Improving Financial Stability: Business Intelligence's Function in Risk Reduction

Bader Amor Ali Alhinai, Ahmad Irdha Mokhtar and Muhammad Faisal Ashaari

Institut Islam Hadhari, Universiti Kebangsaan Malaysia (UKM), Malaysia
Emails: P116445@siswa.ukm.edu.my, irdha@ukm.edu.my, faisal@ukm.edu.my

Abstract
In the realm of business, founders and investors prioritize financial stability, and Business Intelligence (BI) emerges as a crucial tool for significantly enhancing this stability. This study investigates the application of BI in reducing risks and promoting financial stability within the context of modern technology. BI provides precise analytics and strategic information, facilitating informed decision-making and enabling organizations to navigate dynamic financial challenges while anticipating future trends. The research findings underscore the pivotal role of BI in mitigating financial risks and enhancing overall performance. The study employs a descriptive analytical methodology to explore the synergy between financial stability, risk reduction, and BI. Results indicate that leveraging BI substantially elevates decision-making quality through advanced data analysis and a comprehensive understanding of the business landscape. Additionally, BI contributes to heightened operational efficiency and optimized resource allocation. The study underscores the importance of proactive analysis in anticipating financial risks and implementing preventive measures for sustained business viability. Recommendations based on the findings include integrating new technologies with existing systems, enhancing employee training, crafting tailored strategies based on BI analytics, prioritizing information security, and considering cloud computing for cost-effective infrastructure solutions. Key conclusions emphasize the transformative impact of BI, highlighting its role in improving decision-making and bolstering process efficiency by optimizing resource routing and productivity. This study contributes valuable insights for businesses aiming to harness the full potential of BI to navigate financial challenges and foster sustained growth.
Keywords: Business Intelligence, Financial Stability, Risk Reduction, Decision-Making; Strategic Information

Introduction
Based on "scientific management," the field of operations management (OM) is known for its fact-based decision-making. Business intelligence (BI) systems offer businesses a great chance

to increase profitability and lower risk, and businesses use BI systems in their day-to-day operations to analyze internal operational data like productivity and process efficiency as well as external economic and market trends.

Business intelligence system proponents contend that these systems can greatly enhance an organization's capacity for making well-informed decisions, which in turn can enhance its intellectual and risk management capabilities (Popovič et al., 2012; Shollo and Galliers 2016). According to recent research, U.S. companies continue to heavily invest in business intelligence systems Arnott et al (2017), and organizations with BI systems have better performance outcomes and operational capabilities due to better resource alignment.

Risk management is a useful tool for addressing uncertainties about the likelihood of difficult decision-making events. A number of risk management-related factors, such as business intelligence (BI), have the potential to be used to reduce these uncertainties. Decision-making challenges appear to be growing as globalization increases, and organizations and researchers are able to gather more data thanks to user-friendly technologies for data preservation and widespread Internet access (Zhu et al., 2019).

The majority of this data have different origins, contents, and presentations, and they pertain to a variety of environments, including business and financial conditions. As a result, there aren't enough results in the current literature about how this data is modeled and how it helps the company make strategic decisions. based on the factors in the chosen dataset as well.

Businesses have long lamented the lack of access to pertinent data and the flow of information, even though business intelligence has traditionally been viewed as the top priority for investment (Howson, 2013).

Thus, through various BI algorithms that can also lead to financial risk control (Ghosh et al., 2018; Chen, 2017), relevant data from corporate data servers can be analyzed in favor of cost reduction (e.g., time and resources). By implementing risk management processes, many organizations aim to maximize the impact of risk management activities and build value for stakeholders. It can use neuromarketing technology to study artificial intelligence, which is the multidisciplinary field includes psychology, marketing, and neuroscience (Ahmed et al., 2021, 2021a, 2022, 2023; Alsharif et al., 2022, 2021).

The need for using business intelligence arises from the fact that financial institutions, including insurance companies, possess analyzable data that can be used to alter knowledge-based risk management. In this study, our goal was to determine how to apply business intelligence techniques in the risk management process using actual data, in addition to conducting a survey case study and offering an actionable framework.

One of the biggest issues that institutions face in the unstable and changing business environment is managing financial risks. Executive leaders and managers of institutions have a harder time comprehending and effectively managing these risks because changes in the financial markets and the economy can have an impact on the stability of the institution and its financial performance. Managing these risks calls for an accurate understanding of financial data and information, and business intelligence plays a crucial role in thoroughly analyzing this data to support financial decision-making processes.

In addition to focusing on how to apply business intelligence techniques to analyze financial statements effectively and how this analysis can provide strategic insights that enable organizations to deal with financial risks more effectively, this study aims to examine and analyze the role of business intelligence in enhancing financial stability through the examination and assessment of financial risks. The study also seeks to identify how the

application of business intelligence solutions can improve the ability of institutions to make sustainable and logical financial decisions in the face of growing financial challenges.

