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Fuzzy Risk Analysis Model for E-tourism Investment

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ABSTRACT: This paper provides a Fuzzy based decision support system (DSS) for risk analysis in E-tourism (Electronic Tourism) investment. In general term, E-tourism is the use of information and communication technology (ICT) in tourism which may allow operating tourism in least variable cost, least time and increased work efficiency. It is worth noting that there are many factors that affect the development of E-tourism. To demonstrate the effectiveness of the system, four factors of investment, human IT skill, E-tourism infrastructure and stability of the regions are considered in the present study. These parameters are fuzzified and a fuzzy rule-base has been developed for calculating risk factor for the E-tourism investment. The researchers used MATLAB software for fuzzifying the factors and gain the final risk. Case studies have been presented using the developed model. It shows that the investment possibility in developed region is high with low risk to invest.

Keywords: *Tourism, E-tourism, DSS, Fuzzy decision support system, Risk analysis*

INTRODUCTION

Tourism plays a crucial role in developing and underdeveloped countries for foreign exchange earnings and employment generation. Tourism directly or indirectly generates and supports 195 million jobs globally. This is equivalent to 7.6% of the world workforce and is forecasted to rise to over 250 million jobs in 2010 (Cooper et al., 2005).

According to WTO and WTTC about 11% of world gross domestic product is generated by the E-tourism sector which accounts for more than 200 million people of the world employed workforce.

A good definition which captures the essence of tourism has been quoted by Bradgett (2000). It states that *"tourism comprises the activities of person traveling and staying places outside their usual environment for not more than one consecutive year for leisure, business and other purposes."* In the last decade the use of information and communication technology (ICT) has boomed in many sectors, such as business education, commerce etc, all over the world.

E-tourism is the terminology generally used to represent the use of ICT in tourism sector to promote and facilitate E-tourism services (Bradgett, 2000).
Many tourism organizations are confronted by an ever increasing pressure to find new ways to compete effectively in a dynamic global market. Many are turning into e-commerce and virtual structure using e-facilities to expand into global market (Baggio and Copaorell, 2005).

E-tourism is the part of e-commerce that creates new opportunities to increase demand for product and services, and improve management capabilities in tourism sector. The use of ICT in tourism sector leads to reduction of variable cost, saves times and gets improved confidence. Over the years the demand for tourism product and services on the internet has been growing, like the number of internet users and speed of access to the internet (UNCTAD) .The availability of new technologies has led to the development of new skills, new materials, new services, and new forms of organization. In tourism, E-tourism has created a new

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form of business as an important part of e-commerce (Weirermair, 2004).

This paper proposes a decision support system to help decision makers analyze the risk associated with E-tourism investment in a particular situation of a region. A risk analysis tool has been developed using fuzzy rule based approach. The decision support system takes some influencing factors on investment decision in E-tourism sectors, and calculates a risk factor as a recommendation whether the investment can be made.

First it investigates e-tourism development problems in the context of developing countries by investigating the influencing factors, then describes and calculates them before give them as input to the fuzzy system to determine the final risk.

Literature Review

According to E-tourism newsletter (Luc carton, 2006), about 66% of American e-commerce users believe that E-tourism sites provide better services than travel agents. The nature of E-tourism services is characterized as invisible, non stable, customer specific nature, overlapping of productions and consumption and sensitivity to relationship and reputations as reflected the in heightened nature of services process (Prisma Group, 2003).

Prioritizing E-tourism development activities to allocate investment is a complex decision making problem. A local tourism authority or tourist management organization has limited budget and has to decide where to and whether to invest in order to increase revenue earned from tourism. This problem is usually solved by economist or investment analyst with sufficient local and global knowledge. One of the major issues is risk analysis for the proposed E-tourism investment.

Many researches have been conducted by using fuzzy logic technique to solve the problem of vagueness and uncertainty and it is now becoming an important tool for decision making.

