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alphanumeric journal

The Journal of Operations Research, Statistics, Econometrics and Management Information Systems

Volume 3, Issue 2, 2015

*2015.03.02.OR.04*

# A NEW APPROACH TO FINE KINNEY METHOD AND AN IMPLEMENTATION STUDY

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*Received: 16 September 2015*
*Accepted: 17 December 2015*

**Abstract**

In the present day, importance of risk assessments are increasing due to rising awareness of occupational health and safety and excessing legal enforcements. Legal regulations in last years, force all the companies to complete their risk assessments according to their danger class in certain time periods. Technological changes in companies and new legislations are also forcing companies to do their risk assessments before its due time. This ensures risk analyses to be done in more frequent periods and increases importance of being applicable and suitable for the company's structure of chosen risk assessment method. In this study, a new approach has been studied for Fine-Kinney method which is one of the mix risk assessment methods and which is used frequently in construction and cement industries. In this new approach, alternative scales have been created for probability and frequency scales which are used in conventional method. More probable and more frequent risk scores have been augmented to increase their sensitiveness and degree of importance. The new approach has been applied to a mid-scale company and positive or negative effects of scales, which are created with different interpolation results, have been examined. It has been observed that risk scores, which are obtained with the new approach, are more sensitive than conventional Fine-Kinney Methods' risk scores. By this way, action plan of jobs has been changed and risks which are more important have been taken into consideration of company.

*Keywords: Fine-Kinney Method, Risk Analysis, Risk Assessment Methods*
*Jel Code: G32, C02, Z00*

# FİNE KİNNEY METODUNDA YENİ BİR YAKLAŞIM VE BİR UYGULAMA ÇALIŞMASI

**Özet**

Günümüzde iş sağlığı ve güvenliği bilincinin artması ve yasal yaptırımların ciddi boyutlara ulaşması risk değerlendirmelerine verilen önemi daha da arttırmaktadır. Son yıllarda yapılan yasal düzenlemeler tüm kurumların risk değerlendirmelerini tehlike sınıflarına göre belirli zaman periyodlarında yapmalarını zorunlu kılmaktadır. Bir başka yasal düzenlemede de işletmelerdeki teknolojik değişimler ve yeni mevzuatların yayımlanması gibi sebeplerle yapılmış olan risk analizinin zaman periyodunun tamamlanmasını beklemeden yenilenmesi zorunlu hale getirilmiştir. Bu da risk analizlerinin çok daha sık periyodlarda yapılmasını ve dolayısıyla seçilecek risk değerlendirme yönteminin işletmenin yapısına uygun ve kolay uygulanabilir olmasının önemini artırmaktadır. Bu çalışmada karma risk değerlendirme metotları arasında yer alan, inşaat ve çimento sanayide sıklıkla kullanılan Fine-Kinney metoduna yeni bir yaklaşım geliştirilmiştir Bu yaklaşımda klasik metottaki ihtimal ve frekans skalalarına alternatif skalalar oluşturulmuştur. Daha yüksek ihtimale ve daha sık frekansa sahip tehlikelerin skaladaki puanları yükseltilerek hassasiyet ve önem dereceleri daha da arttırılmıştır. Geliştirilen yaklaşım orta ölçekli bir

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işletmede uygulanmış ve farklı interpolasyon metotlarıyla oluşturulmuş skalaların yaratmış olduğu olumlu ve olumsuz etkiler incelenmiştir. Geliştirilen yaklaşım ile elde edilen risk puanlarının, klasik Fine-Kinney metodunun risk puanlarına göre daha hassas olarak ölçüm yaptığı gözlemlenmiştir. Böylece aksiyon planı alınacak işlerin öncelik sıralaması değişerek, daha yüksek öneme sahip risklerin farkındalığı arttırılmıştır.

*Anahtar Kelimeler : Fine-Kinney Metodu, Risk Analizi, Risk Değerlendirme Metodları*
*Jel Kodu : G32, C02, Z00*

## 1. INTRODUCTION

Occupational accidents have become one of the leading causes constituting majority of efficiency losses today. Occupational accidents and diseases in businesses have necessitated taking legal precautions. Following the legal interventions that have gone into effect in the recent years, risk assessment implications are required in all businesses and awareness of all individuals working in occupational safety and health, and risk analysis have attempted to be raised in Turkey. Especially, the law No. 6331: Occupational Safety and Health was gone into effect following its appearance in the Official Gazette on June 30 in 2012. The new law includes more detailed regulations compared to the law No. 4857: Labor Act and brings new and many obligations for employers and specialists (Akpınar and Çakmakkaya, 2014; Turkish Republic Law No. 4857).