Literature Review
The Concept of Business Intelligence
There are two syllables in the term "business intelligence": intelligence (Intelligence) and business (Business). In Webster's New Collegiate Dictionary (1981: 600), intelligence is defined as the capacity to apply knowledge in a clever manner through the adoption of rationality; in other words, intelligence is the capacity to learn and apply knowledge (Awad * Ghaziri, 2004, 33); this is what is known as experienced intelligence, on which management can act (Murphy, 2005, 100).

Regarding the business aspect, it denotes the endeavor to generate revenue by preparing goods and services for others (Nickels et al., 2002; Shaheen, 2007). However, the definition, purpose, and applications of business intelligence have been subject to differing interpretations by scholars, specialized institutes, and software firms.

Business intelligence was first defined as "the ability to obtain ways and methods that direct work towards the planned goal" by researcher Hans Peter Luhn in a 1958 research submission for the IBM computer and software industry. He further explained that business intelligence as it is known today is an evolution of DSS decision support systems, which first appeared at the beginning of 1960 and developed and flourished in the mid-1980s of the same century. Initially, the decision support was a set of models based on algorithms written in computer programming languages that helped plan and support the decision-making process.

Data warehouses, executive information systems, and real-time analytical processing (OLAP) sprang from the rapid development of information technology. In the late 1980s, efforts were made to combine these earlier systems into what is now known as the business intelligence system. In 1989, researcher Howard Dresner defined business intelligence as a comprehensive term that describes the concepts and methods used in the field of business to improve the decision-making process by ultimately relying on decision support systems.

 (Elean & Maiorescu, 2009,3) notes that by the end of 1990, the term had gained widespread usage. This is likely due to the significance of business intelligence in the contemporary organizational environment, which is marked by rapid change and complexity, as well as the role that researchers hope to play in resolving many of the issues that face modern organizations.

The main trends of the concept of business intelligence
Following a comprehensive analysis of the literature on the subject of business intelligence, it was discovered that there are many distinct viewpoints and trends, with some researchers concentrating on:

AI Applications Viewpoint: In order to improve data analysis, predictive modeling, and decision-making processes, this viewpoint stresses the integration of artificial intelligence (AI) technologies into the field of business intelligence. Additionally, artificial intelligence applications are included in business intelligence machine learning, natural language processing, and data mining.

Technical viewpoint on the concept: This viewpoint concentrates on the architecture and infrastructure of business intelligence systems, such as databases, data warehouses, and reporting tools. Business intelligence is viewed from a technical perspective as a collection of instruments, methods, and procedures intended to gather, store, and analyze business data.

Decision Support Perspective

This viewpoint emphasizes how business intelligence, as a decision support system, helps decision-makers by giving them timely and relevant information. It also shows how AI can be used to improve decision-making processes, allowing organizations to make strategic and well-informed decisions based on the data that has been analyzed.

Organizational function perspective: This viewpoint stresses the strategic value of business intelligence in assisting organizations in achieving their objectives, tracking performance, and gaining a competitive edge by promoting a data-driven culture across the entire organization. It sees business intelligence as an integrated organizational function rather than just a collection of tools.

Implementation Perspective: This perspective tackles the issues and best practices related to the actual implementation of business intelligence initiatives. It focuses on the practical aspects of implementing BI solutions within the organization, including planning, developing, deploying, and maintaining business intelligence systems.

Knowledge management perspective: This viewpoint highlights the significance of converting unprocessed data into actionable insights, encouraging a culture of learning, and facilitating knowledge sharing within an organization. Business intelligence is viewed from this perspective as a means of capturing, organizing, and utilizing the knowledge embedded in an organization's data.

The integration of these perspectives enables organizations to fully utilize business intelligence for strategic decision-making and performance enhancement. Table (1) delineates the goals and visions that researchers have for the concept of business intelligence. Each of these perspectives adds to the overall understanding of business intelligence and presents its multifaceted nature and diverse applications in the business landscape.

Table 1

Researchers' visions and intentions for the concept of business intelligence.

#	The researcher	Definition of Business Intelligence	Directions for researchers
1	Fitriana, et. al, (2011)	In order to gain knowledge and support decision-making, big data is extracted, analyzed, transferred, and managed using mathematical models.	Pay attention to the most crucial steps involved in gathering data and obtaining knowledge.
2	Jiangping, et. al., (2011)	It is the comprehensive architecture that supports decision-making processes by incorporating the data warehouse together with systems for acquiring and processing data through analytics procedures.	Pay attention to the process of making decisions by examining the analyses conducted in the data warehouse.
3	Lloyd, (2011)	The management strategy is what enables the company to find data that is pertinent and helpful for making decisions.	Emphasize the process of making decisions.

