REST Journal on Emerging trends in Modelling and Manufacturing
Vol: 5(4), 2019
REST Publisher
ISSN: 2455-4537

Website: www.restpublisher.com/journals/jemm

Risk Analysis and Management for Critical Asset Protection using EDAS Method

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Abstract

National security, public safety, Social economic security, lifestyle because of its importance Critical infrastructure plays a significant role in countries. Of infrastructures Depending on the importance, It is possible to prevent these risks from becoming incidents Risk analysis is essential. The main objective of this thesis is to provide a more secure, to build secure and highly resilient critical infrastructure, with the aim of overcoming the limitations of the traditional approach to operation and control is to present a developed framework. The proposed framework is for effects on value at risk Routine by introducing new parameters Extends RAMCAP (Risk Analysis and Management for Critical Asset Protection). The complexity of the problem and According to the inherent uncertainty, this research MCDM EDAS Adopts multiple criteria as a decision-making technique. Capacity of the model for risk ranking of critical infrastructures and to explain performance Case analysis is implemented. The proposed model shows significant improvement as compared to conventional RAMCAP.

Keywords: RAMCAP, MCDM method.

I. Introduction

Countries of the world experienced recently many incidents in the critical infrastructure sector created due to various reasons. They have caused numerous casualties, massive damage to people, machinery and the environment. This has been proven by many cases where the risk associated with safety, security, of evaluation criteria Relative importance weights whatever, for effective component management Risk assessment method to create For critical infrastructure There seems to be an urgent need. The RAMCAP system deals with critical infrastructure of possible events Identify the importance It is proper to observe and analyze Provides process. The RAMCAP process involves the following seven steps: Property characterization and screening, threatening nature, impact analysis, Regular Advantages of RAMCAP include, but not limited to: (i) Capital and human resources efficient management, (ii) Great need of improvement and ability to identify assets with value, (iii) Limited credit Security within the budget, also to increase resilience development rational allocation of resources. According to the conventional RAMCAP technique, Assault, Threats of Assault, Risk Consequences of attack and is determined by vulnerability. Risk analysis of critical infrastructure in sectors can be more complex than traditional analyses, but detecting vulnerabilities, To prioritize emergency preparedness and risk reduction activities Provides important information. Earthquake in Japan, followed by tsunamis, and coastal disaster in the northeastern part of the country are important to the effect of infrastructural collapse a catastrophic example: Described in this paper Risk analysis A useful framework. Based on the results, May reveal vulnerabilities and Emergency Preparedness Amendments can be planned. Interdependence analyzes cause, Can focus on outcomes or both. As a formalized course Risk analysis has been around for three decades and possible failure modes in our systems and Disclosure of risks and with the purpose of identification has reached a wide range of applications, this way they are fixed before they emerge. Generally, risk involves two dimensions and the functioning of our systems, by our actions and the uncertainty associated with them Describes possible (future) outcomes. Effects are generally negative, In unpleasant terms are intended, Seen with respect to objectives; During an accident about the conditions under which they actually develop their properties are uncertain due to imperfect knowledge. Accident scenes are a relevant part of risk, They lead to undesirable consequences A combination of events; Their uncertainty is related to the frequencies and based on the probabilities of events occurring expressed quantitatively. Estimation based on distance from average solution (EDAS) method with respect to each criterion based on the distance of each alternative. This method is similar to TOPSIS and VIKOR Remotely based Multi-criteria are similar to decision-making methods. This makes it easy to calculate distances for contract settlement and quickly determines the final result. The EDAS method already has its inherent ambiguity; the intuition is extended to fuzzy and type-2 fuzzy versions. In this paper, an expert's truthfulness, falsity and instability Simultaneous consideration of the EDAS method we expand to its interval-valued neutrosophic version.

