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Designing A Risk Management and Customs Data Mining Model

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Abstract: Technological change is one of the fundamental changes that has overshadowed the effects of organizations in the last decade. Today, in response to environmental changes, organizations are looking to find and implement solutions that, despite their positive results, will carry risks, especially in uncertain and indefinite environments. On the other hand, with the growth of management and planning theories and the expansion of their application, the need to use risk management tools, especially in organizations such as customs, which is responsible for collecting import and export duties and taxes, as well as import, transit and export of goods is strongly felt. Therefore, trying to apply risk management techniques to reduce risk in customs is very important. The purpose of this study is to develop a model of risk assessment management model using data mining algorithms. The present research is based on descriptive and analytical methods based on data mining algorithms and also its method and nature are of qualitative-quantitative type. The statistical population of this research includes experts and policy makers, managers and senior customs consultants of Khuzestan province. In the qualitative method section, expert managers and senior consultants were considered, 14 expert colleagues of the organization, 10 university professors were used for the initial extraction of the model, and in a small part, all senior managers and senior consultants of Khuzestan province as the statistical population of the study was considered. In both qualitative and quantitative phases, sampling was done judiciously and purposefully. In this study, the decision tree algorithm was used to build a risk management model and analysis of customs data, which is a decision tree algorithm and analysis of customs data from Rapid miner software version 9.1. The results showed that among the risk factors identified in the transit procedure, the currency value is the highest and the type of transit is the least important. Among the risk factors identified in the insurance import procedure is

the highest importance and the net weight is the least important and among the risk factors identified in the net weight export procedure is the highest importance and the currency value is the least important.

Keywords: risk assessment management, customs data, data mining, Rapid miner

Introduction

Risk management is a preventive activity that relies on standard methods to protect the organization from seizing opportunities and preventing the occurrence of threats and spending too much time and resources. Risk management models that were developed in different years included three common stages of risk identification, analysis and response to risk. The risk assessment model is actually related to the stage of risk analysis (Aven, 2015). The purpose of risk management is to increase the probability of success and this is done through systematic identification and evaluation of risks, providing methods to reduce or eliminate them and maximize opportunities (Dehnavi et al., 2013).

The complexity and volume of international trade and technological changes have had a significant impact on responsibilities and the way business is conducted and even customs formalities. In the meantime, customs have an effective and important role in world trade, law enforcement, collection of customs duties and taxes, and providing conditions for the rapid clearance of goods and legal travelers and is under pressure from governments and international organizations to facilitate customs formalities. In addition to facilitating customs affairs, customs should control the movement of goods, persons and means of transportation, but in carrying out their responsibilities for managing the bases, enforcing laws, collecting customs duties and taxes, they are in an environment of risk and change. On the other hand, the large volume of trade, high passenger traffic and limited customs resources make it impossible to evaluate all goods and passengers, so that any delay in completing the formalities of goods at the points of entry and exit for customs controls creates costs that will increase the cost of goods and thus reduce the competitiveness of these goods in both domestic and foreign markets. Therefore, in order to comply with domestic and foreign regulations and to expedite matters so that people can pass through customs without any delay, the customs has turned to one of the common factors to help customs risk management (CriM).

One of the factors reducing the speed of the trade process and increasing the interruption for the time of clearance of goods for import and export in Iran, has been excessive bureaucracy in the country's customs system. Numerous organizations and institutions are involved in the clearance of goods, and the customs cannot clear the goods until these organizations issue the necessary permits. This will sometimes be the first obstacle to shortening the clearance time. However, the need for many licenses for export and import cannot be ignored. But what causes problems for importers and exporters at customs points is the inconsistency and length of time for issuing such licenses (Ba'idi Mofradnia, 2012). The purpose of this study is to design a model for risk assessment management and analysis of customs data using data mining algorithm in the country's customs. In this regard, after using data mining algorithms such as CART[1] algorithm which is designed for quantitative variables and C4.5 algorithm produces a classifier in the form

[1] Classification and Regression Tree

of a decision tree. Apriori algorithm, which aims to find dependencies between different sets of data, is the best algorithm selected from the existing algorithms that are more accurate.