4	Kronos & Yeoh (2010)	A comprehensive collection of instruments, methods, and applications for gathering, examining, and extrapolating meaningful information from data	Emphasis on IT resources
5	Matei (2010)	It is a collection of techniques and instruments that assist managers in maintaining competitiveness, enhancing organizational performance, and managing business operations.	Concentrate on the technical element
6	Nelson (2010)	It is a collection of tools and application programs for gathering, storing, and analyzing data as well as giving users access to that data so they can make decisions.	Concentrate on important data processes
7	Sacu & spruit (2010)	all methods for analyzing, storing, and retrieving data and knowledge to support decision-makers in their decision-making.	Highlight how crucial knowledge and facts are while making judgments.
8	Castellanos, et al., (2009)	Large-scale data collection, analysis, and presentation techniques, as well as related technology, are used to enhance decision-making.	Concentrate on the technical standpoint and the perspective of decision support through information availability.
9	Dayal, et. al, (2009)	A collection of tools for reporting, data mining, analytics, data warehouses, and data demonstration.	Pay close attention to the technical side when discussing strategic support.
10	Mocanu, et. al., (2009)	It is a collection of ideas, procedures, and techniques that seek to enhance both the organization's strategy and the decision-making process.	Put the decision support perspective up and center.
11	Watson (2009)	A set of technology and application programs that gather, store, analyze, and access data to assist business owners in making better decisions.	Concentrate on important data processes

The researcher elaborates on the meaning of business intelligence, which she defines as the application of technology to gather data from various sources, transform it into a format that aids in statistical analysis of data, and extract and derive accurate information to provide knowledge presentations in various formats (reports, graphs, descriptive… and others), and employing clever presentation techniques to speed up and accurately review knowledge in order to give managers, thinkers, employees, and others intelligent knowledge value that enables them to increase the value of their decisions.

The Importance of Business Intelligence

The state of business conditions is constantly changing due to factors like shifting sales patterns, shifting supplier characteristics such as delivery schedules and prices, and evolving and constantly changing customer requests. Business managers must adapt to these developments in one way or another by satisfying customer demands and staying up to date with advancements to sustain profit growth. The availability of a central information system has made it possible for organizations to understand change and pinpoint the factors driving it through data analysis, customer surveys, financial indicators, and other pertinent dimensions. The value of business intelligence is demonstrated by the advantages and benefits it offers to these organizations, some of which cannot be fully listed here. (Jain, 2006)

1. Reports: The most widely used and least complicated forms in the business and intelligence systems are reports. They come in a variety of formats (tables, specific numbers, pictures, etc.) and types (daily, periodic,… The generation of reports is made easier by the multitude of business intelligence technologies available.
2. OLAP: An acronym for Online Analytical Processing, this function allows you to employ multidimensional analytics to find answers to problems.
3. Data mining: This feature is very significant and has many advantages, but it is expensive. It is the process of obtaining data from the data warehouse using extremely sophisticated statistical methods.
4. Exception reports: These are a specific kind of report that are filed in certain situations, such reports on signs of deterioration for a particular area over the previous week.
5. Graphic interfaces: These are a collection of instruments and monitors that offer a detailed area via visual schematics.
6. Alert (warning): This capability is supported by business intelligence solutions, which notify the user via email or SMS when specific indicators go over or below a predetermined value, among other means of communication.

The business intelligence system's primary benefits have been highlighted in the preceding areas. The following points encapsulate the advantages that business intelligence offers to the company: (Hindriks, 2007)

- Business intelligence combines information from both internal and external sources to generate insights that enhance departmental coordination of cooperative efforts to promptly adjust to shifts in markets, customer preferences, supply chain operations, etc.
- Business intelligence enables decision-makers to make the best decisions quickly with the least amount of guesswork and risk by providing critical information in a timely manner.
- By using forecasting and analytics methodologies, business intelligence enables organizations to be proactive and attacking rather than defensive and mimicking.

- Identifies and promptly satisfies changing needs from customers to increase customer satisfaction.
- The organization is able to strike a balance between its strategy, mission, goals, and tasks thanks to the application of business intelligence.

The researcher concurs with the idea (Jain, 2006, 17) that business intelligence should be used to drive management and business, respectively, based on ICT infrastructure, as seen in Figure (1).

Figure 1: The importance of business intelligence.

Financial Stability

Defining the concept of financial stability has become an increasingly important goal, because everyone who tries to define financial stability realizes that there is no widely accepted analytical model or framework for assessing or measuring financial stability, but the attempts of experts differ in giving a definition and concept of financial stability, including:

The general and less specific concept of financial stability is according to Mishkin, F's definition: It is achieved if the financial system is able to provide an efficient distribution of savings and investment opportunities, relies on a solid base and is free from large imbalances (Mishkin, 1997).

Das U. Quintyn M. Chenardk also thinks that because financial stability analysis is based on standard indicators and financial soundness—which is defined as the capacity to withstand shocks, absorb crises, and bounce back quickly from them—it conforms to some extent to the analysis of recognized macrofinancial soundness (Das et al., 2004). Financial soundness is also a crucial component of the overall concept of financial stability.

