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The Use of Operations Research in Decisions Made by Bank Managers in Saudi Arabia

Melfi A. Alrasheedi

Dept. of Quantitative Methods, School of Business, King Faisal University, Hofuf, Saudi Arabia.

Abstract

The current paper examines strategies that bank managers use in decision-making and seeks to determine awareness level of operations research (O.R.) techniques among bank top management. The study assesses the implementation of the techniques by 46 senior managers in banks in Alhasa, Saudi Arabia, by using survey and statistical methods to test research hypotheses. The survey was designed to collect information about the use of decision-making techniques, the implementation of computers and specialized programs for decision-making, the current status and obstacles that limit the application of decision-making techniques, ways to enhance the use of such tools and the socio-demographic profile of bank managers and employees. The results reveal bank manager's respondents typically felt a need to employ and apply decision analysis techniques. It was also found that the respondents generally favoured the establishment of a training center to enhance O.R. practices that would be a part of the qualifications of future bank's employees.

Keywords: Commercial Banks, Decision Analysis, Decision Making Techniques, Management Sciences, Operations Research, Quantitative Analysis

Introduction

Decision-making approaches have been supported by mathematical evidence at least since the time of World War I and the early part of World War II (McCloskey, 1987). Operations research (OR) is also referred to as management science.

OR, although heavily based on mathematics, goes beyond the realm of academia and the theoretical landscape. Its techniques have real-world applications and are used on a daily basis by organizations in a variety of industries. OR techniques are used by military groups to strategize defensive formation of a battalion. Fortune 500 companies use OR it to determine how to further minimize their expenses and maximize their revenues (Albright and Winston, 2016).

Commercial banks play an important role in supporting economic activity in a society and the economic prosperity that is present within a nation (Cohen, Maier, & Vander Weide, 1981). They also provide valuable services to business, industry, government, and the public, where its primary functions can be divided into three broad areas: accepting deposits/making loans, providing safety (economic stability), and acting as payment agents. Cohen et al. (1981) conducted a study on the relationship between banks and the economy, where they concluded that banks were essential in ensuring successful stabilization of a country's financial system. Beck and Levine (2004) also investigated the relationship between banks and economic growth between the years 1976 to 1998 and corroborated the findings of (Cohen et al. (1981). Similar views on the impact of banks on the economic development of a country are expressed by Paradi et al. (2015), and Zimková (2016).

In addition to the primary functions, banks also provide many other commercial services such as corporate advise, corporate lending, third-party services, securities financing, access to equity and debt markets, clearing services, insurance, asset management, and mortgages. However, banks have recently faced new pressures in light of the Great Financial Crisis and the related Recessions. Challenges faced by the commercial banks such as changing regulations, customers, technology, and economic environment (as shown in Figure 1.1.). The analysis of complex interactions of these challenges with commercial banks can be supported with OR.



Figure 1: Challenges faced by commercial banks

In more recent years, regulations for the promotion of transparency and risk management, have dominated bank dialogue. Customers have also become more demanding, less trusting, less forgiving, and hold higher expectations about how banks operate. However, a large number of banks still use outdated information systems. Decision makers in banks can find it difficult to invest capital into more modern technology as well as pursue investments related to the automation of banking operations, where pressures come from the growth of banking online, on one's mobile phone, and social media (Ahmad, 2017).

OR can be used to inform better bank efficiently. Almost all banks have internal manuals to help ensure standardization of procedures. The goal of such manuals is to provide customer service of a high standard within expected timeframes (Tuskan and Stojanovic, 2016). Using data from OR, management will be better able to identify inefficiencies that exist, and rectify the situation.

OR encompasses the tools, techniques, models, and various combinations that may be used to facilitate project management, multi-criteria optimization, and game theory implementation. It has a broad base enabling it to be easily applied. Some of more common techniques of OR are listed in Table 1.

Table 1: Operational Research Techniques

ANOVA	**Computer simulation**	**Forecasting**
Bayesian statistics	Decision tree analysis	Game theory
Breakeven analysis	Discriminant analysis	Goal programming
Canonical correlation	Dynamic programming	Integer programming
Chi-square test/analysis	Exponential smoothing	Inventory model
Cluster analysis	Factor analysis	Linear programming
Markov chain	Multi-dimensional scaling	Neural network analysis
PERT/CPM	Probabilistic programming	Non-linear programming
Probability analysis	Queuing theory	Regression/ correlation
Statistical sampling	Transportation model	Evaluation and validation

OR, as a discipline, shares characteristics with the field of business intelligence ('BI'). The two areas involve the use of statistical analysis techniques. However, there are differences between the two terms. OR starts with a decision problem. The proponent then seeks to use data to determine the best course of action. BI, on the other hand, starts off with data and then determines what could be done with that information (Howson, 2014). Arguably, BI is inductive approach whereas OR, in comparison, is more deductive.

The current paper focuses on OR, which start with a decision problem and uses quantitative analysis to arrive at a solution. It may involve determining an optimal price level to set a product at which will maximize the firm's profits. Alternatively, it could involve the creation of a mathematical model for forecasting trends.