With the Law No. 6331: Occupational Safety and Health, risk assessment applications are required in all businesses (Korkut and Tetik, 2013; Turkish Republic Law No. 6331). Risk assessment periods are described according to businesses' danger classes and on certain occasions (technological upgrades, new regulations, occupational accidents and diseases, near miss incidents and etc.) a reassessment is required before the due date. This law that went into effect in order to minimize occupational accidents and diseases has caused the conflict of which risk assessment method to be implemented.

Before implementing one of the risk assessment methods, a business is required to know the following definitions;

*Acceptable risk level:* The risk level that is sufficient according to legal obligations and prevention policy of the business and does not cause harm to employees, the business or work equipment (OHSRAR, 2012).

*Prevention:* all of the precautions that are planned and taken in order to remove or minimize risks regarding occupational health and safety on every phase of ongoing work in the business (OHSRAR, 2012).

*Near miss incident:* The incident that happens in the business and has the potential to cause harm to employees, the business or work equipment but does not (OHSRAR, 2012).

*Risk:* The possibility of loss, injury or any other harmful result caused by a hazard (OHSRAR, 2012).

*Risk assessment:* Describing the hazards that exist in the business or might come from outside, grading and analyzing the risks which are caused by hazards and the factors that cause the hazards to turn into risks (OHSRAR, 2012).

*Hazard:* The potential that exists in the business or might come from outside, affects, harms employees or cause harm to business (OHSRAR, 2012).

Implementation of risk assessment methods differs from sector to sector and certain techniques can be employed for all sectors while other techniques are only applicable in some sectors (Mullai, 2006). Using the right risk assessment technique in the right place is sometimes as important as results of assessment (Brown, 1993). The technique to be used depends on the purpose of risk assessment, legal requirements, the needed result/information, data, time availability, requirement of team work, the volume of the work, complexity and type (Mullai, 2006).

The purpose of risk assessment is to diagnose preparations, procedures and checks which will be able to respond to hazards in business, and to minimize the effects of intentional or unintentional threats (Özkılıç, 2005). In line with this purpose, many techniques are available in literature; Risk Map, Initial Threat Analysis, Job Safety Analysis, What-if Analysis, Primary Risk Assessment using Checklist Analysis, Primary Risk Analysis, Risk Assessment Decision Matrix Methodology (L Type Matrix, X Type Matrix), Hazard and Operable Work Methodology, Fault Tree Analysis Methodology, Fine-Kinney Method, Failure Mode and Effects Analysis, Event Tree Analysis, Reason-Result Analysis are some of the common methods employed by businesses (Özkılıç, 2005).

Among the aforementioned methods, Fine-Kinney Method is commonly employed by businesses and various studies have been carried out using the method. Băbuţ et al. (2011) studied implementation steps and calculating tables. They indicated the points that were neglected in Kinney method and the possible threats that might be encountered in the implementation of the method. Besides, an assessment of the method was made and advantages and limitations of the method were stated (Băbuţ et al., 2011). Özgür (2013) implemented Fine-Kinney risk assessment on steel plant and rolling plant sections of an iron and steel business. Within the context of steel plant and rolling plant sections of the studied business, mechanical maintenance and repair, electrical maintenance and quality control processes were analyzed along with main production process. In the study, 376 risks were analyzed and assessed (Özgür, 2013) .

In the literature, risk assessment studies using Fine-Kinney method is numbered. The literature review in this study includes implications of Fine-Kinney method and presents advantages and disadvantages of it. For this reason, in this study Fine-Kinney method is analyzed in detail. The method is dealt with a critical approach and departing from the basis of this method, a new Fine-Kinney method with an increased sensitivity level is attempted to be introduced. The developed approach was implemented in a medium scaled business, and positive and negative effects created by scales out of different interpolation methods were analyzed.