Fuzzy rule based approach has been already applied in a variety of business and engineering activities; for example, Adriaenssens et al. (2004), have used fuzzy rule base in eco-system management, fuzzy multi criteria decision making is also used in evaluation of airlines services quality (Tsaur et al., 2002), uncertainty analysis in political forecasting (Royes and Bastos, 2004) and in loan risk analyzing in the banking sector (Dahal et al., 2005). This relatively new approach has the capability of modeling highly complex problems linguistically rather than numerically. Furthermore, the nature of its modeling ensures that the decision making process is human like and most importantly it captures experienced expert knowledge as it is modeled around company knowledge (Opricovis and Tsang, 2003). Fuzzy logic has been used for decades to embed expert input into computer models for a broad range of applications (Opricovis and Tsang, 2003; Dahal et al., 1999). Fuzzy logic is a capable tool among many decision tools for risk measurement.

Research Objectives

Research objectives in this paper are as follow:

1- Identifying the factors affecting E-tourism investment risk.

2- Suggesting an analysis model for the risks involved in E-Tourism investment based on fuzzy logic.

Research Questions

Research questions in this paper are:

1-What are the factors involved in the E-Tourism investment risk assessment?

2-What is the optimal model of analyzing the risk in E-tourism investment?

RESEARCH METHOD

Modeling techniques that can accommodate a combination of data and expert input are better suited for modeling risks (Dahal et al., 2005). The target population of the study comprised of professors in the universities, tourist agencies' managers and the experts in the field. The demographic characteristics of these experts are given in table 1. It shows that all of them have enough knowledge and experience to be interviewed for the purpose of this research. Figure 1 summarizes the system structure with parameters which are combined to determine the input parameters of the fuzzy risk analyzer.

Identification of the Influencing Factors

In the process of designing a fuzzy investment risk analyzer the first and probably the most important task is to identify those factors that contribute primarily to the investors' risk associated with their investment for E-tourism facilities. After reviewing the relevant literature and discussion with the experts, the researchers identified the four main factors: Available investment amount, human skill, E-tourism related

Table 1: Frequency distribution of research community in accordance with demographic characteristics

Variables	Frequency	Average	Mean	Mod	Minimum	Maximum
Age	50	42/4	42	39	34	59
Experience	50	9/4	9	8	4	19

Variables	Frequency	Percentage
PhD	9	18
M.A	19	38
B.A	19	38
Diploma	3	6

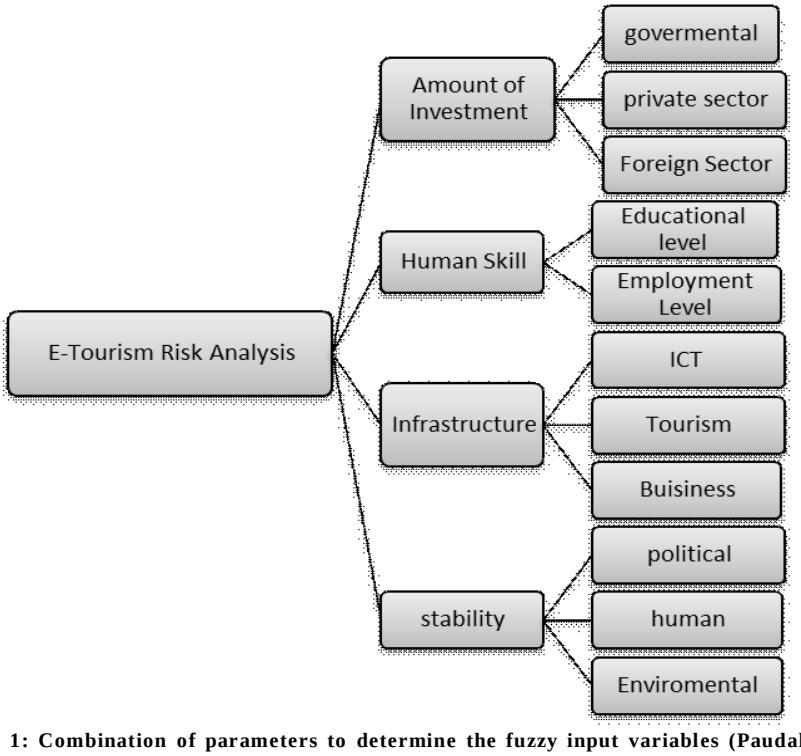

Figure 1: Combination of parameters to determine the fuzzy input variables (Paudal and Hossain, 2005).

infrastructure and stability of the given region (figure 1). These parameters are used as inputs to the risk analyzer, and are discussed in the following subsections.