Theoretical foundations and research background

Although risk management is one of the topics that is well understood in some areas of the enterprise, such as finance, managers of organizations try to have a comprehensive, precise and integrated view in order to establish risk management and assess its level of deployment in order to formulate improvement plans. Arena et al. (2011) believe that firm risk management as a process can focus on all events that prevent the company from achieving its goals. They look at enterprise risk management as an integrated rather than an island, and in this regard introduce the characteristics of integration and strategic focus (Arena et al, 2011). Another limitation of previous research is that it is not normally visible to researchers to what extent companies have covered risk management. In previous studies, it has been limited to accepting or not accepting the establishment of risk management in the company as a binary variable (yes or no); But the maturity of the firm's risk management -as measured by the COSO[2] firm risk management framework- has not been examined (Chileshe & Kikwasi, 2014). 2011 to assess the "maturity" value of firm risk management; In other words, they examined how and to what extent the company's ERM measures were developed. Farrell and Gallagher (2015) surveyed 225 North American and Australian companies from 2006 to 2011 to assess the value of the firm's "maturity" of risk management; In other words, they examined how and to what extent the company's ERM measures were developed. They found that less than half of the companies in their sample had reached higher levels of ERM maturity (Farrell & Gallagher).

The Organizational Support Committee (COSO) framework describes risk management as an ongoing process at the organizational level, consisting of eight interrelated components (Lonescu, 2008). In order to build the foundation for effective organizational risk management, the organization must 1. Create an internal environment that fosters commitment to competency, provides discipline, and describes governance structures within the company's risk culture. With a sound and appropriate infrastructure, 2. management can evaluate goal-setting procedures to ensure that the performance goals of business processes across the organization are relevant and support the organization's strategic goals. Management should then undertake 3. the event identification phase to develop or update a list of specific events that, if they occur, may affect the performance of business processes. For each event, management conducts a 4. risk assessment by assessing the probability of the event occurring and estimating the potential impact of the event if it occurs. Management must then select and execute 5. the appropriate risk response for all events based on the company's risk-taking and cost / benefit relationships for the various response options and 6. then establish control activities to help ensure that those risk responses are properly implemented. To manage this network of processes, the organization must create channels for information and communication that enable employees to fulfill their responsibilities and provide feedback to manage feedback on the success rate of achieving the organization's goals. Finally, in order to govern the risk management process, the organization must create a program to 8. monitor the performance of each pillar and track performance over time (COSO, 2004).

[2] COSO: The Committee of Sponsoring Organizations of the Treadway Commission

The guidelines of the Committee of Sponsoring Organizations of the Treadway Commission describe how to apply these eight pillars to different classes of organizational goals (Strategic, operations, reporting and compliance) at all levels of the organization: institution, department, business unit, and subsidiaries level (Wieczorek-Kosmala, 2014). The framework is presented in Figure 1.

Many researches and articles have been done on risk management and its evaluation in the country and abroad, but the risk assessment management model has not been clearly developed using data mining algorithm. Some of the internal and external researches are mentioned. In internal studies on risk management, the following studies can be mentioned:

Fashtali and Shahbandi (2017) in a study entitled "Presenting a credit risk assessment model for private banks" pointed out that in the first step, the three feature selection algorithms Inf-FS, EC-FS and Fisher were compared and evaluated using the nonlinear SVM[3] classifier and then the features obtained from the superior algorithm were classified by the three classifiers Adabost M, Logit Boost and Random Forests. By implementing the model for the collected data, in the first step, the Inf-FS[4] algorithm (infinite selection approach) obtained the best accuracy and in the second step, the Logit Boost algorithm achieved the best performance according to the evaluation criteria.

Ghasemi and Donyaei Harris (2016) in their research presented a model for ranking customers in the field of credit risk with an integrated approach of MADM[5] and SOM. 29 indices were extracted based on the 6C model and then selected using MADM multi-criteria decision-making methods. Finally, the good and bad customers were separated using the SOM[6] map organizing algorithm.

