COMPARISON AND ANALYSIS OF IT PROJECT RISK ASSESSMENT MODEL METHODS: PROPOSED ENTROPY RISK ASSESSMENT METHOD WITH MANUAL CALCULATION METHOD AND FUZZY TECHNIQUE BASED RISK ASSESSMENT

Pradnya Purandare
Assistant Professor and Research Scholar
Symbiosis Centre for Information Technology
Symbiosis International University, Pune, Maharashtra, India

Abstract— Software Development of projects encounter varied risks which influence project success adversely. Current status of projects indicates crucial need of an effective risk assessment model and methods which can identify and assess risks better. A software project risk assessment model based on three approaches viz. manual calculation, fuzzy method and entropy based is proposed. An earlier paper on entropy method indicates its merits and proposed this method for effective risk assessment. In this paper a comparison of the results of risk assessment via above three methods is made and analyses of the results indicating their significances. These three methods were implemented through spreadsheets and program algorithm implementations and thus the results obtained and analyzed. The risk assessment model and all the three methods can be helpful to the software development project managers and their teams, since the entropy method can give them ease of usage & implementation, fast calculations, accuracy of results of their software development project risk assessment effectively.


I. INTRODUCTION

The Software Project Risk Assessment Model was studies with literature review indicating gap showing the need of an effective risk assessment model. Preliminary surveys conducted to understand the IT practitioner’s views on risk factors and risk assessment aspects relevant to risk assessment. The literature review included thorough study of risk management frameworks, risk taxonomies and risk management standards like PMI PMBOK® IT project Risk management processes [1-10]. Detailed study and analysis of different techniques of software development project risk management techniques like Critical Path Method (CPM), Program Evaluation and Review Technique (PERT), Monte Carlo Simulation (MCS), Fuzzy Technique probed in creating mechanism to find suitable technique for better risk assessment [11-12].

The practitioner’s perceptive survey of their views on imperative risk factors & assessment helped in contributing to the risk assessment model created in this research. The limitations of above techniques and literature review furthered us to study entropy techniques impactful application to risk assessment model [13-15, 25]. Each of the above inputs have contributed and decisively facilitated us to create an effective risk assessment model including the cost based and non-cost based risk factors & risk assessment [16-21].

The proposed method of risk assessment is Entropy Method. Other two methods created in model are manual calculation and fuzzy method. A comparison of proposed Entropy based risk assessment model with existing ones has been studies in
The results of the dataset are analyzed, evaluated and compared with these methods. The rest of the paper is organized as follows. Proposed comparison of risk assessment model methods are explained in section II. Experimental results are presented in section III. Concluding remarks are given in section IV.

II. PROPOSED COMPARISON OF RISK ASSESSMENT MODEL METHODS –

Comparison of proposed Entropy Based Risk Assessment Method for Risk model with existing Manual Calculation of Risk Assessment and Fuzzy Based Method of Risk Assessment Model is done, by implementing the methods through computer calculations, programs. These methods work on risk assessment model which uses the cost based Risk Model created by us during this research work[1-25]. The models are populated with data & results are calculated, then these metrics on the result give useful insights on the performance of the models.

1. Process & Steps of Model Evaluation:
   Methodology used to evaluate the models:
   1.1 Data collection: It uses the cocomo-sdr public datasets
   1.2 Risk Assessment Model Evaluation: Model is created based on the standards, rules, references used by expert cocomo, cocomo2, and referred to relevant important research findings of Tim Menzis.
   1.3 Data Analysis: The project’s risk data points are evaluated through each method and results, obtained, evaluated and analysed with appropriate metrics.
   1.3.1 Obtained Results of Proposed Entropy based Risk Model, Entropy Based Risk Model implemented with by creating .m, .fig files, matlab program source code created in this research study is based on algorithm of our research publication
   1.3.2 Fuzzy Based Risk Model implemented with by creating FIS files, matlab Fuzzy Inference System program source code is created in this research study
   1.3.3 Obtained Results of Existing Manual Risk Model – By implementing Risk Model using spreadsheets in MS Excel. All methods are executed & implemented with the IT project’s risk related data. They show how these models help in improving in depth the strength of RISK ASSESSMENT Level[1-25].

1.1 IT Project Risk Management related Data collection:

IT Project risk management related Dataset is used for testing the IT Project Risk assessment models. The datasets is public dataset with 12 data points i.e. no. of projects.

1.2 Model Evaluation:
The evaluation of manual calculation method, Fuzzy method, and Entropy based method of Risk Models consists of 3 main processes:
1.1.1 Make a risk assessment using manual calculation method MAN_CALC
1.1.2 Make a risk assessment using Fuzzy method Fz_Calc
1.1.3 Make a risk Assessment using Entropy based method Entropy
1.1.4 Calculate, analyze co-relation coefficient, coefficient of determination R²

Once the above all processes are implemented with project data, data analysis step is followed with.