A. Investment Amount

Investment is the most important and necessary factor for development. In case of E-tourism, it is a capital intensive in nature but later on it may reduce variable cost. With respect to underdeveloped countries funding is the crucial factor for launching E-tourism. In the underdeveloped countries the main investors in tourism are**:** government, private and foreign sectors. The government is the major source of investment followed by private and foreign sector. In this paper we assume that the total investment amount is the sum of these three funds.

We have given priority to Government sector (GI), private sector (PI) and foreign sector (FI) according to their importance and their influences. The government

sector is given 50 percent weight while private and foreign sectors are given second and third priority with 40 and 10 percent weight respectively. It is also assumed that government sector, private sector and foreign sector will invest 10, 10 and 5 percent of their total investment amount. Based on these assumptions a formula is derived using weights given in three sectors of investment with respect to percentage of total investment amount available for investment in E-tourism.
*Investment Amount = Percentage of GI*5 + Percentage of PI*4 + Percentage of FI*2.*
This formula gives a normalized investment amount available for E-tourism in the scale of 0 to1, where 0 being no investment available; and 1 being high investment availability.

B. Human Skill

The human skill is determined by level of education, rate of employment, nature of the people, age factor and experiences of people (Paudal and Hossain, 2005). Factors such as rate of education and rate of employment are also taken into consideration in the present study. In this case summation of rate of education and rate of employment is considered with respect to total population for human skill determination. Education and employment is given different priority according to their importance. To derive formula, 70 percent of weight is given in education while 30 percent weight is given for employment and also assumes that 50 percent people of the region are educated and 30 percent of the total population is employed. A formula is derived on the basis of weights given for two sectors of human skill with respect to total population. The weight given for education (70%) divided by the percentage of education level (50%) gives 1.4, while the weight given for employment divided by employment level gives 1. So, human skill becomes:
*Human Skill = Education Rate*1.4 + Employment rate*1.*

C. Infrastructure

Infrastructure is another input factor used in the proposed E-tourism investment risk analyzer. The term infrastructure in this case is defined by tourism, ICT and business infrastructures (Paudal and Hossain, 2005). The 30% and 40% weight are applied according to their importance. In case of tourism infrastructure it is important to develop roads, railway lines, harbors, airport runways, water, electricity, other power supplies, sewerage disposal systems and other utilities and also the tourist influx (suitable accommodation, restaurants and passenger transport terminals form the superstructure of the region) (Lin et al., 2006). Tourism site and tour operators and travel agencies are helpful hand for tourism promotion and tourism development.
1) Tourism infrastructure = percentage of tourist arrival in the tourist site* number of tourist site + percentage of tourist arrival use star hotels*number of star hotels + percentage of tourist arrival use tour and travel agents*number of tour and travel agents.

In the same manner Information technology has crucial role to play in E-tourism development. IT infrastructure is varying in different sector which is defined as a base or foundation for the delivery of information to support the programs and management. The infrastructure contains elements upon which an information technology activity is dependent. An agency must therefore define, implement, and manage these infrastructure elements to succeed in employing information technology (www. sam.dgs.ca.gov).
2) ICT infrastructure = 2* number of telephone line distributed for operation+ number of computers available in the region*10 + number of internet cafe*500 /Total population of the region Number of telephone multiplied by two implies that one telephone is for 2 people. Number of computers multiplied by ten implies one computer for 10 people and in the similar way number of internet café multiplied by 500 implies one internet café for 500 people is acceptable.