Ali Asghari et al. (2015) examined "Identification of systemic and business risks and risk management in customs". While examining the level of agile design of the comprehensive customs system by preparing a questionnaire and interview and checking the reliability of the questionnaire by Cronbach's alpha coefficient and its content validity, they have examined the types of risks arising from the agile design of the system and the risks arising from the nature of business and have examined organizational change and development based on Levitt's model. Then they proposed an adaptive model based on the Smith model to manage risk in customs.

Zarehpour and Chamani (2013) in their research "Risk management and its implementation requirements in customs" have concluded that the use of risk management techniques and risk analysis in customs can optimize many financial and human resources and drastically reduce labor-related costs. In their research, while defining risk and risk management, they have examined the seven stages of risk management, benefits and costs and its implementation requirements in customs.

Oliva (2016) examined the maturity state for organizational risk management. This study was conducted in 150 companies in Brazil and the required data were collected through interviews with senior managers and

[3] Support Vector Machine
[4] Infinite Feature Selection
[5] Multiple Criteria Decision Making
[6] Self-Organizing Map

applicants and a questionnaire and the methods of cluster analysis, factor analysis and multivariate analysis have been used to analyze the data. In this model, the organization is analyzed in five levels, and the model identifies the most effective strategic solutions for the company in terms of risk management.

Fraser and Simkin (2016) in a study examined the challenges and solutions for organizational risk management. Researchers in this field have studied numerous articles and researches from Australia, New Zealand, Canada, United Kingdom and the United States, in which the crisis of 2008-2009 reveals the important role of risk management. Researchers have obtained results from some case studies in 2013 and 2014 and conducted structured interviews with experts and university professors as well as senior executives of companies. Finally, the researchers summarized the necessary techniques for organizational risk management. The findings also indicate the expectations of senior management of organizations in this regard. The researchers have pointed out the failures that have occurred and explained the techniques according to the studies, and at the end of the implementation of this system, the success of organizations has been emphasized.

Brust Boyer (2014) analyzed Organizational Risk Management (ERM) in Small and Medium Enterprises (SMEs) in a study entitled "Optimizing Corporate Risk Management: A Literature Review and Critical Analysis of Wu and Olson's Research" using a structural model based on a questionnaire. The precondition for implementing ERM is derived from ERM applied approaches and their impact on strategic orientation, and it has been concluded that SMEs follow an active or passive ERM approach that affects their strategic orientation; A passive approach leads to a defensive strategy and an active approach. Company size, departmental affiliation, and ownership structure affect ERM implementation. ERM application conceptualization may help SMEs shrink in order to gain strategic advantage and thus increase business competitiveness and success.

Research Methodology

This research is based on descriptive and analytical methods based on data mining algorithms and also in terms of method and nature, it is qualitative-quantitative. The statistical population of this research includes experts and policy makers, managers and senior customs consultants of Khuzestan province. In the qualitative method section, expert managers and senior consultants were considered. 14 experts of the organization, 10 university professors were used for the initial extraction of the model in a small part and also all managers and senior consultants of customs of Khuzestan province were considered as the statistical population of the study. In both qualitative and quantitative phases, sampling was done judiciously and purposefully. In the qualitative phase, sampling continued until the theoretical saturation was achieved, and in the quantitative phase, a number of purposefully selected managers and senior customs consultants of Khuzestan province were selected and a questionnaire was distributed and collected among them. In this research, the decision tree algorithm was used to build a risk management model and analysis of customs data. The decision tree is one of the common techniques in the field of data mining. The most common task of the decision tree is classification. The main purpose of the decision tree is to divide the data backwards into subsets so that each subset contains a homogeneous state of the target variable. In each tree division, all input characteristics are evaluated recursively in order to influence predictable characteristics. When the recursive processing is complete, the decision tree is formed. In this research, we used Rapid miner version 9.1 software to use the decision tree algorithm and analyze customs data.

