International Journal of Engineering Sciences & Research Technology

(A Peer Reviewed Online Journal)
Impact Factor: 5.164

IJESRT

RESEARCHERID
THOMSON REUTERS

[Verma *et al.*, 9(11): November, 2020]
ICTM Value: 3.00

ISSN: 2277-9655
Impact Factor: 5.164
CODEN: IJESS7

IJESRT
INTERNATIONAL JOURNAL OF ENGINEERING SCIENCES & RESEARCH TECHNOLOGY

A KNOWLEDGE BASED USER INTERFACE APPLICATION FOR RISK ASSESSMENT OF POWER PLANT CONSTRUCTION PROJECT

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DOI: https://doi.org/10.29121/ijesrt.v9.i11.2020.3

ABSTRACT

The contracting of a power plant construction is usually regarded as a "high risk activity", primarily due to the lack of sufficient environmental data. Risk management has significant potential to improve the performance of the venture. Nonetheless, this requires proper and structured methods to recognize and quantify both risk factors and their interactions and, most critically, knowledge and experience. There were significantly fewer efforts to develop. The built model uses a micro-system technique to introduce a new methodology for threat assessment to define the risks associated with building power station. The methodology for evaluation enables the use of linguistic and numerical risk factor evaluations. For transform linguistic and numerical evaluations, the Fuzzy Linguistic-Numerical Conversion Scheme (FLNCS) is adopted. The predictive analysis approach often incorporates the plan pre-mitigation contingency, which is the contingency fund of threat, if no mitigation technique is introduced. A new risk management model for the development and assessment of potential mitigation strategies for each threat under consideration is established. A newly developed threat management system contrasts the current exhausted contingency with the post-mitigation contingency, tracking the effects of the chosen reduction technique. The developed risk assessment system provides an early warning that informs users that a select mitigation technique may fail. It also specifies the appropriate time to start the control cycle based on a variety of subjective criteria. Once the threat management process has begun, the control method established defines, reviews, and selects the most effective control mechanisms in favor of the selected reduction approach. If the control intervention chosen fails, the control method established notifies the client of the evaluation of the risk management program. Such alerts enable users to avoid possible future failures with similar risk objects. The built user interface has been programmed with MATLAB for easy usage.

KEYWORDS: Fuzzy Logic, Risk Assessment, Expert System.

1. INTRODUCTION

Risk management is one of the key elements of successful plan execution and performance. The process of risk management can be viewed in various ways. From the perspective of project management, scheduling, detection, assessment, evaluation, response, monitoring, and control are generally seen as key steps. All these measures are interconnected and form part of a process, ensuring that everyone should be properly treated to allow the entire system to operate effectively. The objective of risk analysis is to estimate or evaluate the likely outcomes or impacts, if they materialize, of the risks being considered. The assessment of which steps to be taken and which risk management approaches is based largely on results of the risk analysis.

Many risk analysis techniques and tools are available. In theory, any technique of risk analysis has its strengths and weaknesses and as such, the preference of one technique is determined by several variables, the efficacy of which is crucial to capture the inherent uncertainty. Very often, however, it is more familiarity, simplicity and availability that govern the choice of a specific modeling and analysis technique than the nature of the risk prevailing combined with the power to describe uncertainties. This is likely to significantly hinder the reliability of outcomes and therefore the whole hazard decision-making process. There are instances where qualitative methods are more efficient than quantitative, although for most practitioners the latter can seem to be the most reliable and meaningful. Once, the right evaluation approach captures and handles ambiguity adequately.

ISSN: 2277-9655
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The goal of this paper is to analyze and address strategies for risk analysis best suited to building power plant management. Some of the available risk analysis methods include preliminary risk analysis, defective trees, occurrence trees, sensitivity analysis, likelihood analysis, security factors, Dempster-Shaffer Evidence Theory, and fuzzy logic. The research analyzes the suitability of the techniques for the categories of danger to be addressed, namely operational, international, and godly actions. Among these are clearly acts of God regarded as 'force majeure' in contractual terms quite differently. The strengths and weaknesses of the strategies were stressed and spoken about. The remaining strategies are not regarded because they rarely contribute to the management of project risk. They are more suitable for common problems in fields such as safety / hazard, biology, pharmaceuticals, and health. This research is part of a broader analysis to create a system for controlling risk factors impacting building power plant project. Although the research focuses on the risk to the construction of power plant project, the risk analysis approaches under consideration can be used in many other fields as they are cross-cutting.