If the financial system possesses the following qualities, it is stable:

- Promote the efficacy of other financial and economic activities (such as lending and borrowing, asset pricing, savings and investment, liquidity creation and distribution, and wealth accumulation and production development) as well as the efficient allocation of economic resources.
- Examine, value, recognize, and control monetary hazards.
- The capacity to carry out these fundamental tasks even in the face of shocks from the outside world or when imbalances build up as a result of self-correcting mechanisms.

In other words, the financial system is stable when it can distribute financial imbalances that occur from unfavorable and unanticipated events or from regular development and help the economy function rather than impeding it.

By the aforementioned, and regardless of the definition used, financial stability is associated with the financial system, its elements, and associated activities. The financial markets and commercial banks are given particular attention and significance in this regard, and central banks are among the most significant institutions in charge of achieving this through the monetary and financial policies they take on.

The Significance of Financial Stability

1. 'Global Risks 2008', a report released earlier this year by the World Economic Forum in January, 2008, stated that unstable financial systems—particularly the mortgage crisis that grew worse in America in the middle and end of last year—represent a significant threat to the stability of the global economy. As such, the report advocated for more financial market intervention to lower risks and enhance the governance of the global financial system through the Network of risk management officials. It may become more difficult for governments and businesses to address less urgent risks like climate change in the future due to their greater attention on volatile financial markets and the escalating political tensions of 2008 (Siddiqui, 2016).

2. The state of finance has an impact on economic expansion. In its evaluations published in April of this year, the International Monetary Fund revised its forecasts for economic growth for this year and the following year in light of the effects of the mortgage crisis that originated in America and expanded to other countries. According to the Fund, due to the ongoing mortgage crisis and its effects, the global economy is expected to grow at a rate of (7.3%) in 2009, down from 9.4% estimates in 2007. The Fund also stated that the longer and more severe financial crises persist, the lower the rates of economic growth. These projections are the most optimistic as other projections suggest that the global economy may expand this year and the following year at rates of between 5% and 3%. (Boudiard, 2023).

3. Both locally and globally, financial instability is becoming more and more prevalent. In industrialized nations, financial tremors are increasingly affecting banking and non-bank credit channels (Nofal, 2018), and there is growing evidence that the subprime mortgage crisis is causing a global credit bottleneck that is not yet fully developed. The impact of the tightening bank lending standards in the US and Western Europe, the decrease in the issuance of structured securities, and the widening of yield differentials on corporate debt securities are all noteworthy. The US is most affected, as it is contributing to the intensification of the ongoing housing market correction, and the banks in Western Europe are the ones most directly exposed to the risks associated with low-quality US securities, volatility in the interbank and stock markets, and the recent financial market tensions. The foreign exchange markets were impacted by the latter as well. The drop in foreign investments in US bonds and equities, which was brought on by a lack of trust in the liquidity and return of these assets, as well as the country's weak growth prospects and growing expectations of interest rate cuts, has contributed to the real effective exchange rate of the US dollar from its peak in 2006 by around 5.1% of GDP. Nevertheless, a study conducted by the International Monetary Fund revealed that since the 1980s, 130 of the Fund's 180-member nations have experienced financial instability linked to financial markets. This

situation worsened following the crisis that struck Southeast Asian nations in the late 1990s. After the release of this year's periodic report on financial stability, the International Monetary Fund (IMF) made comments regarding the US mortgage crisis. It stated that the events of the previous six months (October 2007 to April 2008) showed the vulnerability of the global financial system and raised important concerns about the efficacy of the responses given by institutions in the public and private sectors (Tami, 2022).

4. All of these financial crises—the Asian or Japanese bank crises at the end of the 1980s and the beginning of the 1990s, the financial crisis that struck Turkey in 2001 and 2002, which resulted in the failure of Ikhlas House for Islamic Finance and ten (10) conventional banks, eight of which were state-owned, and a total loss estimated at five to thirty percent of the GDP—as well as the mortgage crisis, the effects of which the global economy is currently feeling and which could cost up to $1 trillion ($1000 billion). According to Kindleberger, a financial crisis analyst and historian, there are only a few examples over a long period of time where the sequence of events did not last longer than ten years. Other experts, like renowned American economist Hyman Minsky, concluded that we are attempting to stabilize a system that is fundamentally unstable, fragile, and prone to financial crises.

Due to the mentioned and other effects of financial turmoil, achieving financial stability has emerged as a top priority for the work and meetings of concerned individuals and institutions on a global scale. As a result, it is rare to have a significant meeting of the leaders of the eight countries or other countries without including a discussion of the subject and an appeal for the necessity of concerted efforts to stop the bleeding caused by these turmoils. Almost every central bank has a dedicated unit that works on financial stability through the release of research, reports, alerts, cautions, and initiatives that are easily mentioned in passing (Nofal, 2018):

- The Basel Committee and the Bank for International Settlements established the Financial Stability Institute in 1999 in response to the crisis in Southeast Asia with the goal of assisting financial regulatory organizations throughout the world in fortifying their financial systems.