Analysis of research data and findings

To perform the data mining process and the decision tree, import customs procedure data is required. In this regard, the required data has been received from the comprehensive system of customs affairs for the dates of 23.10.2019 to 30.12.2019 and the customs of Abadan, Imam Khomeini port and Arvand-Khorramshahr free trade zone, which during this period and in these three ports, 1937 cases of imported goods were declared from these customs. The data received included: cottage number, tariff, references, tariff name, product name, net weight, foreign exchange value, Rial value of goods, dollar rate, dollar rate of goods, packaging method, gross weight, number of goods, number of packages, route, unit, customs value, owner of goods, coding of owner of goods, declarant, declarant coding, type of currency, exchange rate, warehouse receipt and electronic warehouse receipt, warehouse receipt date, mark of goods, brand, country of manufacture, country of transaction , item number, insurance, fare, license date, cottage date, customs assessment. In order to reduce the number of special traits and find the most effective features, PCA method has been used. The results of this method show the importance of each special trait in classifying the studied data. The table below shows the most important special traits in order.

Table 1. Value of special traits in classification

Importance	Special trait
0.16209661	insurance
0.16146009	Value (currency)
0.14651328	Package type
0.12713867	Rial value
0.11846722	exchange rate
0.10912303	Dollar value
0.04857569	Font number
0.03597322	Number of packages
0.03389974	Number of goods
0.03084736	Gross weight
0.02590509	net weight

It should be noted that other special traits had less than 0.01 effect on classification and were removed from the decision tree model process to reduce complexity. Finally, net weight (kg), value (currency), rial value, dollar value, packaging method, gross weight (kg), number of goods, number of packages, exchange rate, font number and insurance were selected as the most effective special traits. In the continuation of this section, using these special attributes, the data path will be divided into three categories: GREEN, RED and YELLOW.

In order to classify the data, out of 1924 data, 80% of the data were randomly selected for training and 20% for evaluation. The classification operation is performed using R software.

The CART (Classification and Regression Trees) algorithm is used for classification. The result of this algorithm is a binary decision tree. This means that each internal node has exactly two branches. It uses the Gini index criterion and also has a method for pruning a tree. One of the important features of CART is the ability to generate regression trees.

The following code shows how to calculate the Gini coefficient in R software:

```
gini_process <-function(classes,splitvar = NULL){

#Assumes Splitvar is a logical vector

if (is.null(splitvar)){

base_prob <-table(classes)/length(classes)

return(1-sum(base_prob**2))

}

base_prob <-table(splitvar)/length(splitvar)

crosstab <- table(classes,splitvar)

crossprob <- prop.table(crosstab,2)

No_Node_Gini <- 1-sum(crossprob[,1]**2)

Yes_Node_Gini <- 1-sum(crossprob[,2]**2)

return(sum(base_prob * c(No_Node_Gini,Yes_Node_Gini)))

}
```

The classification method generally consists of four steps:

- Selecting the target trait, calculating the Gini coefficient for each specific trait, selecting the best special trait (the special trait that has the largest Gini coefficient and contains the most important classification information), generating the current node and continue the process until the stop condition is reached (When all the data in the sheet is in a class).

Figure 2 shows a part of the generated decision tree.