## 2. FINE-KINNEY METHOD

Developed by G.F. Kinney and A.D Wiruth in 1976, Fine-Kinney method is an easy-to-use and common method employed to mathematically assess accident control. This method is commonly used in construction and cement industries and in the literature it is stated that it is also one of simple methods applicable to small and middle scaled businesses. In this method, which frequently uses statistical analysis of previous data, individuals to conduct analysis are required to be familiar with related theorems otherwise, the method cannot be used effectively and it might cause time loss.

In Fine-Kinney risk analysis assessment method, probability, frequency and severity parameters and scale tables of each parameter are included. In developing these scale tables, reference points were determined in scoring and according to the reference points, other scores were determined based on experience. Probability, frequency and severity parameter scales recommended for use in Fine-Kinney method were provided in Table 1, Table 2 and Table 3 respectively.

Table 1. Probability Scale of Fine-Kinney Method (Kinney and Wiruth, 1976)

| Probability | Value |
|---|---|
| *Might well be expected | 10 |
| Quite possible | 6 |
| Unusual but possible | 3 |
| *Only remotely possible | 1 |
| Conceivable but very unlikely | 0.5 |
| Practically impossible | 0.2 |
| *Virtually impossible | 0.1 |

In their study in 1976, Kinney and Wiruth determined ‘Might Well be Expected’ with a scale-of-ten and identified it as an incident which has occurred before, has a possibility of occurring again and will occur in future. They exemplified it with deflagration of flammable materials in drying oven and designated 10 to this value. Another reference point ‘Only Remotely Possible’ is exemplified with explosion or leakage of compressed gas in container and appointed 1 to the situation. At the bottom of the probability scale, ‘Virtually Impossible’ is designated as 0.1. The intermediate values are designated based on experience.

Table 2. Frequency Scale of Fine-Kinney Method (Kinney and Wiruth, 1976)

| Frequency | Value |
|---|---|
| *Continuous | 10 |
| Frequent (daily) | 6 |
| Occasional (weekly) | 3 |
| Unusual (monthly) | 2 |
| *Rare (a few per year) | 1 |
| Very rare (yearly) | 0.5 |

In the same study, Kinney and Wiruth also prepared a scale table for frequency values. On this table, two reference points were determined. Reference values on frequency table are between 1 and 10 as in Probability Scale. Risks on frequency table are classified based on incidence frequency by hour, daily and annually. As seen in Table 2, if the frequency of the incident is by hour, then it is accepted as ‘continuous’ and frequency value used on occurrence of risk value is determined as ‘10’, the lowest value as‘1’ and medium value as ‘3’.

Table 3. Severity Scale of Fine-Kinney Method (Kinney and Wiruth, 1976)

| Severity | Value |
|---|---|
| *Catastrophe (many fatalities, or >$\$10^7$ damage) | 10 |
| Disaster (few fatalities, or >$\$10^6$ damage) | 6 |
| Very serious (fatality, or >$\$10^5$ damage) | 3 |
| Serious (serious injury, or >$\$10^4$ damage) | 2 |
| Important (disability, or >$\$10^3$ damage) | 1 |
| *Noticeable (minor first aid accident, or >$ 100 damage) | 0.5 |

On the scale table prepared for severity, which is the third factor in risk score calculation, is formulized considering cost at the end of risk and damage volume. Severity scale table obtained at the end of the calculation is provided in Table 3. Here is also seen the reference values of severity scale. The score is determined considering cost or death ratio caused by severity on the scale. The risk assessment is conducted and a certain severity score is calculated if a hazard is expected to cause cost, and another severity score is calculated if a certain hazard is expected to cause occupational health and safety loss. As the severity of risk is more important on total risk score, values of 1 to 100 are used on risk scale. In their study, Kinney and Wiruth accepted 1 to 100 as their


ISSN 2148-2225
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reference point and intermediate values are calculated with the formula: Severity Value = $(\text{loss}/100)^{0,4}$.