- The formation of a special forum on financial stability in April 1999 by twenty-six national and international financial authorities from developed nations with the aim of promoting financial stability globally by means of information sharing and collaboration in the areas of oversight and management by the relevant authorities.

- The creation of a map by the International Monetary Fund (IMF) to help anticipate crises before they happen; additionally, the Fund now releases a biannual report to track financial pressures and try to contain or limit their spread. (Boudiard, 2023).

These and other attempts show the breadth of the costs and suffering that nations' economies and institutions bear when these crises recur and no practical solution is reached that addresses the root causes of these unrest and crises.

The role of Business Intelligence in Reducing Risk
   1. Systems of early warning

Many studies have examined the value of early warning systems (EWS) in risk management by putting the systems to the test in real-world scenarios. (Krstevska, 2012), for example, used macroeconomic models that included characteristics of the Macedonian economy in her research to demonstrate the effectiveness of EWSs as a useful tool for business intelligence

tools to predict financial crisis risks. Flores (2009) also examined the topic of early warning in insurance by using random optimization to find an investment policy for managing the fund from the viewpoint of a risk-averse government. Early warning was also discussed for the transfer of financial and macroeconomic supervision mechanisms so that RMUs could be taken into account in BI policies to develop existing monitoring tools to improve crisis detection and prevention, and in particular they explained that the RMU could be useful as a tool for macroeconomic consultation Castell (2009), some studies discussed its method in industrial applications and described a method for identifying logistics risks for SMEs (Xie et al., 2009),

A hybrid methodology known as the Mysterious Knowledge Map (FCM) is based on fuzzy logic and neural networks, both of which are included in business intelligence query engines. In order to notify sponsors, users, project managers, and software developers of numerous potential risks as soon as possible, Liu et al (2006) developed an intelligent early warning system using fuzzy logic based on an integrated set of software metrics from multiple perspectives. This system has the potential to significantly improve software development and maintenance. In order to create a hybrid intelligent early warning system for predicting economic crises, Han and Deng (2018) combined artificial neural networks, fuzzy optimization, and time-series econometric models into a single, cohesive framework. Wang et al (2018) proposed a financial crisis early warning monitoring algorithm based on the FCM and assessed the algorithm's effectiveness using pertinent data from Chinese listed companies. Empirical results demonstrated that this technology is efficient, timely, cost-effective, and practically reflect the state of the data crisis. monetary.

2. Making decisions based on risks

Since 1970, researchers have examined how to use computational intelligence to support risk-based decision-making in information systems (Keen 1978; Sprague 1982). Some studies have also used business intelligence to introduce another use for loan risk analysis in financial modeling for the pulp and paper industry (Warenski 2012). The value and risk assessment of IT investments has been the focus of some research (Otim et al. 2012). Through the prism of a potential option and the company's resource-based view, these researchers have discovered that the timing of IT investments affects organizational risk on the downside because these investments involve a complex chain of stakeholders and call for compliance with regulatory policies.

Some researchers have introduced risk assessment technology with multiple criteria for risk analysis in the field of safety by integrating acceptable features of the common failure situation and its effects, and the importance analysis technique in business intelligence tools taking into account economic variables in terms of risk and minimization, as well as the total safety costs by defining a specific indicator called the total risk priority number (WU et al. 2014). Some have studied the role of political pluralism in the expansion of commercial banks, particularly from the perspective of risk management in India (Olson 1996). Additionally, the industrial decision-making process involves multiple stakeholders and multiple criteria. (Lakemond et al., 2013) discussed a model for taking risks into account when developing new products. This model can perform preliminary analyses of risks and other difficulties. Additionally, some neural network applications are used to evaluate reliability in order to lower the risk of project failure. A further application demonstrated the usefulness of artificial neural network models in public-private partnership projects. The use of artificial neural networks to analyze credit card applications was one application in the banking sector that

helped banks effectively manage their risks following the 2008 financial crisis (Yazici, 2011). In another application, researchers combined text mining software and neural networks to address financial risk management in day trading. The findings demonstrated that the accuracy of the approach's prediction for small-scale businesses, particularly those operating in central Italy, is much greater when the method is created offline based on factors such as size, geographic region, and company sector (Ciampi, 2013).