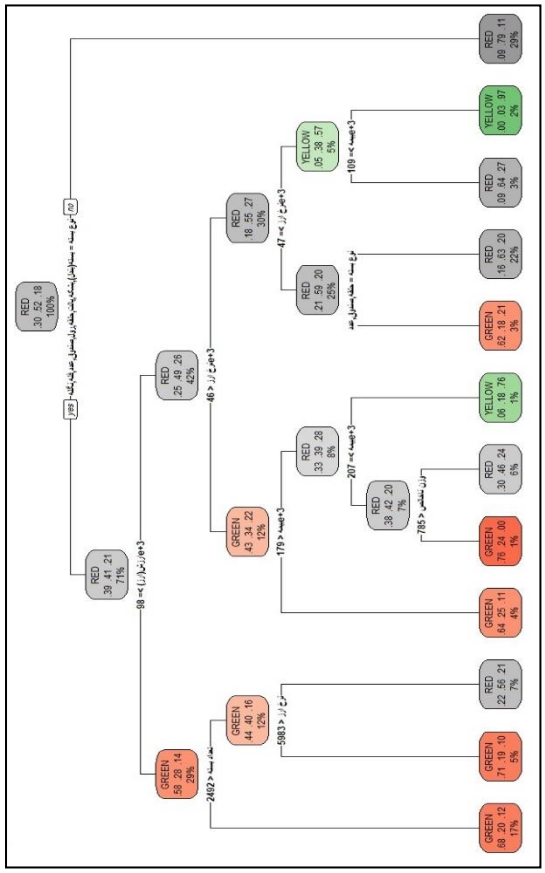

Figure 2. Part of the decision tree model

Evaluation: In order to evaluate the results of the decision tree classification algorithm, the path of data that were not used for training is determined using a model. A Confusion matrix was then formed to compare the reference data with the predicted data. Kappa index and Overall accuracy were also calculated to estimate accuracy. Then the sensitivity and diagnosis of the classification model were calculated and compared.

Overall accuracy and kappa index: Overall accuracy is the ratio of the number of correctly predicted data (the sum of the elements of the original diameter) to the total amount of data. The kappa index, which represents the degree of agreement of the forecast with reality, is calculated from Equation (8).

$$\hat{\kappa} = \frac{N \sum_{i=1}^{k} x_{ii} - \sum_{i=1}^{k} (x_{i+} \times x_{+i})}{N^{2} - \sum_{i=1}^{k} (x_{i+} \times x_{+i})}$$

Where N is the total number of data and $(x_{i+} \times x_{+i})$ means the product of the sum of the first row and the first column in the ambiguity matrix.

Table 2. Ambiguity matrix

DATA				ANTICIPATION
Yellow	Red	Green		
6	11	93	Green	
7	164	7	Red	
61	23	11	Yellow	

According to the table above, the overall accuracy and kappa index are calculated to be 0.83 and 0.73, which indicates the ability of the decision tree model to predict the route of customs goods.

Identification of risk factors in customs procedures (import, export, transit and temporary entry)

Transit procedure:

Other specific traits had less than 0.01 effect on classification and were removed from the decision tree model process to reduce complexity. Finally, currency value, guarantee amount, license weight, number of goods and type of transit were selected as the most effective special traits.

Export procedure:

Other specific traits had less than 0.01 effect on classification and were removed from the decision tree model process to reduce complexity. Finally, net weight (kg), value (currency), Rial value were selected as the most effective special traits.

Import procedure:

Other specific traits had less than 0.01 effect on classification and were removed from the decision tree model process to reduce complexity. Finally, net weight (kg), value (currency), Rial value, dollar value, packaging method, gross weight (kg), number of goods, number of packages, exchange rate, font number and insurance were selected as the most effective special traits.

Determining the importance, reproducibility and consequences of each of the risk factors identified in customs procedures

The importance of the risk factors identified in the transit procedure, in which the currency value is of the highest importance and the type of transit is of the lowest importance.

Importance	Special trait
0.35124	Currency value
0.31254	Guarantee amount
0.23365	Butterfly weight
0.05148	Number of goods
0.02357	Type of transit

The importance of the identified risk factors in the import procedure where insurance is of the highest importance and net weight is of the lowest importance.

Importance	Special trait
0.16209661	insurance
0.16146009	Value (currency)
0.14651328	Package type

0.12713867	Rial value
0.11846722	exchange rate
0.10912303	Dollar value
0.04857569	Font number
0.03597322	Number of packages
0.03389974	Number of goods
0.03084736	Gross weight
0.02590509	net weight

The importance of the identified risk factors in the net weight export procedure is of the highest importance and the currency loss is of the lowest importance.