II. Risk Analysis

Risk background of this study is mentioned "the effect of a threat that has adverse effects on a vulnerable system". Harm means threat or danger or defined as a source of danger, while vulnerability is due to single or compound risk events A community that is negatively affected or Indicates the predictability of the system. Birkman et al. In the context of natural hazards, Due to important factors like impact He argued that to be described. "the exposure of a community or system to a hazard or stressor, the sensitivity of the system or community, and its lack of resilience". Exposure refers to spatial and temporal scale Vulnerability (or vulnerability) describes the vulnerability of components to Harm and physical, environmental, social, economic, such as cultural and institutional it has many dimensions; finally, regression is To anticipate and deal with a hazardous event, A community for recovery or refers to the capacity of a system. Risk analysis is the overall process of risk assessment is part of an understanding the nature of risks and It can be defined as determining its level or extent According to Kaplan and Carrick, The goal of risk analysis is to answer three questions: "What can go wrong?" "How does that happen?" "If that happens, what are the consequences?" Answering these questions requires identifying related views and probability of occurrence and evaluating the effects of those scenarios. A view can be defined as "a hypothetical situation with an identified threat or hazard, an entity affected by that hazard, and associated conditions, including consequences when appropriate." Probability is relative Frequency or future events and about consequences can be interpreted as a subjective measure of uncertainty. Probability of hazards induced by EW, Often the return period or Expressed as the recurrence interval, between events of the same size or intensity gives the estimated time interval, and there are many well-established methods for estimating weather-related magnitude and probability or recurrence interval. However, data commonly used for risk assessment are based on historical information rather than visuals. Also, natural climate variability, on future emissions of greenhouse gases including uncertainty and modeling uncertainty Affect future climate information there are many uncertain sources. When it comes to CIs, impact implies "the severity of the consequences of an undesirable event, particularly the level of disruption and/or destruction of infrastructure." For CI estimates The following impact criteria The European Commission has defined: (i) Public effects (ii) Economic effects (iii) Environmental effects (iv) Political effects and (v) psychological effects on people, These criteria are evaluated based on objective. Most authors focus on economic effects or Tangible and intangible costs of natural hazards and Classify direct and indirect. Intangible costs are materials and Represents damages to the Services. cannot be Easily measured in monetary terms. Direct costs result from the impact of the actual event, For example, direct damages, deaths, and injuries caused by the total or partial destruction of physical property. The indirect effects are devastating after or outside the disaster area Effects over time and a CI is particularly severe if affected by risk. n quality, semi-quantity or quantity Assessed using assessment methods; Impact of semi quantitative methods and combine probability, using numerical assessment scales, to quantify risk. Impact of Quantitative Analysis and estimates practical values for probability and in specific units Creates risk level values. Since the true risk values are unknown, since the value added by measurement is not guaranteed, Quantitative risk analysis of risk creates a "best estimate" or "best allocation".

III. EDAS Method

Relativity of experts, A reflection of the whole and such as the independence of subgroups of the neutrosopic set To incorporate the benefits of these packages The EDAS method was extended for the first time with neutrosophic sets. This freedom assigns values to subsets Gives professionals more freedom. The proposed neurotrophic EDAS method than other fuzzy set types includes all the benefits of nutrosopic packages. As previously mentioned, Introduced by Korabe et al EDAS Cashovers. So from scratch It can be said that the proposed method. A fuzzy extension of this method is Keshawar's Corabe and developed by many others. Basic concepts of EDAS method the use of two distance measurements is, ie from the mean (PDA). Positive distance and negative distance from the mean (NDA); and evaluation of alternatives Higher values of PDA, According to the lower values of NDA. Calculation procedure of EDAS method, m criteria and For a decision problem with n alternatives, can be given as follows Used in the original EDAS system To facilitate the new extension Some labels have been changed. In the MCDM problem, we usually have to prioritize some alternatives depending on several criteria. EDAS method for evaluating alternatives positive and from the mean solution uses negative distances. Calculating the average solution very easy, on every scale of performance values of different alternatives we need to determine the arithmetic mean. In stochastic processes Arithmetic mean is very important. For this reason, Application of the EDAS method to stochastic MCDM problems will be very efficient. In this section, we present a stochastic extension of the EDAS method. Importance of normal distribution and because of compatibility, Performance values of the alternatives in each criterion A normal distribution we consider following. We have an alternate look suppose that and criteria exist.