For E-tourism investment decision here we use number of telephone line distributed for operation, number of computers available in the region and number of internet café facility available in the region or country with respect to total number of population of the region or country. We use average number of telephone line, average number of computers in use and average number of internet café in the region are 200,000, 30,000 and 500 respectively and total population 500,000. These values are used to determine formula for ICT infrastructure. And business itself is the important factor for tourism development and also the important component for E-tourism development. In general E-tourism business is performed via internet and electronic and communication media. Considering that 20 percent business use ICT for their business, we use different formula to determine ICT, Tourism and business. Formula for these three sectors is as follows:

3) Business infrastructure = percentage of business use IT in their business.

For determination of infrastructure summation of tourism sector, IT sector and business sector is used and formula is derived. The formula is given below.

*Infrastructure = value obtained from ICT*0.267 + value obtained from Tourism*0.0067+ Percentage of Business use ICT in their business*1.5*

The weighting coefficient 0.267, 0.0067 and 1.5 are determined on the basis of weight given for ICT (0.4) divided by the value obtained for ICT infrastructure (1.4), tourism (0.3) divided by the value obtained for tourism (45) and business (0.3) divided by the value obtained for business (0.2) in their business respectively.

D. Instability

It is general proverb that higher the stability higher the development. Instability is a probability of harmful consequences, or expected losses resulting from interactions between natural or human-induced hazards and vulnerable conditions (Paudal and Hossain, 2005). In the similar way instability is the chance that the value of an investment could decline in the market and it is also the degree of uncertainty regarding the rate of return on and/or the principal value of an investment (Paudal and Hossain, 2005).

In this case summation of political, human and environmental instability gives the instability factor. To determine instability, three sectors political, human and environmental instability are considered. Different instability are defined in terms of our knowledge is given below.

1) Political Instability (PI): Instability prevails by changing rules and regulation, demonstration by the oppositions, international pressures, political instability and civil wars.

2) Human Resource Instability (HRI): Instability prevails by destroying tourist sites, destroying infrastructures, the computer hackers, the unfair competition, the pirating.

3) Environmental Instability (EI): Instability prevails by the natural calamities, the environmental deterioration, and the environmental fluctuation (seasonal).

It is assumed that political instability has 50 percent impact to enhance the risk followed by human and environmental 30 and 20 percent. As political environment (situation) play major role to determine the nation future, so it is given higher priority. And for this contribution of political instability is 50 percent while human and environmental instability contribution is assumed 25 percent each.

*Instability = Percentage of PI*1 + Percentage of HRI*1.2 + Percentage of EI*0.8.*

1, 1.2 and 0.8 are the weights given for political instability, human resource instability and environmental instability divided by the contribution to enhance instability respectively.

RESULTS AND DISSCUSSION

Model of the DDS

A. Fuzzy Based Decision Support System

Decision support systems are the tools that help policy makers to deal with either simple or complex decision problem. It is used for different decision making. A decision support system presents information graphically and may include an expert knowledge or artificial intelligence. It is a specific class of computerized information system that supports business and organizational decision-making activities. A properly designed DSS is an interactive software-based system intended to help decision makers compile useful information from raw data, documents, personal knowledge, and/or business models to identify and solve problems and make decisions (Tourban, 2005). Decision-support systems are interactive computer-based tools used since the 1960s by decision-makers to help answer questions, solve problems and support or refute conclusions (Tourban, 2005). A decision support system is highly flexible and interactive Information Technology system which has a purpose of supporting decision making when the problem is not structured (Tourban, 2005).

In the present paper the fuzzy logic approach is used as a decision making tool within the proposed investment decision support system. Fuzzy model consists of fuzzification of input, fuzzy inference and defuzzification of output. In 1965 fuzzy logic was introduced by Zadeh as modification of classical set theory. Fuzzy set theory enables the processing of imprecise information by means of membership function (Zadeh, 1965). Fuzzy sets are usually identified with the membership function but determining the good membership function and fuzzy rules in the rule based is not always straight forward. Even after extensive testing, it is difficult to determine how many membership function and rules are really required (Cornelissen, 2001).