Importance	Special trait
0.56254	net weight
0.23475	Rial value
0.19654	Currency value

Develop a model for risk assessment management and analysis of customs data main customs procedures

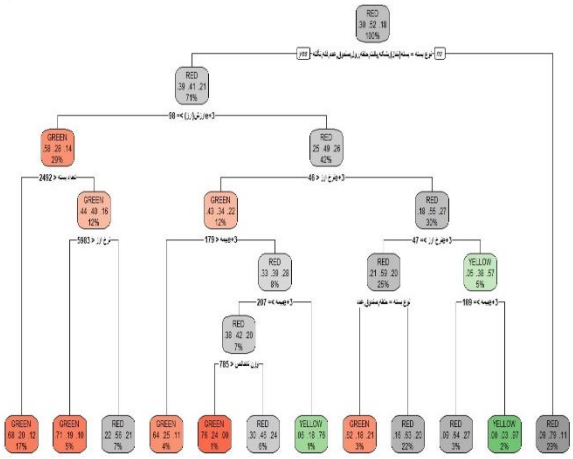

Figure 3. Import procedure model

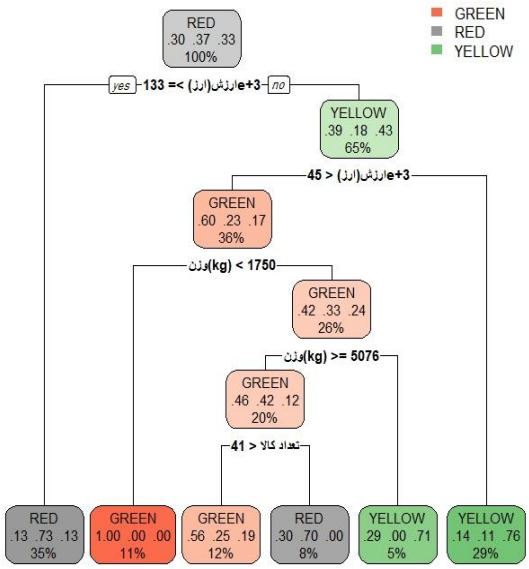

Figure 4. Transit procedure model

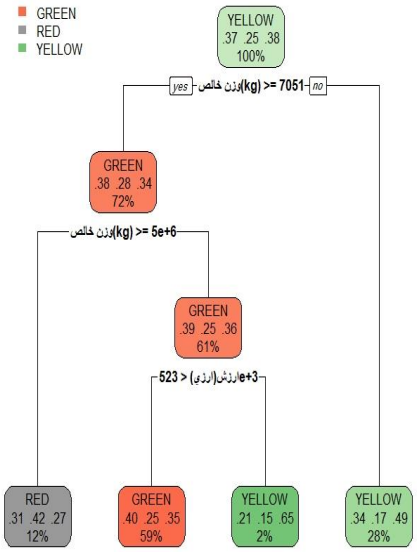

Figure 5. Export procedure model

Conclusion

However, in recent decades we have witnessed the creation and development of risk management systems in banks and other financial institutions, and most of these cases have been the general focus on financial issues and the focus of most past research in the field of risk and risk management on topics such as project investment, company finance, scientific research, engineering risk and similar topics have been discussed, but this research was conducted in order to design a risk assessment model in the customs of Khuzestan province. For this purpose, in the present study in the form of a data mining, in the first stage to identify risks from the decision tree and in the second stage to test and localize the developed system according to industry conditions, we used the survey method. It was developed using risk assessment management and customs data analysis, which includes four main procedures. In addition to designing the model, in this study, risk reduction factors in customs procedures were identified.

Finally, suggestions are provided to help customs activists to reduce risk in customs procedures:

- ✓ Expanding the steps of the risk management system of the country's customs administration
- ✓ Testing and explaining the risk management system in other important industries of the country
- ✓ Expanding information resources and management dashboards on the subject of risk assessment management.
- ✓ Systematization of risk management system for its practical application in the country's customs
- ✓ Define and approve a research plan designed to implement a risk management system
- ✓ Raising awareness of the need for risk assessment management through similar researches

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