2. DESIGN OF FUZZY LOGIC BASED RISK ANALYSIS

The risk factor is determined based on the likelihood of failure (frequency of an event) and its likely effects. Most of the approaches recently developed focused on the probabilities of incidents. The Fuzzy logic model was based on the popular Mamdani algorithm (Jamshidi et al., 2012), and the most popular composition method (Ross, 2010), used for composite relations. Figure 1 outlines the inputs and outputs used to create this Fuzzy Inference System (FIS).

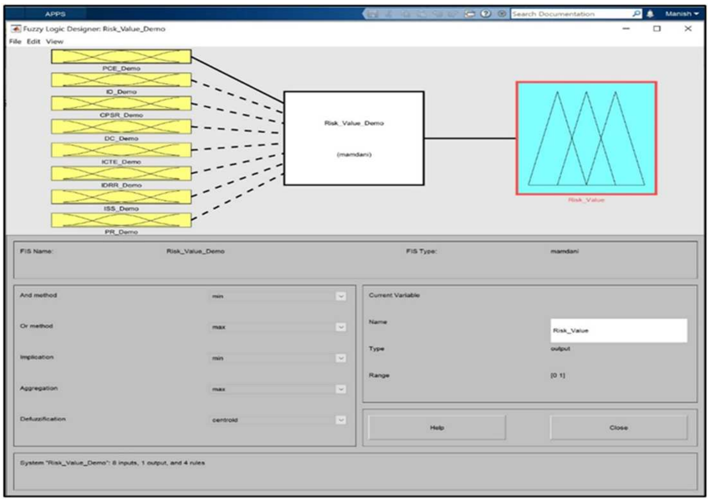

Figure 1. FIS configuration

The results from the FIS consequence model were various types of effects considered as inputs to the first FIS and final consequences. A variation of the final consequences and occurrence in the second FIS culminated in each launch incident involving a risk factor.

Table 1. Values of membership functions

Trapezoidal Membership Function		
Variable	Universe of discourse	Membership functions
Poor Cost Estimate (PCE) [INPUT]	[0 1]	Low [0 0 0 0.2]
		Medium [0.2 0.25 0.25 0.3]
		High [0.3 0.4 0.4 0.5]
		Critical [0.5 1 1 1]
Incomplete Design (ID) [INPUT]	[0 1]	Low [0 0 0 0.2]
		Medium [0.2 0.25 0.25 0.3]

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		High [0.3 0.4 0.4 0.5]
		Critical [0.5 1 1 1]
Change in Project Scope and Requirement (CPSR) [INPUT]	[0 1]	Low [0 0 0 0.2]
		Medium [0.2 0.25 0.25 0.3]
		High [0.3 0.4 0.4 0.5]
		Critical [0.5 1 1 1]
Design Change (DC) [INPUT]	[0 1]	Low [0 0 0 0.2]
		Medium [0.2 0.25 0.25 0.3]
		High [0.3 0.4 0.4 0.5]
		Critical [0.5 1 1 1]
Inaccurate Contract Time Estimate (ICTE) [INPUT]	[0 1]	Low [0 0 0 0.2]
		Medium [0.2 0.25 0.25 0.3]
		High [0.3 0.4 0.4 0.5]
		Critical [0.5 1 1 1]
Inadequately Defined Roles and Responsibilities (IDRR) [INPUT]	[0 1]	Low [0 0 0 0.2]
		Medium [0.2 0.25 0.25 0.3]
		High [0.3 0.4 0.4 0.5]
		Critical [0.5 1 1 1]
Insufficient Skilled Staff (ISS) [INPUT]	[0 1]	Low [0 0 0 0.2]
		Medium [0.2 0.25 0.25 0.3]
		High [0.3 0.4 0.4 0.5]
		Critical [0.5 1 1 1]
Political Risks (PR) [INPUT]	[0 1]	Low [0 0 0 0.2]
		Medium [0.2 0.25 0.25 0.3]
		High [0.3 0.4 0.4 0.5]
		Critical [0.5 1 1 1]
Risk Value of Project [OUTPUT]	[0 1]	Low [0 0 0 0.2]
		Medium [0.2 0.25 0.25 0.3]
		High [0.3 0.4 0.4 0.5]
		Critical [0.5 1 1 1]

The values of fuzzifying membership functions for inputs and outputs of both FIS are presented in Table1.