Fuzzy set theory is primarily concerned with quantifying the vagueness in human thought and perception, where linguistic terms can be properly represented by the approximate reasoning of fuzzy sets (Lin, 2006). Finally, applying the model shows that the investment possibility in developed region is high with low risk to invest and the investment possibility in developing region is medium with medium risk.

B. Determination of Linguistic Terms and Membership Functions

Linguistic variables are used in fuzzy logic. A linguistic variable is a variable with has a lingual expression as its value. The defuzzification stage involves converting linguistic variables into fuzzy sets. Different shapes of membership function can be used, depending upon the type of an application. In most of the cases triangular and trapezoidal membership functions are used. Triangular functions are commonly applied because of their simplicity, and trapezoidal membership functions are straight forward extension of triangular membership function and represent a decreased uncertainty involved in the computation (Adriaenssens, 2004).

There are a large number of input factors that affect the investment risk determination process. These factors are explained in Section 1. For simplicity these large number of input factors are combined using simple mathematical equations to derive a limited number of parameters, which was described in the previous section. In this application we have four input parameters. Figure 2 shows an example of fuzzification of the input variables considered in this paper. Low and high are shown in trapezoidal membership function while medium is determined in triangular function. In our case we use the range between [0, 1], that can be seen in table 2.

A set of fuzzy rules need to be developed for the fuzzy inference system. For the proposed E-tourism investment risk analyzer, fuzzy rules with two parts an antecedent as an input and consequent as an output are used. The fuzzy rule-base is derived from expert knowledge and own personal view related to E-tourism and historical data. We have four inputs parameters each have three fuzzy sets: LOW, MEDIUM and HIGH. Therefore, there are 236 possible rules.

Figure 3 shows some part of a specific situation for the rules those fires.

Figure 4 shows one of the three dimensional diagrams of 2 inputs in all situations.

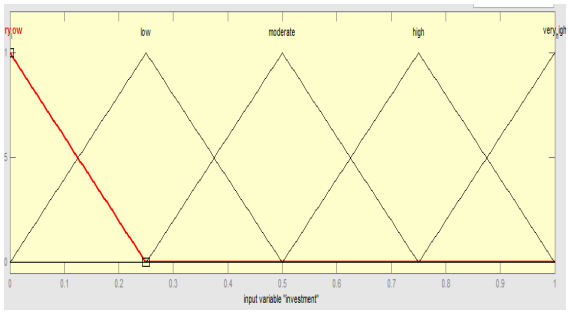

Figure 2: Membership function of the factors

Table 2: Range of fuzzy sets and membership

Linguistic term (fuzzy set)	Membership function
Very low	(0,0,0.25)
low	(0, 0.25,0.5)
Medium	(0.25,0.5,0.75)
High	(0.5,0.75,1)
Very high	(0.75,1,1)

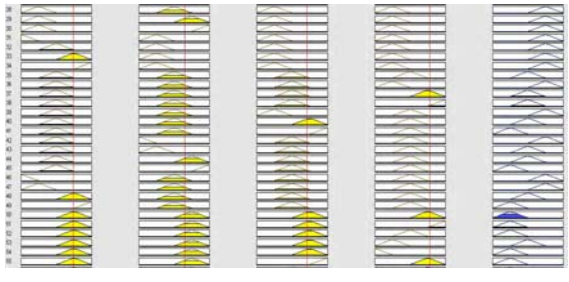

Figure 3: Fired Rules

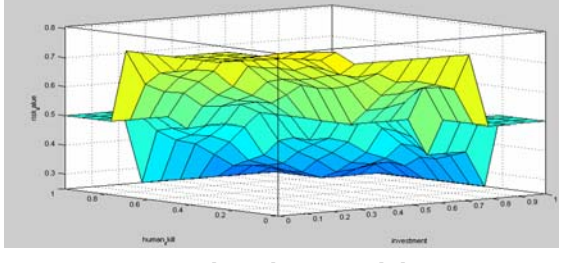

Figure 4: Three dimensional diagram

The decision making logic is an inference mechanism which determines when a particular rule is valid and what the effect is of applying that rule. The decision making logic produces a fuzzy action for each rule applied to a particular situation.