Table 4. Risk Scale of Fine-Kinney Method

(Kinney and Wiruth, 1976)

| Probability | Value |
|---|---|
| R<20 | Risk; perhaps acceptable |
| 20<R<70 | Possible risk; attention indicated |
| 70<R<200 | Substantial risk; correction needed |
| 200<R<400 | High risk; immediate correction required |
| R>400 | Very high risk; consider discontinuing operation |

Depending on the determined risk, probability, frequency and severity values are obtained from the table and these three factors are multiplied, and the risk score is calculated. The obtained risk scores are classified according to Table 4 and risk avoidance activities are planned according to risk priority order of each hazard.

In this phase of the study, two methods which will increase the sensitivity of probability and frequency scales developed with Fine-Kinney Method were undertaken. It was observed that on the tables of probability and frequency in Fine-Kinney method, the scores of hazards which involve higher probability and frequency were not determined sensitively enough compared to hazards with lower probability and frequency. In other words, when the probability table is considered, ‘Might Well be Expected’ is accepted as 10, ‘Unusual but Possible’ as 6 and ‘Quite Possible’ as 3 based on experience. The facts that there is no mathematical relationship between values, intermediate values in the scale-of-ten are determined with experience cause the sensitivity to be broken anywhere risk assessment is implemented and priority order of hazards to be changed.

## 3. FINE-KINNEY METHOD DEVELOPED WITH THE NEW APPROACH

In this study, two different interpolation types were undertaken in gravimeters of values in probability and frequency tables. In one of the implemented interpolations, increases were seen to follow a linear fashion and in another a square fashion, and Fine-Kinney method reference points were considered again and interpolations were implemented regarding these points. Probability and frequency values obtained from the implementation of linear interpolation are presented in Table 5 and Table 6 respectively.

Table 5. Probability Scale of Fine-Kinney with Linear Fashion

| Probability | Value |
|---|---|
| *Might well be expected | 10 |
| Quite possible | 7 |
| Unusual but possible | 4 |
| *Only remotely possible | 1 |
| Conceivable but very unlikely | 0,66 |
| Practically impossible | 0,33 |
| *Virtually impossible | 0,1 |

Table 6. Frequency Scale of Fine-Kinney with Linear Fashion

| Frequency | Value |
|---|---|
| *Continuous | 10 |
| Frequent (daily) | 7,75 |
| Occasional (weekly) | 5,5 |
| Unusual (monthly) | 3,25 |
| *Rare (a few per year) | 1 |
| Very rare (yearly) | 0,5 |

Probability and frequency values obtained from the implementation of square interpolation are presented in Table 7 and Table 8 respectively.

Table 7. Probability Scale of Fine-Kinney with Square Fashion

| Probability | Value |
|---|---|
| *Might well be expected | 10 |
| Quite possible | 8,2 |
| Unusual but possible | 5,2 |
| *Only remotely possible | 1 |
| Conceivable but very unlikely | 0,61 |
| Practically impossible | 0,45 |
| *Virtually impossible | 0,1 |

Table 8. Frequency Scale of Fine-Kinney with Square Fashion

| Frequency | Value |
|---|---|
| *Continuous | 10 |
| Frequent (daily) | 8,8 |
| Occasional (weekly) | 7 |
| Unusual (monthly) | 4,4 |
| *Rare (a few per year) | 1 |
| Very rare (yearly) | 0,54 |

Comparison of Fine-Kinney linear and square interpolation probability and frequency values are presented in Table 9 and Table 10 respectively. (a: Fine-Kinney; b: Linear Interpolation; c: Square Interpolation)


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Table 9. Comparison of Probability Values

| Probability | FK[a] | LI[b] | SI[c] |
|---|---|---|---|
| *Might well be expected | 10 | 10 | 10 |
| Quite possible | 6 | 7 | 8,2 |
| Unusual but possible | 3 | 4 | 5,2 |
| *Only remotely possible | 1 | 1 | 1 |
| Conceivable but very unlikely | 0,5 | 0,66 | 0,61 |
| Practically impossible | 0,2 | 0,33 | 0,45 |
| *Virtually impossible | 0,1 | 0,1 | 0,1 |

Table 10. Comparison of Frequency Values

| Probability | FK[a] | LI[b] | SI[c] |
|---|---|---|---|
| *Continuous | 10 | 10 | 10 |
| Frequent (daily) | 6 | 7,75 | 8,8 |
| Occasional (weekly) | 3 | 5,5 | 7 |
| Unusual (monthly) | 2 | 3,25 | 4,4 |
| *Rare (a few per year) | 1 | 1 | 1 |
| Very rare (yearly) | 0,5 | 0,5 | 0,54 |

Taking into account the comparative values in Table 9 and Table 10, linear interpolation method obtains higher values than classic Fine-Kinney method in high probability and high frequency values, as in square interpolation method compared to linear interpolation method. This situation will affect the risk priority order of hazards by affecting scores gathered from risk analysis.

