A Risk Management Framework for Business Continuity in Agriculture

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Abstract. The article introduces a modern risk management framework, which can serve as a driver for an objective business continuity management, especially in agriculture where disaster recovery issues are of major importance due to the existence of multiple environmental hazards. The method is supported by a user-friendly interface developed by the authors in Visual Basic for Applications and the MS excel software. The impact-weight value of each factor is mathematically calculated while the probability of occurrence for each factor is determined based on a semi-quantitative one-to-five scale.

Keywords: business continuity, risk management, agriculture, visual basic for applications (VBA).

1 Introduction

Business continuity policy is nowadays a crucial issue for the enterprises of the private sector as well as the public organizations and institutions. However, in the agricultural sector "the preservation of processes is not dependent solely on information systems, but on the continuity of all processes that lead to the fulfillment of the global goal of agriculture" (Hájek and Urbancová, 2013). This goal involves the amelioration of outdated technical and technological infrastructure for eliminating the negative environmental impact (Fedyszak-Radziejowska, 2011).

On the other hand, risk assessment (RA) and business impact analysis (BIA) are crucial elements for understanding the organization (ISO 22301, 2012) in order to implement an integrated business continuity management strategy. "Risks are part of every business operation and can never be avoided completely. To minimize the danger of corporate crisis, a conscientious and responsible approach to the handling of risks and the resulting impact on business is essential. Unforeseen events pose an especially great challenge for companies and require quick decision-making and immediate reactions" (Breuer et al, 2015).

"Risk management in agriculture is now an essential tool for farmers to anticipate, avoid and react to shocks. An efficient risk management system for agriculture will preserve the standard of living of those who depend on farming, strengthen the via-

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bility of farm businesses, and provide an environment which supports investment in the farming sector (OECD, 2011).

The goal of the current paper is to describe a modern risk management framework for calculating possible time deviations from defined by business continuity or domain experts recovery timeframes for bringing back to their normal state interrupted critical business activities. The framework includes the application of the mathematical risk magnitude formula in order to predict time deviations (in absolute value) from the initially defined by experts recovery time. Moreover, the recovery process is influenced by unexpected factors which, if emerging, they can significantly delay the recovery procedure for a business function, information system or business process. The weights of these factors are mathematically calculated, while the probability of occurrence for each factor is semi-quantitatively determined. Finally the proposed contribution estimates a new recovery time by considering the aforementioned factors. The calculations are implemented via a VBA user friendly interface in MS Excel. Methods and Tools

1.1 Risk magnitude estimation

The current approach is based on a semi-quantitative method for probability determination regarding the occurrence of factors which can cause a prolonged information system/business function interruption. The illustrated idea, is based on the assumption when no past data is available of similar crisis situation in order to determine the probability with pure quantitative mathematical tools. In such cases, semi-quantitative scales can be defined. According to (FAO, 2009), a semi-quantitative risk assessment "does not require the same mathematical skills as quantitative risk assessment, nor does it require the same amount of data, which means it can be applied to risks and strategies where precise data are missing". Our currently presented model uses a one-to-five (1-5) scale for defining the probability of an unexpected factor's presence. The Risk Magnitude (RM) is estimated according to the following formula:

$$\text{RM} = \text{Impact} * \text{Probability} \tag{1}$$

In the proposed framework, the Risk Magnitude for a number N of specific factors is estimated according to the following equation (Eq. 2):

$$RM = \sum_{i=1}^{N} W_i P_i \tag{2}$$

The model's representation is based on the following steps (Fig. 1). The RTE value is initially determined based on business function recovery tests when unexpected situations are not considered (ideal conditions).

Fig. 1. Risk Management Framework Represented with a UML Activity diagram (Source: Authors)

1.2 Weight Assignment of Factors with the Rank Order Centroid (ROC) Method

Part of the proposed risk management framework is the decision making process regarding the impact of the factor which can delay the business function recovery process. Due to the fact that our model is based on the concept of a non-arbitrary weight assignment, the selected technique for assigning weights is the Rank Order Centroid method. In the proposed framework, the weights of the factors are quantitatively estimated according to the Rank Order Centroid Method (ROC) (Barron and Barett, 1996) as follows:

$$
\begin{aligned}
W_i &= \frac{1}{m}\sum_{i=1}^{m}\frac{1}{n}, and \\
\sum_{i=1}^{m} W_i &= 1
\end{aligned}
\tag{3}
$$

1.3 Visual Basic for Applications (VBA Excel) – Applied Cases in Agriculture, Food and Environment

The Visual Basic for Applications is utilized in Microsoft Office Tools, such as Microsoft Excel in order to ameliorate and strengthen its future developing functions. It was developed based on the very popular programming language Visual Basic and took after its language structure (Wang and Hu, 2012). Multiple software based activities in agriculture, food and environment have been developed in VBA and MS Excel (Li et al, 2007, Ma et al, 2003).