TABLE 1. Data set for risk analysis EDAS

	Consequence	Detectability	Reaction against event	Threat	Vulnerability
RPP	50.92600	46.87500	183.33300	78.94700	91.83700
RST	13.88900	234.37500	127.22200	53.93200	137.75500
MST -200	51.92600	351.56300	61.11100	53.64200	91.83700
SY	27.77800	289.06300	62.11100	78.94700	15.30600
RC	28.77800	575.52100	61.41100	53.63200	139.75500
TUA	13.88900	289.06300	124.22200	96.49100	91.83700
SUA	50.92600	54.68800	183.33300	8.77200	45.91800
MST -300	14.88900	703.12500	123.22200	78.94700	138.75500
AVj	31.62513	318.03413	115.74563	62.91375	94.12500

Table 1 shows the data set for risk analysis EDAS here the Consequence, Detectability Reaction against event , Threat , Vulnerability of return of RPP, RST, MST-200, SY, RC, TUA, SUA, MST-300 are presented in the above tabulation. From the above table the other values are being calculated.

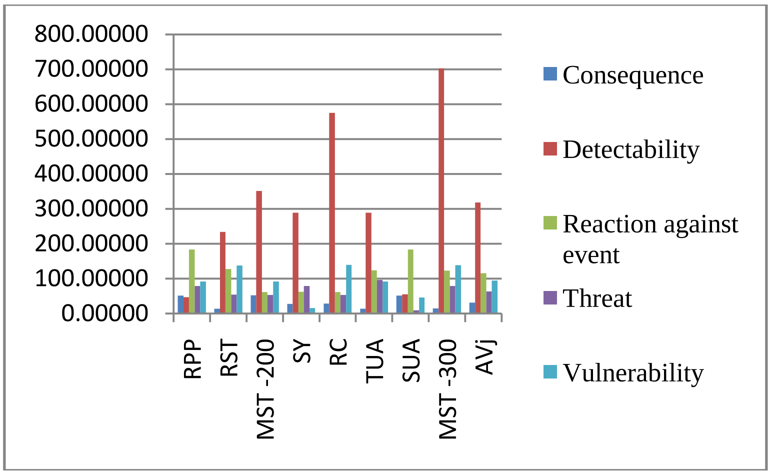

FIGURE 1. Data set for risk analysis EDAS

Figure 1 shows the data set for risk analysis EDAS. The Internal rate of return on Detectability is high.

TABLE 2. Positive Distance from the average

RPP	0.61	0.00	0.00	0.00	0.02
RST	0.00	0.00	0.00	0.14	0.00
MST -200	0.64	0.11	0.47	0.15	0.02
SY	0.00	0.00	0.46	0.00	0.84
RC	0.00	0.81	0.47	0.15	0.00
TUA	0.00	0.00	0.00	0.00	0.02
SUA	0.61	0.00	0.00	0.86	0.51
MST -300	0.00	1.21	0.00	0.00	0.00

Table 2 shows the positive distance from the average it calculate from the average of the first table these value are calculated for the later calculation to get the final rank.

TABLE 3. Negative Distance from Average (NDA)

RPP	0.00000	0.85261	0.58393	0.25484	0.00000
RST	0.56082	0.26305	0.09915	0.00000	0.46353
MST -200	0.00000	0.00000	0.00000	0.00000	0.00000
SY	0.12165	0.09109	0.00000	0.25484	0.00000
RC	0.09003	0.00000	0.00000	0.00000	0.48478
TUA	0.56082	0.09109	0.07323	0.53370	0.00000
SUA	0.00000	0.82804	0.58393	0.00000	0.00000
MST -300	0.52920	0.00000	0.06459	0.25484	0.47416

Table 3 shows the negative distance from the average it calculate from the sum of the average of the first table these value are calculated for the later calculation to get the final rank.