Since the antecedent of each rule contains a number of conditions of the input parameters, a minimum operator is used to calculate the strength (membership value) of the rule (Dahal et al., 1999). Because of the partial matching attribute of fuzzy control rules, the preconditions of the rules do overlap, and usually more than one fuzzy control rule can fire at one time. In such a condition a membership function for the combined conclusion of the overlapping rules is calculated by using a maximum operator (Dahal et al., 2005).

A defuzzification method must be applied to obtain a crisp value of investment risk that best represents a membership function of an inferred fuzzy action. Here we use the standard Centre of Area method, which calculates the approximate centre of gravity of the distribution for the fuzzy action. This defuzzification method is more common for simple applications. This gives a crisp value of investment possibility which can determine investment risk.

Then for FIS inference system, MAMDANI method is used . Min–Max operator has been used in fuzzy inference system and COA is used for defuzzification. The most common defuzzification method is the centre of area (COA).

The validity of the model is presented in table 3 using one-sample t-test with the help of experts.
Three case studies are presented in table4. It is found that risk on investment is higher in under developed region but fruitful in developing region while it is beneficial for developed region.

CONCLUSION

The concept of E-tourism is new in modern era. In the present context E-tourism concept is growing in developed countries because of availability of resources. Least developed and under developed countries are still beyond the E-tourism development. Slow internet access, lack of human resource, lack of funding, poor infrastructure and persistence of variety of risk hampering for E-tourism development. Among the many decision making methods fuzzy rule based system has been applied and different case studies have been presented.

From the case study most probably least developed region has high risk to invest in E-tourism while it is

Table 3: The validity of the model

Questions	N	Mean	S.D	t-test	Significant level
1- Effectiveness	11	7	1.2	5.2	000
2- simplicity	11	7.1	1.4	5.1	000
3- understandable	11	6.63	1.2	4.5	0.001
4- flexi ability	11	7	1.5	4.2	0.002
5- User-friendly	11	7.1	1.07	6.7	000
6- ability to assist	11	7.1	1.4	5.1	000
7- adoptable variables	11	6.8	1.07	5.5	000
8- suitable membership function	11	6.4	1.5	3.06	0.01
9- logic and acceptable rules	11	7.5	0.93	9.03	000

Table 4: The fuzzy sets and membership value

For Developed Region Case Study:
In case of developed region in our study four rules have been fired. The defuzzified value we obtain is 0.73. It gives the investment possibility is high with low risk to invest.

Inputs/s.n	IA	HS	INF	ST	Result
1	M	H	M	M	H
2	M	H	H	H	H
3	H	H	H	M	H
4	H	H	H	H	H

For Developing Region Case Study:
In case of developing region in our study 8 rules have been fired. The defuzzified value we obtain is 0.55. The investment possibility is medium with medium risk.

Inputs/s.n	IA	HS	INF	ST	Result
1	L	H	H	L	M
2	L	H	H	M	M
3	L	H	M	L	M
4	L	H	M	M	M
5	M	H	H	L	M
6	M	H	H	M	H
7	M	H	M	L	M
8	M	H	M	M	M

somehow fruitful in developing region and most beneficial in the developed region.

It gives the government sector to open the door to initiate private and foreign sector by providing different types of facilities for E-tourism development, such as subsidies, tax holiday for few years, full insurance and security etc. The main contribution of this research paper is to initiate further research in this sector. And this concept can also be used in other different risk analysis. The investment risk analysis is a multi-criterion optimization problem. The multicriteria-decision-making (MCDM) followed by ranking procedures may be an alternative solution approach for this problem. A comparative study of the proposed approach with the MCDM may be a useful extension of this research work.

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