## 4. IMPLEMENTATION STUDY

In this part of the study, a risk assessment study was implemented for maintenance workshop of a middle scaled company. Company has been mainly focused on production and distribution of solar panels since 2005. They have been conducting risk assessments on all of their workshops periodically with their experienced occupational health and safety specialist, who had provided all data for an implementation part of this study. Risk scores gathered from risk assessment were at first calculated with classic Fine-Kinney method. Later risk scores were recalculated according to scales of Fine-Kinney method based on linear and square interpolation improved by a new approach and each of the three methods were compared for each hazard.

On Appendix A, according to Classic Fine-Kinney method, probability, severity and frequency values were given and risk points were calculated. On Appendix B, risks were numbered and regarding Fine-Kinney risk scale as basis from Table 4. Calculated risk values were ordered decreasingly and risk states were determined. Risks with equal scores were given the same priority and in this way, risk prioritization table was created.

As seen in Appendix B, use of hand tools and not using personal protective equipment named as hazard no. 4 and hazards resulting from the lack of warning signals named as hazard no. 10 have the highest two scores. In the business, it was stated that the biggest number of occupational accidents had occurred due to these hazards and it was concluded that immediate precautions were needed in the action plan. According to classic Fine-Kinney method, the third rank is occupied by two hazards (No. 1 and 5) on the prioritization table. It is also seen from the risk situation column of this table that fourth and fifth hazards on the prioritization table (hazard No. 2; hazard No. 8 and 9) require equal amount of precaution. Comparatively, risk points of hazards No. 6 and 7 are low and they are considered to be possible risk and hazard No.3 is regarded as acceptable risk.

As seen on Appendix B, two hazards (No. 1 and 5) were concluded to be “High Risk; Immediate Correction Required, Required To Be Included In Short Term Action Plan”. Among hazards with equal priority order, a complexity (hazards No. 1, 5 or 8, 9) occurred as to which hazard would be given priority. For example, as the risk scores of the hazard out of working with the rotating parts and lack of lightening are the same, the decision of which one to have higher priority is reserved to the business. Therefore, it can be concluded that even in a small scaled implementation, classic Fine-Kinney method is seen to cause complexity and inefficiency. Departing from the assumption that complexity and inefficiency in classic Fine-Kinney method result from gaps in scale, the gaps in probability, severity, frequency scales were arranged again and the implementation of the study was conducted with this new approach.

On Appendix C, risk assessment results based on linear interpolations and square interpolations taking Tables 5, 6, 7 and 8 as reference were compared to the ones on Appendix A that were gathered from classic Fine-Kinney Method.

Following the reassessment of the implementation in the business, probability and frequency values were calculated with Linear and Square interpolation methods and the change in risk scores were comparatively presented in Table XIII. The hazards in maintenance workshop were reconsidered, new probability and frequency values were given on new tables and new risk scores were calculated.

When the risk scores from Classic Fine-Kinney method and methods based on Linear and Square interpolation are compared, a considerable conclusion is gathered. In the maintenance workshop of the business in question, there are 10 risk scores gathered from certain hazards. Once risk scores were calculated with Classic Fine-Kinney method, actions to be taken were indicated on Appendix B. However, at the end of the two developed approaches, changes occurred due to the change in risk scores. These changes are presented on Appendix D.

According to data from Appendix D, risks from certain hazards are shown to be taken into more consideration on action plans. When all the changes on the table are analyzed in detail,

Priority of the hazard No. 1 "breakdown of electric wiring" in the action plan is on the third rank as in the classic method. However, the action to be taken was upgraded to "Very High Risk" from "High Risk" in both of the new approaches. In other words, in linear and square interpolation based Fine-Kinney methods, the sensitivity of the risk from the hazard No. 1 had its importance increased.