TABLE 4 weight age

RPP	0.25	0.25	0.25	0.25	0.25
RST	0.25	0.25	0.25	0.25	0.25
MST -200	0.25	0.25	0.25	0.25	0.25
SY	0.25	0.25	0.25	0.25	0.25
RC	0.25	0.25	0.25	0.25	0.25
TUA	0.25	0.25	0.25	0.25	0.25
SUA	0.25	0.25	0.25	0.25	0.25
MST -300	0.25	0.25	0.25	0.25	0.25

Table 4 gives same weight age value 0.25.

TABLE 5 Weighted PDA

	Weighted PDA					**SPi**
RPP	0.15258	0.00000	0.00000	0.00000	0.00608	0.15865
RST	0.00000	0.00000	0.00000	0.03569	0.00000	0.03569
MST -200	0.16048	0.02636	0.11801	0.03684	0.00608	0.34776
SY	0.00000	0.00000	0.11585	0.00000	0.20935	0.32519
RC	0.00000	0.20241	0.11736	0.03688	0.00000	0.35665
TUA	0.00000	0.00000	0.00000	0.00000	0.00608	0.00608
SUA	0.15258	0.00000	0.00000	0.21514	0.12804	0.49576
MST -300	0.00000	0.30271	0.00000	0.00000	0.00000	0.30271

TABLE 6 Weighted NDA

	Weighted NDA					**SNi**
RPP	0.00000	0.21315	0.14598	0.06371	0.00000	0.42285
RST	0.14021	0.06576	0.02479	0.00000	0.11588	0.34664
MST -200	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
SY	0.03041	0.02277	0.00000	0.06371	0.00000	0.11690
RC	0.02251	0.00000	0.00000	0.00000	0.12120	0.14370
TUA	0.14021	0.02277	0.01831	0.13343	0.00000	0.31471
SUA	0.00000	0.20701	0.14598	0.00000	0.00000	0.35299
MST -300	0.13230	0.00000	0.01615	0.06371	0.11854	0.33070

Table 5 and table 6 shows the Weighted PDA the value of weighted PDA are product of the positive distance average to get the spi value. The Weighted NDA the value of weighted NDA are product of the Negative distance average to get the sni value.

TABLE 7.NSPi, NSPi

	NSPi	**NSNi**
RPP	0.32002	0.00000
RST	0.07199	0.18022
MST -200	0.70148	1.00000
SY	0.65595	0.72355
RC	0.71939	0.66016
TUA	0.01226	0.25573
SUA	1.00000	0.16520
MST -300	0.61060	0.21792

Table 5 shows the NSPi ,NSNi the data set for techno economic feasibility EDAS here the Consequence, Detectability Reaction against event , Threat , Vulnerability of return of RPP, RST, MST-200, SY, RC, TUA, SUA, MST-300 are presented in the above tabulation. From the above table the other value is being calculated table 5 and table 6 is calculated from the table 4.

