OCCUPATIONAL SAFETY RISK ANALYSIS OF ORGANIZED INDUSTRIAL ENTERPRISES IN NEVSEHIR PROVINCE OF TURKEY BY FINE-KINNEY METHOD

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ABSTRACT

This research has been carried out within the scope of the solutions proposed for the evaluation of occupational safety risk analysis in 10 selected enterprises by random sampling in Organized Industrial Zone of Nevşehir province, Turkey and elimination of risk factors towards the results obtained. In scope of the study, Fine – Kinney method were used as risk assessment methods in each of the food, metal processing, machining and plastic firms. At the end of the study, a total of 122 risk factors have been identified in the whole enterprises. Commonly risks arising from falling from heights, fire, exposure to chemicals, electrical components and ergonomic situation insufficiency have been identified. In addition, risks such as insufficient environmental hygiene, lack of ventilation, excessive noise, inadequate training for emergency situations and insufficient use of protective equipment were determined. The identified risks were put forward by different method approaches and it was concluded that the findings were similar in all methods. The regulations and principles to be applied in order to eliminate or minimize the identified risks were discussed and the dimensions of the preventive measures were exhibited. As a result, audits of organized industrial enterprises related to occupational health and safety need to be conducted more strictly. In addition, the measures should put into practice in order to define identified risks and the issue should be monitored by the experts.

1. INTRODUCTION

Work-related accidents and injuries that they cause leads to serious problems in Turkey and many other countries. While the damages of work accidents occur economically and socially, work accidents can cause permanent injuries or even deaths. Permanent injuries in workers cause social and psychological problems.

As a result of these problems, it is extremely important to analyze the risk and safety conditions in organized industrial zone where collective industrial enterprises are located together and to take necessary measures in the light of the obtained results in order to prevent and detect accidents that may occur. It is necessary to anticipate possible work accidents in a facility and to determine the prevention activities.
Risk assessment at the facilities creates a plan to prevent occupational accidents. Thanks to the risk assessment, the issues to be followed in terms of occupational safety are placed in order of importance and a risk prevention plan is created in this way. As a result of these procedures performed according to the risk assessment and the resulting results, the rate in the prevention of occupational accidents is increased. There is no risk assessment method that can be applied to all facilities and workplaces. Because every workplace has its own different dangers. Each method provides risk assessment in a unique system. While performing a risk assessment in a facility, the most important step is to decide which method will be applied in that facility, whether it is a single person or a team formed by experts.

Only in this way, an efficient and accurate assessment is made and the most accurate results are encountered in terms of both cost and labor. When deciding which risk assessment method to choose, factors such as the hazard class of the facility, the operations carried out in that facility, the products produced, the environmental conditions provided for those products, the size of the facility are taken into consideration. Due to improperly applied methods, there will be a delay in taking security measures or an accident will occur before measures can be taken. Correctly identified hazards prevent wrong safety measures from being taken in the workplace. It changes false security awareness in humans. This is only possible by choosing the right method.

Choosing the right risk assessment method will contribute to the prevention of occupational accidents and diseases, to provide a safe working environment in the facilities, to reduce health expenditures, to increase efficiency and the level of quality of the substances produced. Risk assessment is extremely important in order to anticipate possible accidents in the future and to eliminate the factors that will cause accident risks. It is important for the enterprises to be able to produce in a healthy working environment, in order to predict the accident risks that may occur in the employees or tools, equipment depending on the workflow in the enterprises and to eliminate the risk factors for this completely.

In enterprises where risk analysis has been previously made and possible risks are identified and precautions are taken, this will have a positive impact on production stages and employees, which will positively reflect the enterprise's welfare level. This research was carried out to determine the risks related to occupational safety with different model approaches in companies operating in the Organized Industrial Zone of Nevşehir province, Turkey and working in different fields of activity selected by random sampling and to reveal the dimensions of measures that can be taken in order to foresee possible accident risks in the future.