- Risk score No. 2 "fire hazard" is the fourth in the priority list considering the classic method. The importance of the same risk was decreased on linear interpolation based method and is on the sixth rank. Despite this, the action to be taken is observed to be unchanged. However, when the same risk is analyzed in square interpolation based method, the risk group was upgraded to "High Risk" from "Substantial" and was concluded to be added to short term action plan.
- The actions to be taken considering the hazard No. 3 "hangar door" in classic and linear interpolation based method are unchanged however, in square interpolation based method; the score of this risk was upgraded to "Possible Risk" group and was concluded to be added to the action plan.
- Risk score from hazard No. 4 "Use of Hand Tools and Not Using Personal Protective Equipment" does not exhibit change in terms of priority order among the three methods. It is the first in the priority list considering all three methods. However, its sensitivity was increased.
- Priority order of hazard No. 5 "Using cutting and penetrative tools" does not require change in actions to be taken. But its sensitivity was increased.
- The actions to be taken considering the hazard No. 6 "smoking" in classic and linear interpolation based method are unchanged however, the priority orders were observed to be changed. In Square interpolation based method, the score of this risk was upgraded to "Substantial Risk" was concluded to be monitored closely in the action plan.
- Priority order of hazard No. 7 "Stowing" in the action plan is on the seventh rank in classic method. However priority of same risk was decreased on both linear and square interpolation methods and is on the ninth rank. But it does not exhibit change in terms of action plan among the three methods.
- Priority order of hazard No. 8 "working with rotating parts" in classic and linear methods are the same, however, this risk is placed in "Substantial Risk" in classic method while in linear and square interpolation based methods, it is placed in "High Risk" group. It was also concluded that immediate correction is required; in that way sensitivity of this risk was increased.
- Priority order of hazard No. 9 of "lack of lightening" regressed to two ranks lower in the classic method however; actions to be taken in classic and linear interpolation based methods were not changed. The score of these risks in square interpolation based method increased to "High Risk" group and were concluded to be added to short term action plan.
- Priority order of hazard No. 10 "Lack of warning signals" in the action plan is on the second rank in both linear and square interpolation methods as in classic method. Also it does not exhibit change in terms of priority order among the three methods.

## 5. CONCLUSION

Although they involve differences in terms of implementation among sectors, risk assessment methods have an increasing importance today. As expertise regarding which assessment method to be used in which situations is required and the importance of risk assessment methods increase day by day, new businesses and jobs are being created in this field. Especially, following the occupational health and safety law No. 6331, all businesses are required to have a risk assessment implemented and thus, they are striving to accelerate their research regarding the issue and obtain more reliable and valid conclusions by implementing the right methods.

In this study, departing from Classic Fine-Kinney method, a new approach was brought to risk scoring. The classic method and the new approximation were implemented in maintenance workshop of a medium scaled business and conclusions were compared. Primarily in this study, alternative scales were created for scales of probability and frequency of the classic method. Scores of risks with higher probability and frequency were upgraded and priority degrees were increased. In this way, awareness of hazards was raised. Also, with the implementation of the study, the conclusions of the classic Fine-Kinney method were seen to involve complexity in terms of prioritization and this problem was eliminated with the new approach. The fact that there are more than one hazard with the same risk point in classic Fine-Kinney method poses a problem for businesses as to determining prioritization among these hazards. For example, in classic Fine-Kinney method, there are two hazards with 240 points and also there are two hazards with 120 points and it is not known which hazard needs to be prioritized compared to others. However, in the methods formulized with the new approach, scores of these hazards have been changed and their priorities were separated.

Conclusions of the implementation indicate that the classic method is insufficient on certain points and the new approximations bring sensitivity to risk scores.