1.3 Data Analysis:
Data Analysis is to compare the risk assessment results of manual calculation method, Fuzzy method, Entropy based method methodologies respectively.

![Fig 1. Risk Model Evaluation Steps](image-url)
The output of “Manual Method of Risk Model” emerges as Project Risks which consists of various risk values of schedule risk, product risk, platform risk, personnel risk, process risk and reuse risk. 

**Analysis:**
From data set of 15 project points, MAN_CALC determined that out of 12 projects 9 were categorized as low risk and 3 were medium risk projects.

Table - 1 provides partial list of risk assessment results using MAN_CALC for project data set.

<table>
<thead>
<tr>
<th>Proj_ID</th>
<th>Size (KSLOC)</th>
<th>Actual Effort (person-mo)</th>
<th>Risk_Level</th>
<th>Project Risk</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>3000</td>
<td>1.2</td>
<td>LOW_RISK</td>
<td>62,6929</td>
</tr>
<tr>
<td>2</td>
<td>2000</td>
<td>2</td>
<td>LOW_RISK</td>
<td>69,0494</td>
</tr>
<tr>
<td>3</td>
<td>4250</td>
<td>4.5</td>
<td>LOW_RISK</td>
<td>76,2454</td>
</tr>
<tr>
<td>4</td>
<td>10000</td>
<td>3</td>
<td>LOW_RISK</td>
<td>63,9438</td>
</tr>
<tr>
<td>5</td>
<td>15000</td>
<td>4</td>
<td>LOW_RISK</td>
<td>87,4967</td>
</tr>
<tr>
<td>6</td>
<td>40530</td>
<td>22</td>
<td>MODERATE_RISK</td>
<td>107,1441</td>
</tr>
<tr>
<td>7</td>
<td>4050</td>
<td>2</td>
<td>MODERATE_RISK</td>
<td>114,5001</td>
</tr>
<tr>
<td>8</td>
<td>31845</td>
<td>5</td>
<td>LOW_RISK</td>
<td>90,8471</td>
</tr>
<tr>
<td>9</td>
<td>114280</td>
<td>18</td>
<td>MODERATE_RISK</td>
<td>169,2621</td>
</tr>
<tr>
<td>10</td>
<td>23106</td>
<td>4</td>
<td>LOW_RISK</td>
<td>84,0309</td>
</tr>
<tr>
<td>11</td>
<td>1369</td>
<td>1</td>
<td>LOW_RISK</td>
<td>36,83874</td>
</tr>
<tr>
<td>12</td>
<td>1611</td>
<td>2.1</td>
<td>LOW_RISK</td>
<td>33,51586</td>
</tr>
</tbody>
</table>

**B. Risk Assessment Model Fuzzy Based Method Evaluation**

Risk Assessment using Fuzzy calculation methodology is based on the Risk Model created which is based on Fuzzy Inference System methodology, our derived reference model’s cost based risk factors & model as mentioned from above model prescribed by this research study which has been based taking literature references from earlier expert risk models, and Shannon’s entropy.

We have created, run, evaluated, implemented Entropy based Computer Calculator i.e. program.

Entropy Based Method of Risk Model is implemented in matlab with .fig file GUI and .m code files. It reads project’s risk attribute data from excel files, calculates risk factor wise & From data set of 15 project points, MAN_CALC determined that out of 12 projects, 6 were categorized as moderate risk projects, 1 project of high risk, 2 projects of very high risks, 3 projects of extremely high risks.


**Analysis:**
Table - 2 provides partial list of risk assessment results using MAN_CALC for project data set.

<table>
<thead>
<tr>
<th>Size (KSLOC)</th>
<th>Actual Effort (person-mo)</th>
<th>Risk_Level</th>
<th>Project Risk</th>
</tr>
</thead>
<tbody>
<tr>
<td>3000</td>
<td>1.2</td>
<td>MODERATE_RISK</td>
<td>312.8239</td>
</tr>
<tr>
<td>2000</td>
<td>2</td>
<td>MODERATE_RISK</td>
<td>313.3057</td>
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<tr>
<td>4250</td>
<td>4.5</td>
<td>MODERATE_RISK</td>
<td>311.9874</td>
</tr>
<tr>
<td>10000</td>
<td>3</td>
<td>MODERATE_RISK</td>
<td>304.5382</td>
</tr>
<tr>
<td>15000</td>
<td>4</td>
<td>MODERATE_RISK</td>
<td>301.2694</td>
</tr>
<tr>
<td>40530</td>
<td>22</td>
<td>MODERATE_RISK</td>
<td>295.9016</td>
</tr>
<tr>
<td>4050</td>
<td>2</td>
<td>MODERATE_RISK</td>
<td>312.1404</td>
</tr>
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<td>31845</td>
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<td>MODERATE_RISK</td>
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</tr>
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<td>114280</td>
<td>18</td>
<td>MODERATE_RISK</td>
<td>301.2412</td>
</tr>
<tr>
<td>23106</td>
<td>4</td>
<td>MODERATE_RISK</td>
<td>296.1487</td>
</tr>
<tr>
<td>1369</td>
<td>1</td>
<td>MODERATE_RISK</td>
<td>313.5312</td>
</tr>
<tr>
<td>1611</td>
<td>2.1</td>
<td>MODERATE_RISK</td>
<td>313.3699</td>
</tr>
</tbody>
</table>