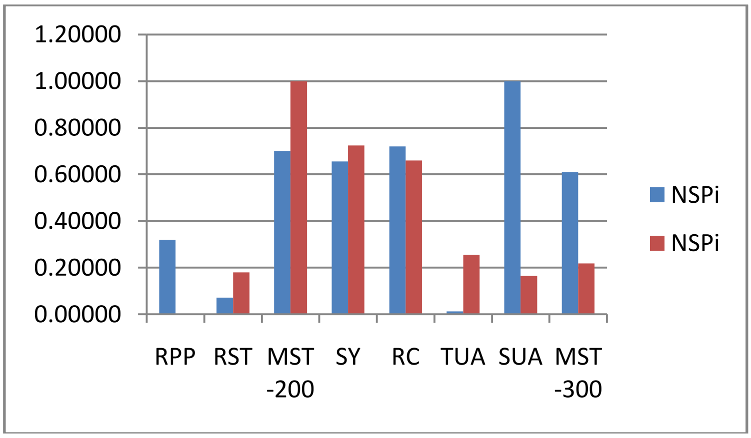

FIGURE 2. NSPI, NSPI

Figure 5 shows the NSPi ,NSNithe data set for techno economic feasibility EDAS here the Consequence, Detectability Reaction against event , Threat , Vulnerability of return of RPP, RST, MST-200, SY, RC, TUA, SUA, MST-300 are presented in the above tabulation. From the above table the other value are be calculated table 5 and table 6 is calculated from the table 4 .

TABLE 8. ASI

	ASi
RPP	0.16001
RST	0.12611
MST -200	0.85074
SY	0.68975
RC	0.68978
TUA	0.13399
SUA	0.58260
MST -300	0.41426

Table 8 gives ASI value.

TABLE 9. Rank

	Rank
RPP	**6**
RST	**8**
MST -200	**1**
SY	**3**
RC	**2**
TUA	**7**
SUA	**4**
MST -300	**5**

Table 7 shows that the MST -200 is in 1st rank, SUA is in the 4th rank, SY is in the 3rd rank, RC is in 2nd rank. MST-300 is in 5th rank, is in 6th rank, is in 7th rank, is in 8th rank.

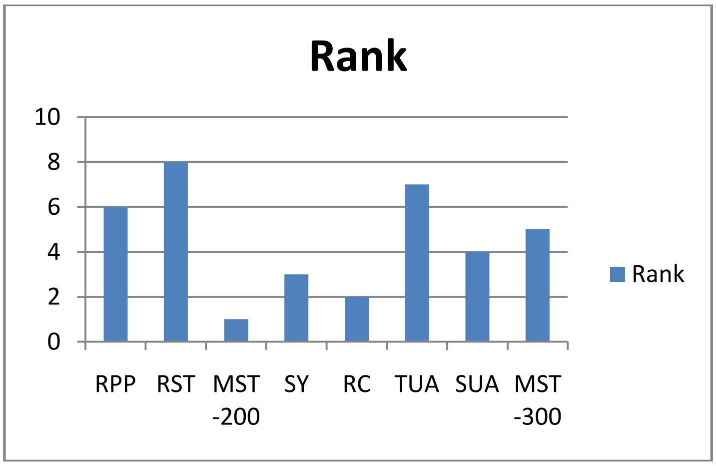

FIGURE 3 Ranking

IV. Conclusion

Rapid growth of military industries, To carry out destructive activities In response to the increasing capabilities of terrorists, Especially for critical infrastructure, Property restrictions and the need for risk measures It is governments and responsible It has attracted the time and attention of departments. On the other hand, risk and Due to the intangible nature of threats, It is difficult for decision makers to accurately measure risk. Most previous studies have assessed risk Only RAMCAP parameters were used. In this thesis, For risk assessment in critical infrastructure A new structure has been introduced and developed. The proposed model is of existing risks Very accurate To get classification, will have consequences on the level of risk Routine by introducing new parameters Extends RAMCAP. They contradict each other, Based on theory decision making handle the uncertainty of the problem, This technique indicates the relative importance of criteria to the decision maker; it also helps determine judgments through linguistic variables. Potential of this method Demonstrate application a case study is presented. To be useful, Vulnerability based on new, extended paradigms and risk analysis should be conducted. Natural events ranging from random mechanical/physical/material failures; From software crashes and deliberate malicious attacks of various natures When exposed to hazards High quality and inter-connectivity achieved by critical infrastructure, A global disruption of these systems makes them vulnerable, both human and institutional. This wide range of risks and threats, For their effective protection To understand the failure behavior of such systems It is widely recognized that this calls for an all-risk approach.

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