2 Results

2.1 The proposed RM Framework

The weight assignment formula (Eq. 3) prohibits the arbitrary weight assignment of the presence for a given factor during the BF Recovery process. According to the proposed method, if RTE is the time required to recover a business function in ideal conditions, a non-ideal recovery case should estimate the recovery time as follows:

$$RTE1 = RTE + \left| RTE \frac{RM}{100} \right|, \qquad \text{and}$$

$$TimeDeviation = RTE \frac{RM}{100}$$

where RTE1 is the new Recovery Time. A practical example is illustrated for the better interpretation of the approach. **Example:** If RTE= 2Hours, Number of Factors (N) = 4, W_{F1}= 0.521, W_{F2}= 0.271, W_{F3}= 0.146, W_{F4}= 0.062 and we assume that semi-quantitatively defined probabilities of occurrence for each factor are $P_{F1=}$ 2, $P_{F2=}$ 5, $P_{F3=}$ 2, $P_{F4=}$ 4 then:

$$RTE1 = 2 \pm 2\frac{RM}{100} = 2 \pm 0.42 = 2.42 Hours(MAO) \qquad \text{or}$$
$$1.58 Hours(RTO)$$

It should be noticed that the RM values are normalized by multiplying the weight values of each factor with 10 for obtaining more rational results (w1+w2+w3+w4=10). The business process aspect of the proposed framework is demonstrated via an ORD Diagram which is part of the Business Object Relation Model (BORM) (Fig.2), which is used for modeling agricultural and environmental processes (Nedvedova, 2015).

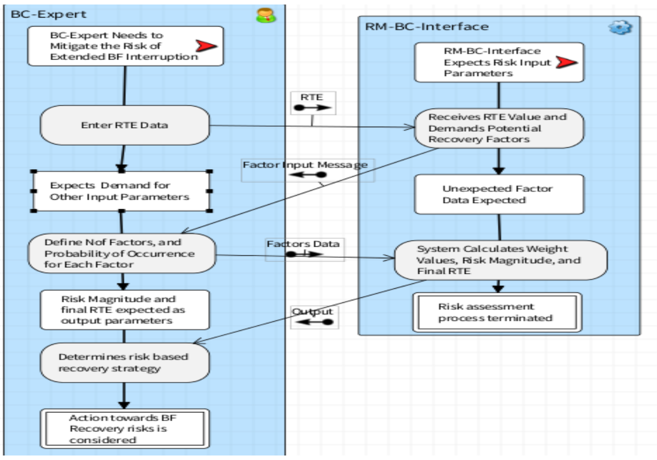

Fig. 2. ORD (Object Relation Diagram) of the Proposed Risk Management Framework

Moreover, the above delineated risk management framework, is also supported by a VBA Excel tool which is developed by the authors and implements all the above stated calculations (Fig. 3).

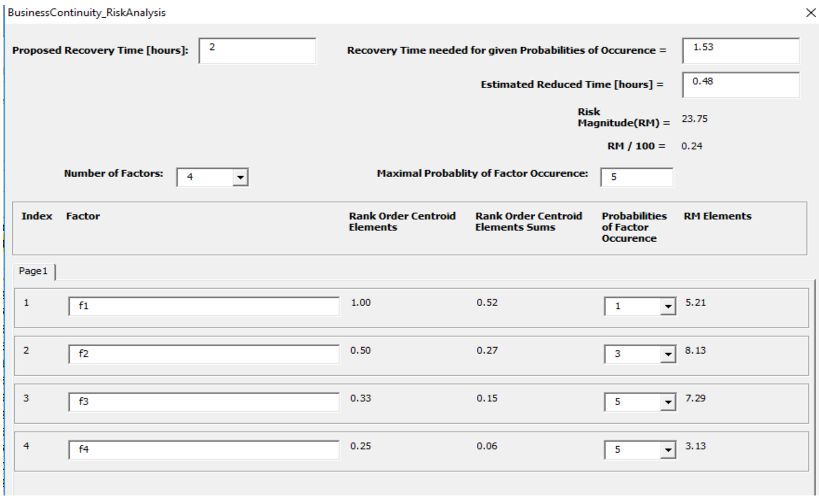

Fig. 3. The RM-BC-V1.0 Main User Form in VBA for Business Continuity Risk Management

The initial form is loaded by the user in order to estimate the time deviation from the estimated in ideal recovery testing conditions by the business continuity experts. The user is prompted to store the input parameters, which are:

-Proposed RTE Value or Proposed Recovery Time

-Number of Factors, which are unexpected factors which could trigger the extended recovery time for a given business function,

-Probability of occurrence for each factor based on the semi-quantitative risk assessment 1-5 scale. The output values are the risk magnitude RM, the ratio RM/100, new RTE1 when hard recovery scenarios are considered, the Time Deviation from the initially expected recovery time and the weights for all the potential factors based on the Rank Order Centroid approach.

3 Discussion

Even if the proposed risk assessment framework is simple to use, specific issues should be further discussed and clarified. The first issue is the so called semi-quantitative probability of occurrence of each unexpected situation (factor). Simple risk management models avoid complex mathematical quantification methods of a given probability. Moreover, quantification is not suggested when past data for similar disasters is not available to experts who implement risk analysis for a more detailed business continuity management.

Another point, which requires further explanation, is the absolute value determined by for the Time Deviation from the initially defined RTE value. The model follows the principle that a reasonable recovery time (RTO) can be based on the negative time deviation, and, respectively, a maximum accepted timeframe (MTD) (Harris, 2010) that can justify the unavailability of a BF is determined via a positive Time Deviation.

4 Conclusion – Future work

The current paper illustrated a risk management framework, which supports an efficient business continuity strategy in organizations. The framework can be successfully implemented within the agricultural domain where automation is highly demanded for precision agriculture, irrigation techniques, gas emissions control and multiple other critical business activities. The framework is supported by a developed by the authors VBA excel standalone software environment. Its adjustment to other agricultural IT systems is currently considered as a future step but has not yet been achieved. Additional future implementation involves the proposed, by the developed framework/VBA Tool, corrective recovery actions and risk mitigation policies for an integrated business continuity strategy.

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