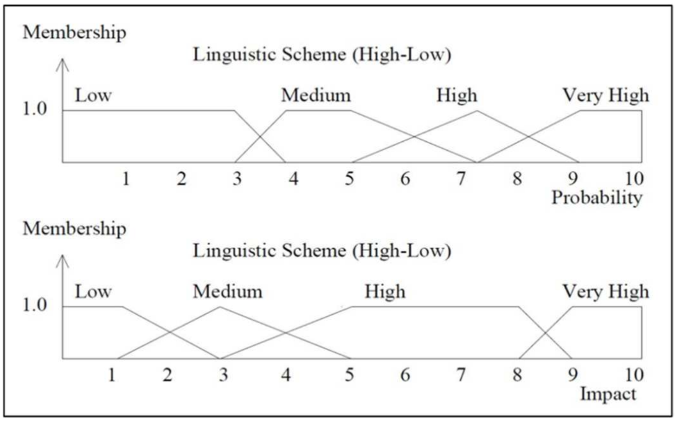

Figure 2. FIS configuration

As we can see in the figure 2, range of both probability and impact is 0 to 10 with trapezoidal membership functions.

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Table 2. Design table for fuzzy variables

Probability/Impact	Low	Medium	High	Very High
Very High	Low	Medium	Critical	Critical
High	Low	Medium	Critical	Critical
Medium	Low	Low	High	Critical
Low	Low	Low	High	High

As per the design matrix from the table 2, we will have 16 rules for each risk factor.
Rule: 1 (for example)

IF	Probability	is	Medium
AND	Impact	is	High
THEN	Risk (Poor_Cost_Estimate)	is	High

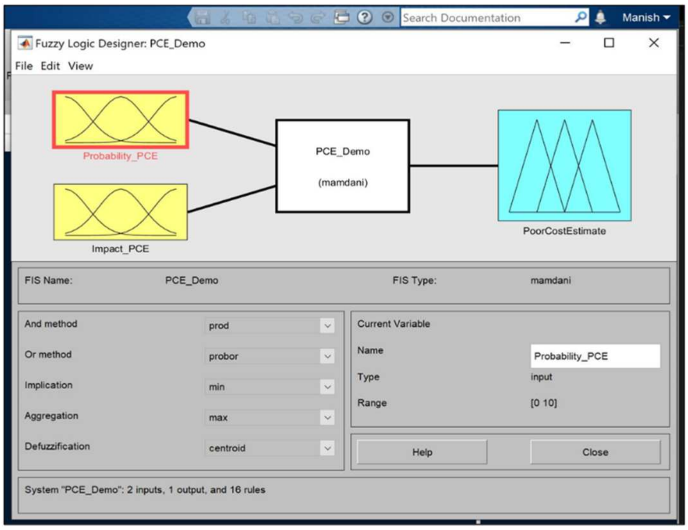

Figure 3. Fuzzy logic designer with Mamdani method

To add another input just click on edit button and add the variable. This fuzzy logic designer has two inputs and one output with total 16 rules as shown below left hand of the figure 3.

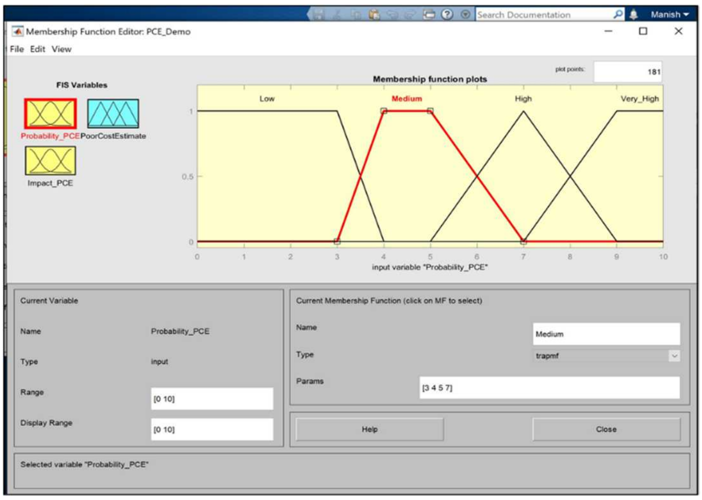

Figure 4. Membership function editor for probability

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To edit the fuzzy inference variables, double click on it. Click on variable which we want to edit, and the picture will be shown as figure 4. We will change the range first. From the type choose the membership function e.g. triangular, trapezoidal, gaussian, sigmoid etc. According to membership function plugin the Params, which is parameters. As shown in figure 4, type for current membership function (Probability_PCE) is trapmf (Trapezoidal membership function), range is 0 to 10, Params (values or parameters) is [3, 4, 5, 7] for Medium.