3. Game-based risk analysis

Nash played a significant contribution in the introduction of game theory and competitive strategy research (Nash, 1950). This field's primary focus is on industrial risk management. Researchers have examined a complete information game model, which analyzes various risks that arise in the context of project management. They have designed an efficient algorithm to address a customization solution based on Nash balance, which can also be reflected in business intelligence-based plans. An experiment was presented to illustrate the practicality of the suggested gameplay. The suggested approaches can help with decision-making in project risk management (Zhao, 2009). Some have extended game theory models to incorporate probabilistic risk analysis in counterterrorism efforts; they have compared probabilistic risk analysis techniques like virtual networks, decision trees, and game theory—the primary algorithms in business intelligence tools—to gain understanding of significant variations in assumptions and results. They discovered that determining the distribution of possible attackers' decisions is difficult, particularly when considering how striker and defender decisions differ from one another. An extension of sequential game theory and decision analysis that can be used to analyze such decisions is intelligent analysis of discount risk (Merrick, 2011). Some have applied this theory to model vertical discrimination in online advertising and discovered that lower service prices can result from increased revenues (Lin et al., 2012).

4. Credit Risk Decisions

The financial industry's main responsibility in risk management is to investigate the likelihood of default. Some researchers have supplied the registration form for Czech banks using linear discriminatory analysis, and the registration form in US banks is used to calculate the initial probability of default. Their findings indicate that, despite the fact that all banks are well-run, there is still a significant likelihood of a "financial crisis" (Gurny, 2009). While some have demonstrated how scorecards can be used to predict large banks' credit value risk management, others WU (2010) have examined the effectiveness of credit scoring for public (state-sponsored) institutions and have shown how credit bureau registration supports various risk escape strategies or preferences for lower risk and the risk of greedy investments. Caracota et al (2010) introduced a registration model for enterprises (SMEs) that applied for loans.

5. Data Mining for Enterprise Risk Management

Data mining is widely used in statistical and artificial intelligence tools, as well as business intelligence tools to analyze large amounts of data. Researchers have applied data mining tools to corporate finances for fraud detection, credit risk estimation, and performance forecasting (Shiri et al., 2012). Some argue that data mining in internal fraud produces better results than a single variable analysis Jans et al (2010); Holton (2009) used data mining for professional fraud in an audit whose primary focus is on discovering motivational aspects such

as employee dissatisfaction, as their proposed model predicts whether emails contain disgruntled communications, providing highly relevant information that is unlikely to be detected in the fraud audit process. The model can be linked into fraud risk analysis systems to improve their ability to detect and discourage fraud. In other industries, data mining is used to better predict power supply outages, particularly those induced by storms (Nateghi et al.). Recognized research paper insights, gaps, and future trends can inspire new investigative actions aimed at risk management in a globalized supply chain environment Ghadge et al (2012); Shojaei and Haeri (2019), while other studies have used data mining to reduce the risk of occupational damage (Murayama et al., 2011; Zhu et al., 2019).

Although businesses have not been able to fully realize the benefits of business intelligence systems and are instead focusing on ways to leverage the value from implemented systems (Visinescu et al., 2017), the aforementioned studies thus support the adaptation and use of BI systems and capabilities in broader organizational environments, including sequential case studies. However, prior research has not provided a comprehensive solution that addresses the techniques related to the adoption and use of a business intelligence system in realistic and sequential stages in financial environments.

Conclusion and Recommendations

Business intelligence technology plays a pivotal role in reshaping corporate strategies and optimizing overall performance by improving financial stability and reducing risks. This transformative technology empowers organizations to make informed decisions quickly and accurately, revolutionizing how they manage financial affairs and long-term planning. In light of these discussions, several key conclusions and recommendations have emerged:

The application of business intelligence enhances decision-making quality by leveraging advanced data analysis capabilities and a deeper understanding of the business landscape. It equips organizations with the tools to make well-informed and strategic choices. Additionally, business intelligence streamlines operations, leading to heightened process efficiency through resource allocation and productivity optimization. Organizations can operate more effectively and efficiently, thereby increasing their competitive edge.

Furthermore, astute analytics within business intelligence systems enable the identification and forecasting of financial risks with precision. This proactive approach allows companies to take preventive measures to safeguard their financial well-being. Moreover, business intelligence fosters sustainability by evaluating the financial and environmental impacts of business decisions, leading to the development of models that prioritize sustainability and responsible practices.

To maximize the advantages of business intelligence, the following recommendations are proposed: Firstly, organizations should prioritize technology integration, seamlessly incorporating BI technologies into their existing systems to ensure the smooth flow of data and information. Secondly, investing in employee training and professional development is vital to equip staff with the skills to effectively utilize business intelligence tools and enhance their analytical capabilities. Thirdly, crafting customized strategies based on business intelligence analytics is essential for achieving specific financial objectives. Fourthly, organizations must reinforce information security and data protection measures to ensure the safe and secure use of business analytics. Finally, exploring cloud computing can lead to reduced infrastructure costs and more efficient delivery of business intelligence features, offering a cost-effective and agile solution.

References

Popovič, A., Hackney, R., Coelho, P. S., & Jaklič, J. (2012). Towards Business Intelligence Systems Success: Effects of Maturity and Culture on Analytical Decision Making. Decision Support Systems, 54(1), 729-739.