2. MATERIALS AND METHODS

The study area is located Nevşehir Organized Industrial Zone in Turkey’s Nevşehir province. The place where the occupational safety risk analysis is made is the 10th km of the Nevşehir-Aksaray highway, The total area of Nevşehir organized industrial is 57,111,92 m². Nevşehir Organized Industrial Zone has an industrial area of 527,944,98 m². 94% of the total area is used as an industrial area. There are 84 parcels in total in Nevşehir Organized Industrial Zone. 83 of these areas are allocated to industrial enterprises. By its location, Nevşehir Organized Industrial Zone is located 40 km from the closest airport, Cappadocia Airport. Within the scope of the research, it was examined within the scope of occupational safety risk assessment in a total of 10 enterprises, located in the Nevşehir organized industrial zone, with food, iron processing, machining and plastic enterprises selected by random sampling. The location and position of the research area are shown in Figure 1.
Within the scope of the study, Fine - Kinney method was used for risk assessment in Nevşehir organized industrial enterprises. While calculating the risk value in this method;

Risk = Probability x Frequency x Violence

Formula was used. (Kinney and Wiruth, 1976). Information regarding the probability, frequency and severity scales used in the Fine - Kinney risk assessment method and decision making and action plans for risk level and assisting decision making are summarized in Tables 1, 2, 3 and 4.

**Table 1:** Probability scale (Kinney, 1976)

| Probability / Probability Value | Explanation                              |
|---------------------------------|------------------------------------------|
| 0,1                             | The loss is theoretically impossible to occur |
| 0,2                             | The loss is practically impossible to occur |
| 0,5                             | Loss is not expected to occur but still possible |
| 1                               | Possible to occur but very low            |
| 3                               | Likely to happen                          |
| 6                               | High probability of occurrence            |
| 10                              | Loss is expected to occur                 |

**Table 2:** Frequency scale (Kinney, 1976)

| Frequency scale | Probability to be seen                  |
|-----------------|------------------------------------------|
| 0,5             | Once a year or less                      |
| 1               | Several times in a year                  |
| 2               | Once or several times in a month         |
| 3               | Once or several times in a week          |
| 6               | Once or several times in a day           |
| 10              | Several times in an hour                 |
Table 3: Violence scale (Kinney, 1976).

| Measure of Violence | Accident Level                                      |
|---------------------|-----------------------------------------------------|
| 1                   | Bypass accident                                     |
| 3                   | Minor damage and internal first aid                 |
| 7                   | Significant damage and external first aid           |
| 15                  | Permanent damage and loss of work                   |
| 40                  | Fatal accident                                      |
| 100                 | Multiple fatal accidents                            |

Table 4: Decision to risk level and action plan (Kinney, 1976).

| Risk Value (R) | Result of Risk Assessment                        |
|----------------|--------------------------------------------------|
| R > 400        | Unacceptable Risk, Work should be stopped and measures should be taken quickly. |
| 200 < R < 400  | Critical Risk, The situation of the risk is very important and should be included in the action plan. |
| 70 < R < 200   | Serious Risk, The situation of the risk is important, it should be included in the action plan and the work should be followed. |
| 20 < R < 70    | Possible Risk, It should be included in the Action Plan and the risk should be kept under surveillance. |
| R < 20         | Low Risk, Risk is not Priority, it may not be included in the Action Plan. |

3. RESEARCH FINDINGS

In the risk assessment carried out with the Kinney method, 3 food, 3 iron processing, 2 machining and 2 plastics enterprises were evaluated and the results were analyzed according to the method developed by Finne-Kinney. There were 41 risks in iron processing and 32 risks in machining enterprises. In this sense, an example analysis is shown on a visual form developed specifically for this study and presented in Figure 2 in order to make Kinney risk assessment more visual and healthy.
All factors, such as falling from height, fire, exposure to chemicals, excessive noise and sound, physical factor risks, ergonomic situations, electrical installation risks, insufficient training, biological risks and emergency risks, have been examined and results obtained in all businesses. The test was presented in accordance with the evaluation criteria. As an example, the results of the risk assessment made in hair processing companies are presented in detail in Table 5.