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**APPENDIX A.** Risk Evaluation Table According to the Classic Fine-Kinney Method

| **Order** | **Hazard** | **Risk** | **Probability** | **Frequency** | **Severity** | **Risk Score** |
|---|---|---|---|---|---|---|
| 1 | Breakdown Of Electric Wiring | Financial Damage – Injury - Death | 3 | 2 | 40 | 240 |
| 2 | Fire Hazard | Financial Damage – Injury - Death | 3 | 0,5 | 100 | 150 |
| 3 | Hangar Door | Financial Damage – Injury - Death | 1 | 0,5 | 40 | 20 |
| 4 | Use of Hand Tools and Not Using Personal Protective Equipment | Financial Damage – Injury - Death | | 3 | 40 | 720 |
| 5 | Using cutting and penetrative tools | Financial Damage – Injury - Death | 6 | 1 | 40 | 240 |
| 6 | Smoking | Sickness – Psychological Effects - Fire | 3 | 1 | 15 | 45 |
| 7 | Stowing | Financial Damage – Injury - Death | 1 | 1 | 40 | 40 |
| 8 | Working with Rotating Parts | Financial Damage – Injury - Death | 1 | 3 | 40 | 120 |
| 9 | Lack of Lightening | Financial Damage – Injury - Death | 3 | 1 | 40 | 120 |
| 10 | Lack of Warning Signals | Financial Damage – Injury - Death | 6 | 2 | 40 | 480 |

**APPENDIX B.** Risk Prioritization Table According to the Classic Fine-Kinney Method

| **Hazard No.** | **Risk Score** | **Priority No.** | **Interval of Risk Value** | **Risk Situation** |
|---|---|---|---|---|
| 4 | 720 | 1 | R>400 | Very High Risk; Consider Discontinuing Operation, Immediate Precautions Needed |
| 10 | 480 | 2 | R>400 | Very High Risk; Consider Discontinuing Operation, Immediate Precautions Needed |
| 1 | 240 | 3 | 200<R<400 | High Risk; Immediate Correction Required, Required To Be Included In Short Term Action Plan |
| 5 | 240 | 3 | 200<R<400 | High Risk; Immediate Correction Required, Required To Be Included In Short Term Action Plan |
| 2 | 150 | 4 | 70<R<200 | Substantial Risk; Correction Needed, Should Be Monitored Closely In Action Plan |
| 8 | 120 | 5 | 70<R<200 | Substantial Risk; Correction Needed, Should Be Monitored Closely In Action Plan |
| 9 | 120 | 5 | 70<R<200 | Substantial Risk; Correction Needed, Should Be Monitored Closely In Action Plan |
| 6 | 45 | 6 | 20<R<70 | Possible Risk; Attention Indicated, Need To Be Added In Action Plan |
| 7 | 40 | 7 | 20<R<70 | Possible Risk; Attention Indicated, Need To Be Added In Action Plan |
| 3 | 20 | 8 | R<20 | Risk; Perhaps Acceptable, No Immediate Action |

**APPENDIX C.** Comparison of Risk Assessment Methods

| Order | Hazard | Classic Fine-Kinney Method | | | | Fine-Kinney Method Based on Linear Interpolation | | | | Fine-Kinney Method Based on Square Interpolation | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Probability | Frequency | Severity | Risk Score | Probability | Frequency | Severity | Risk Score | Probability | Frequency | Severity | Risk Score |
| 1 | Breakdown Of Electric Wiring | 3 | 2 | 40 | 240 | 4 | 3,25 | 40 | 520 | 5,2 | 4,4 | 40 | 915,2 |
| 2 | Fire Hazard | 3 | 0,5 | 100 | 150 | 4 | 0,5 | 100 | 200 | 5,2 | 0,54 | 100 | 280,8 |
| 3 | Hangar Door | 1 | 0,5 | 40 | 20 | 1 | 0,5 | 40 | 20 | 1 | 0,54 | 40 | 21,6 |
| 4 | Use of Hand Tools and Not Using Personal Protective Equipment | 6 | 3 | 40 | 720 | 7 | 5,5 | 40 | 1540 | 8,2 | 7 | 40 | 2296 |
| 5 | Using cutting and penetrative tools | 6 | 1 | 40 | 240 | 7 | 1 | 40 | 280 | 8,2 | 1 | 40 | 328 |
| 6 | Smoking | 3 | 1 | 15 | 45 | 4 | 1 | 15 | 60 | 5,2 | 1 | 15 | 78 |
| 7 | Stowing | 1 | 1 | 40 | 40 | 1 | 1 | 40 | 40 | 1 | 1 | 40 | 40 |
| 8 | Working with Rotating Parts | 1 | 3 | 40 | 120 | 1 | 5,5 | 40 | 220 | 1 | 7 | 40 | 280 |
| 9 | Lack of Lightening | 3 | 1 | 40 | 120 | 4 | 1 | 40 | 160 | 5,2 | 1 | 40 | 208 |
| 10 | Lack of Warning Signals | 6 | 2 | 40 | 480 | 7 | 3,25 | 40 | 910 | 8,2 | 4,4 | 40 | 1443,2 |