Schermann, M., Hemsen, H., Buchmüller, C., Bitter, T., Krcmar, H., Markl, V., & Hoeren, T. (2014). Big Data. Business and Information Systems Engineering, 6(5), 261-266.

Arnott, D., Lizama, F., & Song, Y. (2017). Patterns of Business Intelligence Systems Use in Organizations. Decision Support Systems, 97, 58-68.

Visinescu, L. L., Jones, M. C., & Sidorova, A. (2017). Improving decision quality: the role of business intelligence. Journal of Computer Information Systems, 57(1), 58-66.

Shollo, A., & Galliers, R. D. (2016). Towards an Understanding of the Role of Business Intelligence Systems in Organizational Knowing. Information Systems Journal, 26(4), 339-367.

Ahmed, H. A., NorZafir, M. S., & Lina, P. (2023). A Comprehensive Bibliometric Analysis of fNIRS and fMRI Technology in Neuromarketing. Scientific Annals of Economics and Business, 70(3), 1-14.

Zhu, X., Jin, X., Jia, D., Sun, N., & Wang, P. (2019). Application of data mining in an intelligent early warning system for rock bursts. Processes, 7(2).

Ahmed, H. A., NorZafir, M. S., & Rohaizat, B. (2021a). The neural correlates of emotion in decision-making. International journal of academic research in business and social sciences, 11(7), 64-77.

Ahmed, H. A., NorZafir, M. S., & Rohaizat, B. (2021). To better understand the role of emotional processes in decision-making. International Journal of Academic Research in Economics and Management Sciences, 10(2), 49-67.

Ahmed, H. A., NorZafir, M. S., Shaymah, A. A.-Z., & Ahmad, K. (2022d). Consumer Behaviour to Be Considered in Advertising: A Systematic Analysis and Future Agenda. Behavioral Sciences, 12(12), 472.

Howson, C. (2013). Successful Business Intelligence: Unlock the Value of BI & Big Data (2nd ed.). McGraw-Hill Osborne Media.

Alsharif, A. H., Salleh, N. Z. M., Ahmad, W. A. b. W., & Khraiwish, A. (2022). Biomedical Technology in Studying Consumers' Subconscious Behavior. International Journal of Online and Biomedical Engineering, 18(8), 98-114.

Alsharif, A. H., Salleh, N. Z. M., Baharun, R., & Effandi, Y. M. (2021). Consumer behaviour through neuromarketing approach. Journal of Contemporary Issues in Business and Government, 27(3), 344-354.

Chen, C. H. (2017). Research on Business Intelligence with Data Mining Applications. International Journal of Business and Economic Research, 6(2), 19.

Ghosh, P., Som, S., & Sen, S. (2018). Business Intelligence Development by Analyzing Customer Sentiment. In 2018 7th International Conference on Reliability, Infocom Technologies and Optimization: Trends and Future Directions (ICRITO) (pp. 287-290).

Keen, P. G. W., & Scott Morton, M. S. (1978). Decision Support Systems: An Organizational Perspective. Addison-Wesley.

Sprague, R. H. J., & Carlson, E. D. (1982). Building Effective Decision Support Systems. Prentice-Hall.

Warenski, L. (2012). Relative Uncertainty in Term Loan Projection Models: What Lenders Could Tell Risk Managers. Journal of Experimental & Theoretical Artificial Intelligence, 24(4), 501-511.

Otim, S., Dow, K. E., Grover, V., & Wong, J. A. (2012). The Impact of Information Technology Investments on Downside Risk of the Firm: Alternative Measurement of the Business Value of IT. Journal of Management Information Systems, 29(1), 159-194.

Olson, D. L. (1996). Decision Aids for Selection Problems. Springer.

Wu, D., Dash, S-H., & Chen. (2014). Business Intelligence in Risk Management: Some Recent Progresses. Information Sciences, 256, 1-7.

Yazici, M. (2011). Combination of Discriminant Analysis and Artificial Neural Network in the Analysis of Credit Card Customers. European Journal of Finance and Banking Research, 4(4), 1-10.

Ciampi, F., & Gordini, N. (2013). Small Enterprise Default Prediction Modeling Through Artificial Neural Networks: An Empirical Analysis of Italian Small Enterprises. Journal of Small Business Management, 51(1), 23-45.

Liu, X., Kane, G., & Bambroo, M. (2006). An Intelligent Early Warning System for Software Quality Improvement and Project Management. Journal of Systems and Software, 79(11), 1552-1564.

Wang, Q., Hui, F., Wang, X., & Ding, Q. (2018). Research on Early Warning and Monitoring Algorithm of Financial Crisis Based on Fuzzy Cognitive Map. Cluster Computing, 7.

Han, Y., & Deng, Y. (2018). A Hybrid Intelligent Model for Assessment of Critical Success Factors in High-Risk Emergency System. Journal of Ambient Intelligence and Humanized Computing, 9(6), 1933-1953.