**Table 5:** Results of risk assessment done by iron processing enterprise using the Fine - Kinney method

| Result of Risk Assessment | I. Iron Processing enterprise | II. Iron Processing enterprise | III. Iron Processing enterprise |
|---------------------------|------------------------------|-------------------------------|-------------------------------|
| 1. Risk                   | Lack of fire extinguisher tube, Fire risk | Lack of fire extinguisher tube, Fire risk | Ambient overheating, fire risk |
| Risk assessment           | Serious risk                 | Serious risk                  | Serious risk                  |
| 2. Risk                   | Chemical contact, poisoning risk | Risk of inhaling chemical substance | Explosion risk of Chemical substance |
| Risk assessment           | Possible risk                | Critical risk                 | Possible risk                 |
| 3. Risk                   | Noisy environment, risk of hearing sense | Risk of not concentrating from high noise | Risk of distraction from excessive sound |
| Risk assessment           | Low risk                     | Possible risk                 | Possible risk                 |
| 4. Risk                   | Insufficient ventilation, risk of physical factors | Instrument vibration, stress risk of physical factors | Risk of compressed air physical factor |
| Risk assessment           | Serious risk                 | Possible risk                 | Serious risk                  |
| 5. Risk                   | Excessive standing, risk of fatigue ergonomics | Heavy transport, risk of aching ergonomics in the arm | Ergonomic risk of heavy transport in waist |
| Risk assessment           | Critical risk                | Possible risk                 | Critical risk                 |
| 6. Risk                   | Passage of electrical cables through the wet ground, risk of electric shock | Risk of electric shock from switchboards not locked | Insufficiency of electrical hazard warning signs |
| Risk assessment           | Critical risk                | Serious risk                  | Possible risk                 |
| 7. Risk                   | Insufficient training for iron cutting jobs, injury risk | Not using chemical training | Emergency training not provided |
| Risk assessment           | Serious risk                 | Critical risk                 | Possible risk                 |
| 8. Risk                   | Metal application paints and fluids contact, infection biological risk | Iron processing in machine, infection risk | Insufficient use of gloves and masks, risk of catching germs |
| Risk assessment           | Possible risk                | Critical risk                 | Critical risk                 |
| 9. Risk                   | In case of emergency, fire detector warning and warning system insufficiency | Chemical exposure, no emergency hand washing shower | No emergency shower washing system |
| Risk assessment           | Serious risk                 | Serious risk                  | Critical risk                 |

Eight critical risk factors were identified in the risk assessment conducted in iron processing enterprise. II. The risk of respiratory damage due to inhalation of the chemical in the environment is high in the hair processing company. In this sense, the constant ventilation of the environment and the realization of the protective mask will reduce the risk level to minimum levels. Again II. and III. In manufacturing, there may be a risk of infection from open wounds on the hands in manufacturing. In order to prevent this, it is necessary to monitor the use of gloves and also to give training on the use of chemicals, as well as to create an emergency hand, shower system in case of chemical exposure, will show its effect as a risk reducing or completely eliminating factor.
The lack of fire extinguishers in these enterprises, the risk of fire due to the constant heating of the air in the environment, the insufficiency of ventilation and the low air environment, the risk of electric shock due to the lack of locked electrical panels, the lack of a hand washing shower as a result of exposure to chemicals, the insufficiency of the warning system and fire detectors in case of emergency and iron In cutting operations, the risks of training insufficiency causing injuries were encountered.

In the risk assessments made in food companies, 11 risk factors, which are among the various risk factors, have entered the “serious risk” class. Another “possible risk” factor was again encountered in 11 applications and “low risk” factor was determined in 2 applications.

As a result of the evaluation made in machining companies, the critical risk factor was determined in 7 different applications. Chemical smell breathing risks have been observed in these enterprises. It has been observed that the risk of burning in the limbs of the employees as a result of chemical spills in the enterprises, insufficiency of fire tubes, ergonomic risk in the waist as a result of heavy transportation, and its condition is at a critical level. In figure 3, there is an image regarding the controls made regarding the fire extinguisher tube.

In the serious risk levels encountered in plastic enterprises, there are insufficient fire extinguisher tubes in the work areas, there are sound working environments, there are risks of hearing loss due to the high noise level, dusty working environments and ventilation insufficiency, and insufficient training in the operating principles of the production lines.

In addition, serious risk factors such as the lack of training on the actions to be given by the employees in emergency situations, the ergonomic negative effects on the load carrying cause discomfort in the employees, especially the arms, neck and waist, the risk of contact with chemicals and the emergency exit door locked.

The distribution of the risk classes determined as a result of Fine-Kinney risk assessment in enterprises operating in different fields of activity evaluated within the scope of the study is presented as chart in Figure 4.

Figure 3: Fire extinguisher tube controls

Figure 4: Distribution of the total number of risk classes encountered in organized Industry Zone
Risk assessments were carried out in 10 enterprises, which are subject to the research and their field of activity, food, hair processing, machining and plastic using the Fine-Kinney method. In the light of the findings obtained, in summary, the common risks encountered in all of the enterprises and the solution suggestions that need to be made to eliminate these risks are summarized in Table 6.

