclusions

Human life is fragile, it is quickly affected by external factors. Among these factors, disasters have a large share with their loss of life and property. Disasters cause damage everywhere on earth, whether natural or man-made. Likewise, emergencies occur at unexpected times, catching people off guard. These situations that require rapid response can only be dealt with by taking precautions beforehand and acting planned when the incident occurs.

People may experience a disaster or an emergency while at home, school, garden or on the street, or they may encounter them while working in the workplace. In addition to disasters, there may be emergencies in the work area caused by work-specific issues. Of course, the way to deal with these situations while at work is disaster and emergency management.

To prepare for disasters and emergencies, it is of great importance that workplaces evaluate the current and potential hazard/risks, determine the measures to be taken in this direction,

reveal how to response in which event and then document all processes with disaster and emergency plans. It is not the one who continues the old management habits and focuses only on crisis management; It is necessary to take measures according to the hazards and risks identified by giving priority to risk management, then to plan and implement how to intervene if an incident occurs. While preparing a workplace disaster and emergency plan, evaluations should be made according to the location of the workplace, the type of work done, the number of employees, the physical characteristics of the facility and the facility capacity, as well as the generally known dangers and risks.

Training should be provided to all employees after the workplace disaster and emergency plan is prepared or updated. Because when an incident occurs, it is very important not only for the teams to know the response process, but also what other employees will do, which door they will exit, and the location of the shelter and gathering area. The formation and training of the teams are among the subjects that must be followed meticulously by respecting the time and numbers specified in the legislation. In addition, it is essential for the most effective intervention to not only adhere to the legal period but also to repeat the training in shorter periods if necessary and to reinforce it with drills. Complying with the four steps of the plan preparation process stated in this study and with a good risk analysis to be made, workplaces will have a more effective disaster and emergency management.

To researchers who will conduct a similar study in the future, if it is suitable for their field of work and the necessary permission, budget and time can be obtained; It is recommended that the Natech risk of the workplace be evaluated in detail. The European Commission Joint Research Center has a program for risk assessment in this area (RAPID-N). With this program, it is possible to calculate the risks of technological accidents triggered by natural disasters. In this way, further precautions can be taken for the workplace.

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