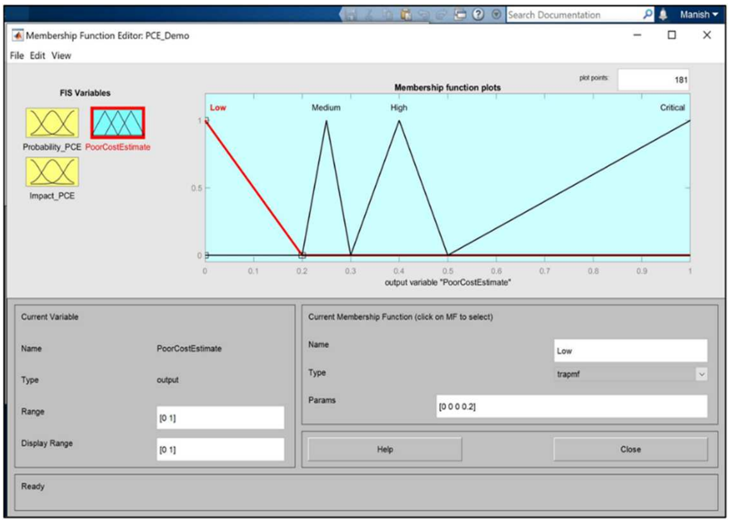

Figure 5. Membership function editor for probability

For the output variable (Poor Cost Estimate), we will plug in the variables of trapezoidal membership function as per table1.

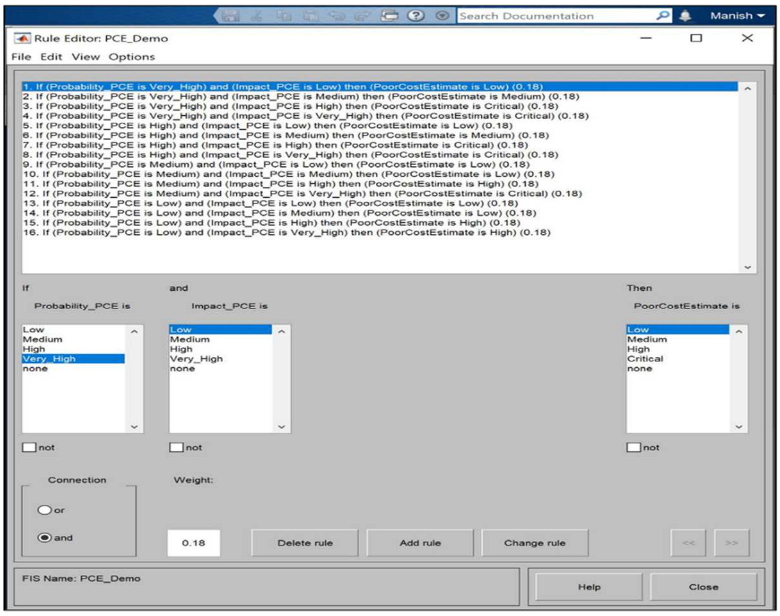

Figure 6. Fuzzy rules for poor cost estimate

The required information to produce the vague rules can be obtained from an offline simulation. Much awareness can be based on an understanding of the actions of the regulated dynamic system. A symmetrical rule table is very

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suitable for the monotonic system, although sometimes it may require slight modification based on the behavior of the system. When process mechanics is uncertain or strongly nonlinear, the laws will be focused on trial and error protocols and practice. As shown in figure 6, we can add or delete the rules.