**Table 6:** Common risks encountered in organized industry enterprises and solution suggestions

| Risk / Solution Suggestions | Common Risks Encountered in All Enterprises and Solution offers |
|-----------------------------|----------------------------------------------------------------|
| Risk Fire Exit Risk          | - The measures to be taken in accordance with the regulation on health and safety measures to be taken in the workplace buildings and additions (Regulation published in Turkey Official Newspaper No. 28710 dated 12 July 2013) (Anonymous 2013b). |
| Solution offers             | - TSE ISO / TS 11602-2 fire protection - what to do in accordance with the standards for portable and wheeled fire extinguishers (Anonymous 2005). |
| Risk Noise Exposure Risk     | Measures to be taken in accordance with the regulation on the protection of employees from risks related to noise (Regulation published in Turkey Official Newspaper No. 28721 dated 28 July 2013) (Anonymous 2013d). |
| Solution offers             | - Measures to be taken in workplace buildings and additions (Regulation published in Turkey Official Newspaper No. 28710 dated 12 July 2013) (Anonymous 2013b). |
| Risk Risk of Falling from Height | - Measures to be taken in workplace buildings and additions (Regulation published in Turkey Official Newspaper No. 28710 dated 12 July 2013) (Anonymous 2013b). |
| Solution offers             | Measures to be taken in accordance with the health and safety conditions regulations in the use of work equipment (Regulation published in Turkey Official Newspaper No. 28620 dated 25 April 2013) (Anonymous 2013c). |
| Risk Risks from Ergonomic Condition Deficiency | - Measures to be taken in accordance with the regulation on health and safety measures to be taken in the workplace buildings and additions (Regulation published in Turkey Official Newspaper No. 28710 dated 12 July 2013) (Anonymous 2013b). |
| Solution offers             | Measures to be taken in accordance with the health and safety conditions regulations in the use of work equipment (Regulation published in Turkey Official Newspaper No. 28620 dated 25 April 2013) (Anonymous 2013c). |
| Risk Electric Shock Risks   | - Measures to be taken in accordance with the regulation on health and safety measures to be taken in the workplace buildings and additions (Regulation published in Turkey Official Newspaper No. 28710 dated 12 July 2013) (Anonymous 2013b). |
| Solution offers             | Measures to be taken in accordance with the health and safety conditions regulations in the use of work equipment (Regulation published in Turkey Official Newspaper No. 28620 dated 25 April 2013) (Anonymous 2013c). |
| Risk Insufficient Ventilation Risks (Insufficient physical environment) | - Measures to be taken in accordance with the regulation on health and safety measures to be taken in the workplace buildings and additions (Regulation published in Turkey Official Newspaper No. 28710 dated 12 July 2013) (Anonymous 2013b). |
| Solution offers             | Measures to be taken in accordance with the health and safety conditions regulations in the use of work equipment (Regulation published in Turkey Official Newspaper No. 28620 dated 25 April 2013) (Anonymous 2013c). |
| Risk Risks from Unhygienic Environment | - Measures to be taken in accordance with the hygienic (workplace) education regulation (Regulation published in Turkey Official Newspaper No. 28698 dated July 5, 2013) (Anonymous 2013f). |
| Solution offers             | Measures to be taken in accordance with the regulation on health and safety precautions in chemical work (Regulation published in Turkey Official Newspaper No. 28733 dated 12 August 2013) (Anonymous 2013a). |
| Risk Risks from Causes by Chemical Substances | - Measures to be taken in accordance with the regulation on health and safety measures to be taken in the workplace buildings and additions (Regulation published in Turkey Official Newspaper No. 28710 dated 12 July 2013) (Anonymous 2013b). |
| Solution offers             | Measures to be taken in accordance with the health and safety conditions regulations in the use of work equipment (Regulation published in Turkey Official Newspaper No. 28620 dated 25 April 2013) (Anonymous 2013c). |
| Risk Risks from Tools and Equipment | - Measures to be taken in accordance with the health and safety conditions regulations in the use of work equipment (Regulation published in Turkey Official Newspaper No. 28620 dated 25 April 2013) (Anonymous 2013c). |
| Solution offers             | Measures to be taken in accordance with the procedures and principles of the occupational health and safety training of employees (Regulation published in Turkey Official Newspaper No. 28646 dated 15 May 2013) (Anonymous 2013e). |
4. CONCLUSIONS AND RECOMMENDATIONS

A total of 122 risk factors were identified in the repair of the enterprises subject to the research. In the enterprises, the risks arising from falling from height, fire, chemical exposure, electrical components and the lack of ergonomic status have been identified. It is obvious that these situations, in which hazardous risk factors are high in all of the companies subject to research, will increase the risk of loss of material and moral damages on the employees, the production loss in the workplace. As a result, audits of organized industrial enterprises regarding occupational health and safety should be done more strictly. In addition, measures to be taken to prevent identified risks should be put into practice, should not be left on paper and it is recommended that the subject be closely followed by the relevant experts.

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CONFLICT OF INTEREST

None.

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