H-Alsharif, A., Md Salleh, N., & Baharun, R. (2020). Research trends of neuromarketing: A bibliometric analysis. Journal of Theoretical and Applied Information Technology, 98(15), 2948-2962.

H-Alsharif, A., Salleh, M. N., & Baharun, R. (2021a). Neuromarketing: Marketing research in the new millennium. Neuroscience Research Notes, 4(3), 27-35.

Krstevska, A. (2012). Early Warning Systems: Testing in Practice. IUP Journal of Financial Risk Management, 9(2), 7-22.

H-Alsharif, A., Md Salleh, N., & Baharun, R. (2021b). Neuromarketing: The popularity of the brain-imaging and physiological tools. Neuroscience Research Notes, 3(5), 13-22.

Flores, C. (2009). Management of Catastrophic Risks Considering the Existence of Early Warning Systems. Scandinavian Actuarial Journal, 1, 38-62.

Castell, M. R. F., & Dacuycuy, L. B. (2009). Exploring the Use of Exchange Market Pressure and RMU Deviation Indicator for Early Warning System (EWS) in the ASEAN + 3 Region. DLSU Business and Economics Review, 18(2), 1-30.

Xie, K., Liu, J., Peng, H., Chen, G., & Chen, Y. (2009). Early-Warning Management of Inner Logistics Risk in SMEs Based on Label-Card System. Production Planning & Control, 20(4), 306-319.

Zhao, L., & Jiang, Y. (2009). A Game Theoretic Optimization Model between Project Risk Set and Measurement. International Journal of Information Technology & Decision Making, 8(4), 769-786.

Lin, M., Ke, X., & Whinston, A. B. (2012). Vertical Differentiation and a Comparison of Online Advertising Models. Journal of Management Information Systems, 29(1), 195-236.

Lina, P., Ahmed, H. A., & Alharbi, I. B. (2022). Scientometric analysis of scientific literature on neuromarketing tools in advertising. Baltic Journal of Economic Studies, 8(5), 1-12.

Merrick, J., & Parnell, G. S. (2011). A Comparative Analysis of PRA and Intelligent Adversary Methods for Counterterrorism Risk Management. Risk Analysis, 31(9), 1488-1510.

Gurny, P., & Tichy, T. (2009). Estimation of Future PD of Financial Institutions on the Basis of Scoring Model. In 12th International Conference on Finance & Banking: Structural & Regional Impacts of Financial Crises (pp. 215-228).

Chen, Y. C., Chen, S. C., Huang, M. Y., & Tsai, C. L. (2012). Application of Six Sigma DMAIC Methodology to Reduce Financial Risk: A Study of Credit Card Usage in Taiwan. International Journal of Management, 29, 166-176.

Caracota, R. C., Dimitriu, M., & Dinu, M. R. (2010). Building a Scoring Model for Small and Medium Enterprises. Theoretical and Applied Economics, 17(9), 117-128.

Wu, D., & Olson, D. L. (2010). Enterprise Risk Management: Coping with Model Risk in a Large Bank. Journal of Operations Research Society, 61(2), 179-190.

Poon, M. (2009). From New Deal Institutions to Capital Markets: Commercial Risk Scores and the Making of Subprime Mortgage Finance. Accounting, Organizations and Society, 34(5), 654-674.

Shiri, M. M., & Amini, M. T. (2019). Development of Supply Chain Risk Management Approaches for Construction Projects: A Grounded Theory Approach. Computers & Industrial Engineering, 128, 837-850.

Murayama, S., Okuhara, K., Shibata, J., & Ishii, H. (2011). Data Mining for Hazard Elimination through Text Information in Accident Report. Asia Pacific Management Review, 16(1), 65-81.

Ghadge, A., Dani, S., & Kalawsky, R. (2012). Supply Chain Risk Management: Present and Future Scope. International Journal of Logistics Management, 23(3), 313-339.

Holton, C. (2009). Identifying Disgruntled Employee Systems Fraud Risk through Text Mining: A Simple Solution for a Multi-Billion Dollar Problem. Decision Support Systems, 46(4), 853-864.

Jans, M., Lybaert, N., & Vanhoof, K. (2010). Internal Fraud Risk Reduction: Results of a Data Mining Case Study. International Journal of Accounting Information Systems, 11(1), 17-41.

Nateghi, R., Guikema, S. D., & Quiring, S. M. (2011). Comparison and Validation of Statistical Methods for Predicting Power Outage Durations in the Event of Hurricanes. Risk Analysis, 31(12), 1897-1906.

Mishkin, F. (1997). The Causes and Propagation of Financial Instability: Lessons for Policymakers. Federal Reserve Bank of Kansas City.

Das, U., Quintyn, M., & Chenard, K. (2004). Does Regulatory Governance Matter for Financial System Stability? An Empirical Analysis. IMF Working Paper, No WP/04/89.