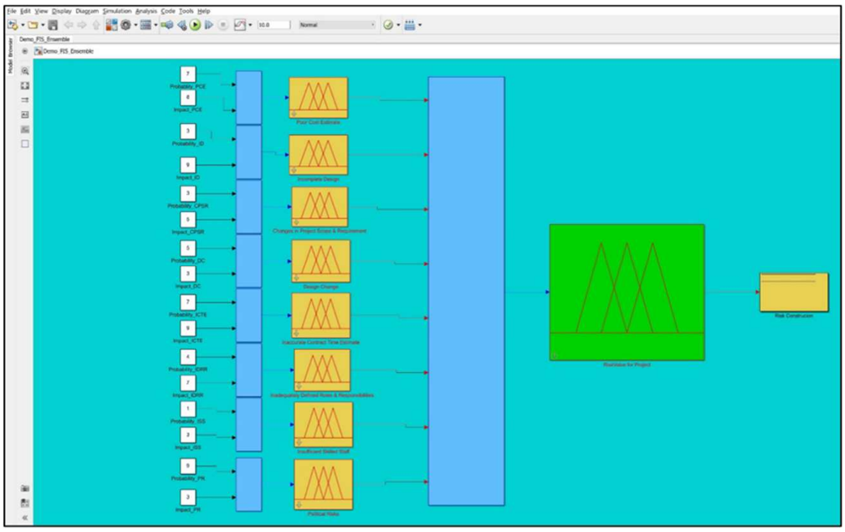

Figure 7. Final simulation model for the use case

Final simulation model is shown as figure 7. We have custom inputs of probability and impact for each risk factors which gives the final risk value of the project. Before starting the simulation, we must import all individual model into the workspace. After opening the model, click on the edit and export it to the workspace.

3. GRAPHICAL USER INTERFACE FOR RISK ANALYSIS

The digital model explores the connection between users and software. It then utilizes the interpretation of these experiences to construct an experience with well-thought-out behaviors. Great digital technology not only anticipates how an individual communicates and corrects issues in a timely manner, it can also invent new ways for a device to communicate and respond to users. A UI (User Interface) is a visual interface in one or more windows with buttons, or elements, that allows a user to execute digital activities. To execute the functions, the user does not need to construct a file or type command on the command line. While programming software for projects, the user does not have to learn how to perform the tasks in depth. Project risk is an unknown occurrence or situation that has an impact on at least one project objective if it happens. Risk management works on project hazard recognition and risk assessment and risk management to reduce the task effect. There are no risk-free programs, since an unlimited number of events will negatively impact the venture. Risk management is not about threat prevention, but about risk recognition, assessment, and control.

Figure 8. Start with the user interface

To start with the user interface of MATLAB, click on APPS and choose Design App 

as shown in figure 8.

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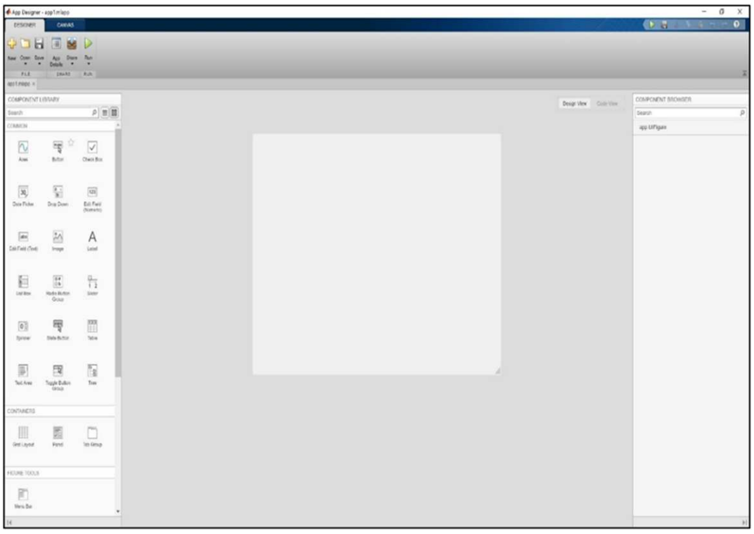

Figure 9. Application designer

Once we click on the design app, application designer window will open as shown in figure 9. As we can see on the left of the window, we have options of common components such as axes, push button, check box, drop down etc. To start with the design, drag and drop from left tools to the design view window in the middle. Once we drag and drop all required components into the design view, we have to activate the user interface window. For that, in our case we want to calculate the risk value of the project once we click on push button, after selecting the inputs.

