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Business intelligence in risk management: Some recent progresses

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ABSTRACT

Risk management has become a vital topic both in academia and practice during the past several decades. Most business intelligence tools have been used to enhance risk management, and the risk management tools have benefited from business intelligence approaches. This introductory article provides a review of the state-of-the-art research in business intelligence in risk management, and of the work that has been accepted for publication in this issue.

1. Introduction

We are very pleased to see the completion of this special issue on Information Sciences: Business Intelligence in Risk Management. Risks exist in every aspect of our lives, and can mean different things to different people, while negatively they always in general cause a great deal of potential damage and inconvenience for the stakeholders. For example, recent disaster risks include terrorist leading to the gassing of the Japanese subway system, to 9/11/2001, and to the bombings of the Spanish and British transportation systems, as well as the SARS virus disrupting public and business activities, particularly in Asia. More recently, the H1N1 virus has sharpened awareness of the response system world-wide, and the global financial crisis has resulted in recession in all aspects of the economy [59].

Risk management has become a vital topic in both academia and practice during the past several decades. Integrated approaches are required to manage the risks facing an organization, and sometimes effective risk-taking strategies may involve new business philosophies such as enterprise risk management. Most business intelligence tools have been used for enhancing risk management, and the risk management tools benefit from business intelligence approaches. For example, artificial intelligence models such as neural networks and support vector machines have been widely used for establishing the early-warning system for monitoring a company's financial status [38,2,36]. Agent-based theories are employed in supply chain risk management [27,34]. Business intelligence models are also useful in hedging financial risks by incorporating market risks, credit risks, and operational risks [59]. The investigation of business intelligence tools in risk management is beneficial to both practitioners and academic researchers.

In this issue, we present papers addressing recent advances in using business intelligence for enterprise risk management.

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2. Risks and risk management

All human endeavors involve uncertainty and risk. In the food production area, science has made great strides in genetic management. But there are concerns about some of the manipulations involved, with different views prevailing across the globe. In the United States, genetic management is generally viewed as a way to obtain better and more productive sources of food in a more reliable manner. Nonetheless, there are strong objections to bioengineered food in Europe and Asia. Some natural diseases, such as mad cow disease, have appeared, and these diseases are very difficult to control. The degree of control accomplished is sometimes disputed. Europe has strong controls on bioengineering, but even then there has been a pig breeding scandal involving hazardous feed stock and prohibited medications [57]. Bioengineering risks are important considerations in the food chain [50,14]. Genetic mapping offers tremendous breakthroughs in the world of science, but involves political risks when applied to human resources management [37]. Even applying information technology to better manage healthcare delivery risks involves risks [54]. Reliance on computer control has been applied to flying aircraft, but has not always worked [13].

Risks can be viewed as threats, but business exists to cope with risks [45]. Different disciplines have different ways of classifying risks. In order to explain the risk management lessons from the credit crisis, Jorion [26] classified risks into: known knowns, known unknowns and unknown unknowns. This is actually based on the degree of risk and is similar to what Olson and Wu [45] discussed (see page 6 of Chapter 1).

We propose the following general classification of risks: Field-based and Property-based.

- *Field-based type*
  Financial risks, which basically include all sorts of risks related to financial sectors and financial aspects in other sectors. These comprise, but are not restricted to, market risk, credit risk, operational risk, operational risk, and liquidity risk. Non-financial risks, which include risks from sources that are not related to finance. These include, but are not restricted to, political risks, reputational risks, bioengineering risks, and disaster risks.
- *Property-based type*
  Risks can have four properties: uncertainty, dynamics, interconnection and dependence, and complexity. The first two properties have been widely recognized in inter-temporal models from the behavioral decision and behavioral economics areas [3]; the last two properties are well studied in finance disciplines.
  Risk probability applies probability theory and various distributions to model risks. This approach can be dated back to the 1700s, leading to Bernoulli, Poisson, and Gaussian models of events as well as general Pareto distributions and general extreme value distributions to model extreme events. The dynamics of risks mainly involves the use of stochastic process theory in risk management. This can be dated back to the 1930s where Markov processes, Brownian motions and Levy processes were developed. The interconnection and dependence of risks deals with correlation among risk factors. Various copula functions are built and Fourier transformations are also used. Risk complexity needs to be handled further through the use of various models based on complexity science, such as agent-based modeling approaches.

Risk management can be defined as the process of identification, analysis and either the acceptance or mitigation of uncertainty in investment decision making. Risk management is about managing uncertainty related to a threat. Traditional risk management focuses on risks stemming from physical or legal causes such as natural disasters or fires, accidents, death and lawsuits. Financial risk management deals with risks that can be managed using traded financial instruments. The most recent concept, enterprise risk management, provides a tool to enhance the value of systems, both commercial and communal, from a systematic point of view. Operations research (OR) is always useful for optimizing risk management.

Various areas that relate to **business intelligence in risk management** can be identified in the literature.

3. Different perspectives and tools

The last several decades have also witnessed tremendous progress in computational intelligence including fuzzy logic, neural networks and genetic algorithms, evolutionary computation and optimization approaches such as linear programming, nonlinear programming, game theory, and multicriteria decision analysis. Optimization approaches have been widely applied in industry in many areas of forecasting, performance evaluation, automatic control, and function approximation. This section presents a survey on key areas, along with its associated techniques.

3.1. Early-warning systems

Many papers have addressed the value of early-warning systems as a means to control risk. Krstevska [30] cited their use in macroeconomic models, with specifics to the economy of Macedonia. A number of models have been implemented