**C. Risk Assessment Model Entropy Calculation Based Method Evaluation**

Risk Assessment using proposed Entropy calculation methodology is based on the Risk Model created which is based on cocomo2 methodology, our derived reference model’s cost based risk factors & model as mentioned from above model prescribed by this research study which has been based taking literature references from earlier expert risk models, and Shannon’s entropy.

We have created, run, evaluated, implemented Entropy based Computer Calculator i.e. program.

Entropy Based Method of Risk Model is implemented in matlab with .fig file GUI and .m code files. It reads project’s risk attribute data from excel files, calculates risk factor wise & From data set of 15 project points, MAN_CALC determined that out of 12 projects, 6 were categorized as moderate risk projects, 1 project of high risk, 2 projects of very high risks, 3 projects of extremely high risks.


**Analysis:**
Table - 3 provides partial list of risk assessment results using MAN_CALC for project data set.

<table>
<thead>
<tr>
<th>Size (KSLOC)</th>
<th>Actual Effort (person-mo)</th>
<th>Risk_Level</th>
<th>Project Risk</th>
</tr>
</thead>
<tbody>
<tr>
<td>3000</td>
<td>1.2</td>
<td>MODERATE_RISK</td>
<td>347.6628733</td>
</tr>
<tr>
<td>2000</td>
<td>2</td>
<td>MODERATE_RISK</td>
<td>213.4085597</td>
</tr>
<tr>
<td>4250</td>
<td>4.5</td>
<td>MODERATE_RISK</td>
<td>401.5746104</td>
</tr>
<tr>
<td>10000</td>
<td>3</td>
<td>HIGH_RISK</td>
<td>840.712854</td>
</tr>
<tr>
<td>15000</td>
<td>4</td>
<td>VERYHIGH_RISK</td>
<td>1296.943345</td>
</tr>
</tbody>
</table>
Data Analysis:
Comparison of Three Methods Entropy, Fuzzy Based and Manual Calculation Method of Risk Assessment Model

<table>
<thead>
<tr>
<th>Risk Level</th>
<th>Project Risk</th>
<th>Calculation Method</th>
</tr>
</thead>
<tbody>
<tr>
<td>LOW_RISK</td>
<td>MODERATE_RISK</td>
<td>Fuzzy</td>
</tr>
<tr>
<td>MODERATE_RISK</td>
<td>MODERATE_RISK</td>
<td>Manual</td>
</tr>
<tr>
<td>MODERATE_RISK</td>
<td>MODERATE_RISK</td>
<td>Entropy</td>
</tr>
</tbody>
</table>

Table 4: Correlations

**Fig. 2. Comparison of Manual, Fuzzy and Entropy based methods of Risk Assessment Model Diagram**

**Fig. 3. Analysis of Graph Diagram**

**Fig. 4. Comparison of Manual, Fuzzy and Entropy based methods of Risk Assessment Model Graphical representation Diagram**

The correlation coefficient gives the degree of correlation between project risks and other project parameters. It also gives information about sensitivity of project risks to the variations in these parameters. Here, correlation coefficient is calculated between project risk with software size and with actual project effort. Software Size in a software development project is having a proportional relationship with project risk; Larger software size means Higher project Risk. Project risk due to project effort problems. Table 4 shows correlation between Project Risk versus software size, actual effort based on Manual Method, Fuzzy Method and the Entropy based Method for dataset. Correlation chart diagram for risk against software size for dataset is in fig below

<table>
<thead>
<tr>
<th>corr (d1)</th>
<th>Size</th>
<th>Actual_Effort</th>
</tr>
</thead>
<tbody>
<tr>
<td>MAN_CALCD</td>
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<td>0.6984756</td>
</tr>
<tr>
<td>Fz_PPMDL</td>
<td>-0.556258</td>
<td>-0.5978806</td>
</tr>
</tbody>
</table>

**Entropy**

0.999925 0.777403
V. REFERENCE