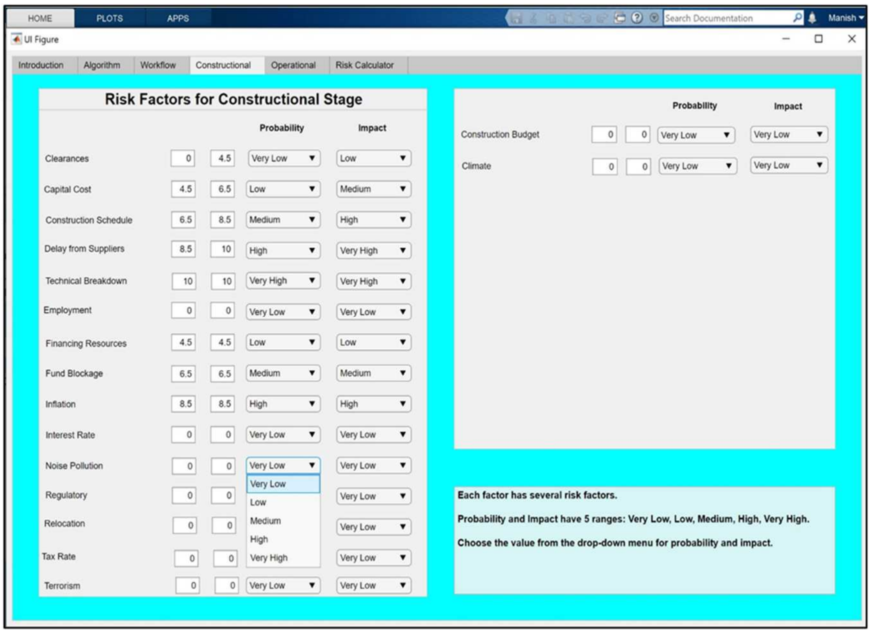

Figure 10. User interface for constructional stage

To start, first we have to go to the risk factors then, select value for probability. In our user interface we have five options: Very Low, Low, Medium, High and Very High as shown in figure 10. The same we did for the impact. Here, users also free to plugin values between 1 to 10. After this we went to the risk calculator window and chose the defuzzification method as shown in figure 11.

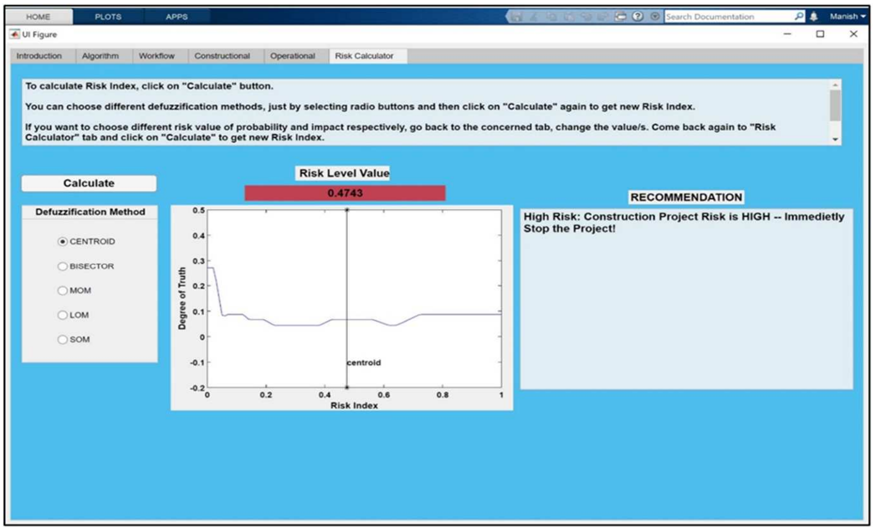

Figure 11. Risk index using centroid method

4. CONCLUSION

The developed user interface model provides a sophisticated way to calculate risk index of general power plant project. However, it can be useful for other types of project too. Also, it allows user to add risk factors for other power plant projects. This generates a microsystem approach to identify various risk factors at micro level. The system established uses the concept of the fuzzy logic for predicting potential risks related to the existence of the risk and uncertainty related to the feedback of the experiment.This platform offers a user-friendly development tool to help the model built and to illustrate its essential features. The concept was also applied using conceptual graphical models to show the entire application process and explain its essential characteristics. Such findings were evaluated to demonstrate the key features of the existing model and to research future development prospects. There are non-linear, dynamic, and intertwined risks involved with infrastructure projects. The model offers a structural theoretical and practical assessment of risk by combining fuzzy theory with probability.

It also involves creation of a fundamental cause analysis and result diagram recognition process, along with brainstorming, to determine the root causes and impacts of each danger factor along with prevention and corrective measures. Micro-Fuzzy risk assessment technique promotes the use of language terms and establish a method for translating language terms into numeric. This approach involves a qualitative estimation framework using a flexible and fuzzy principle of probability and a risk mapping technique that illustrates the level of risk involved with each project variable. It also requires a comprehensive examination that measures the pre-mitigation contingency needed for each danger element, before choosing a mitigation technique.

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