**APPENDIX D.** Comparison Table of Action Plan

| Order | Hazard | Classic Fine-Kinney Method | | Fine-Kinney Method Based on Linear Interpolation | | Fine-Kinney Method Based on Square Interpolation | |
|---|---|---|---|---|---|---|---|
| | | **Score/ P.N** | **Action Plan** | **Score/ P.N** | **Action Plan** | **Score/ P.N** | **Action Plan** |
| 1 | Breakdown Of Electric Wiring | 240 / 3 | High Risk; Immediate Correction Required, Required To Be Included In Short Term Action Plan | 520 / 3 | Very High Risk; Consider Discontinuing Operation, Immediate Precautions Needed | 915,2 / 3 | Very High Risk; Consider Discontinuing Operation, Immediate Precautions Needed |
| 2 | Fire Hazard | 150 / 4 | Substantial Risk; Correction Needed, Should Be Monitored Closely In Action Plan | 200 / 6 | Substantial Risk; Correction Needed, Should Be Monitored Closely In Action Plan | 280,8 / 5 | High Risk; Immediate Correction Required, Required To Be Included In Short Term Action Plan |
| 3 | Hangar Door | 20 / 8 | Risk; Perhaps Acceptable, No Immediate Action | 20 / 10 | Risk; Perhaps Acceptable, No Immediate Action | 21,6 / 10 | Possible Risk; Attention Indicated, Need To Be Added In Action Plan |
| 4 | Use of Hand Tools and Not Using Personal Protective Equipment | 720 / 1 | Very High Risk; Consider Discontinuing Operation, Immediate Precautions Needed | 1540/1 | Very High Risk; Consider Discontinuing Operation, Immediate Precautions Needed | 2296 / 1 | Very High Risk; Consider Discontinuing Operation, Immediate Precautions Needed |
| 5 | Using cutting and penetrative tools | 240 / 3 | High Risk; Immediate Correction Required, Required To Be Included In Short Term Action Plan | 280 / 4 | High Risk; Immediate Correction Required, Required To Be Included In Short Term Action Plan | 328 / 4 | High Risk; Immediate Correction Required, Required To Be Included In Short Term Action Plan |
| 6 | Smoking | 45 / 6 | Possible Risk; Attention Indicated, Need To Be Added In Action Plan | 60 / 8 | Possible Risk; Attention Indicated, Need To Be Added In Action Plan | 78 / 8 | Substantial Risk; Correction Needed, Should Be Monitored Closely In Action Plan |
| 7 | Stowing | 40 / 7 | Possible Risk; Attention Indicated, Need To Be Added In Action Plan | 40 / 9 | Possible Risk; Attention Indicated, Need To Be Added In Action Plan | 40 / 9 | Possible Risk; Attention Indicated, Need To Be Added In Action Plan |
| 8 | Working with Rotating Parts | 120 / 5 | Substantial Risk; Correction Needed, Should Be Monitored Closely In Action Plan | 220 / 5 | High Risk; Immediate Correction Required, Required To Be Included In Short Term Action Plan | 280 / 6 | High Risk; Immediate Correction Required, Required To Be Included In Short Term Action Plan |
| 9 | Lack of Lightening | 120 / 5 | Substantial Risk; Correction Needed, Should Be Monitored Closely In Action Plan | 160 / 7 | Substantial Risk; Correction Needed, Should Be Monitored Closely In Action Plan | 208 / 7 | High Risk; Immediate Correction Required, Required To Be Included In Short Term Action Plan |
| 10 | Lack of Warning Signals | 480 / 2 | Very High Risk; Consider Discontinuing Operation, Immediate Precautions Needed | 910 / 2 | Very High Risk; Consider Discontinuing Operation, Immediate Precautions Needed | 1443,2 / 2 | Very High Risk; Consider Discontinuing Operation, Immediate Precautions Needed |