Managers are generally supportive of OR; however, a lack of training and knowledge in the domain is believed to limit its use (Yousef, 2009). For some managers, OR is seen as unnecessary and resulting in unjustified supplementary costs for the company. These managers avoid investment in OR. Incumbent

managers generally rely on experience rather than on mathematical models. Newer graduates who may have the necessary knowledge to utilize OR are often yet to occupy key positions in companies (Kathawala, 1988).

The implication is that awareness and application of OR methods differs depending on the level of training of the particular manager. Similarly, use of different methods and techniques improve the reliability, transparency, and precision.

Research Justification

The banking sector has experienced a radical transformation in major industrial countries and in several developing countries during the last two decades. Due to banking sector failure and intensive competition, the role of operation managers has become more central (Alidi & Bu-Bshait, 1993). Managing performance has become a significant factor in ensuring competitive edge. Structural changes brought by internationalization, financial innovations, regulatory reforms and changes in customer demands have each placed new demands on banks. Banking institutions must continuously improve their efficiency and offer their customers cost savings if they wish to hold their own amongst the numerous domestic and international contenders (Golany and Storbeck, 1999). OR can meet a need in the performance measurement and strategic planning of a bank. Many larger banks already use OR informed techniques to manage resources in the most efficient way. Also, supported by OR tools, managers can make better informed strategic decisions. As an example, Merrill Lynch Bank has a Management Science Group to support strategic decision- making using OR and management science techniques (Duffy et al., 2005). The purpose of this paper is to assess the competencies and awareness of banking manager towards the adoption of OR processes and methods.

Research Questions

The research questions are as follows:

1. To what extent does the literature support the use of OR for banking managers?
2. To what extent do banking managers/employees use OR in their daily processes?
3. Which tools and technologies do banking managers/employees prefer to use in their routine processes?
4. Which products and services in banks are not currently linked with OR?
5. What factors influence the use of OR tools and technologies by banking managers/employees?
6. How can OR be supported in banks?

Research Objectives

The main objective of the present research is to study applications of OR techniques presently used in banks. The study aims to provide recommendations for enhancing the usage of OR techniques in commercial banking by conducting a primary research in region of Alahsa, Saudi Arabia in 2013. The

work is based on the past experience learned from a secondary research conducted through a comprehensive literature review.

The research deals with the implementation of the OR in the banking sector. It sets out to highlight the awareness level regarding OR among bank top management. Furthermore, the study plans to emphasize the techniques most frequently used and the motivation of such choices, the perceived competitive advantage and ways to motivate non-users to change their opinion.

The main purpose of the present analysis is a critical evaluation of OR use in commercial banks, concentrating on the tools used and the acquired level of exploitation.

The final objective is to investigate which factors influence the use of OR in bank, including barriers which may prevent the use of OR based techniques in banks and financial institutions.

The objectives of the study can be summarized as follows:

1. Assess the socio-demographic profile of commercial bank employees that use OR tools.
2. Identify OR tools and techniques used, including the frequency and the areas where these tools are employed
3. Evaluate awareness and knowledge level for OR.
4. Identify main issues/barriers in regard to OR use.
5. Suggest strategies to increase awareness and usage level of OR techniques.

Research Plan

The research has been planned in the following steps:

1. Step 1: Conduct a literature review in order to understand the issues faced in the past, the current OR scenario in commercial banks, the trends in the field and the preparation of a base for further research.
2. Step 2: This stage is devoted to the research methodology, the criterion for selecting the respondents and the preparation of the questionnaire for obtaining the views of the respondents.
3. Step 3: Data analysis.
4. Step 4: Findings
5. Step 5: This final step is related to the development of the strategy for enhancing use of OR techniques for improving efficiency and the productivity of the bank to gain competitive edge.

Literature Review

The vast majority of the current OR literature focuses mainly on the deployment of OR-based applications, and other topics related to its implementation. There are only a handful of studies regarding the impact due to the use of OR in different activity sectors and even fewer on the topic of OR's contribution to bank management. Compared to other organizations that have an influence on the economy, banks have the potential to make the most out of OR techniques due to the nature of their business and the main “product” they're involved with—money.

One of the pioneering studies concerning OR usage at banks comes from McClure and Miller (1979), which illustrates the 12 most commonly used OR techniques at 52 U.S. banks. McClure and Miller found that the most appreciated models were the simpler ones, such as forecasting, computer simulations, and

combinations thereof. In contrast, probabilistic/dynamic programming and networks found few supporters among the top managers. The authors found that the size of a bank was not correlated with OR usage, and its tools and techniques were found to be used at both small and mediam-sized banks depending on the popularity of OR at the bank and its perceived usefulness.

Another review, conducted by Zanakis, Mavrides, and Roussakis (1986), showed that the banking departments of operations, loan management, and financial planning used OR tools. They found that 38% of published articles were in the banking operations area, 15% of banking articles covered loan management, while 12% investigated financial management. Most OR studies during the past twenty years focused on bank profitability, performance, and/or efficiency.

Furthermore, a study was conducted on OR usage in 1988 by Kathawala, the study allows the observation of its usage at various different organizations in the U.S. including commercial. Kathawala found that although 50% of managers use some kind of OR strategy, only seven particular techniques were repeatedly being exploited: ANOVA, breakeven analysis, forecasting, computer simulation, regression/correlation, inventory analysis, and statistical sampling. It suggested the powerful predictive and descriptive tools like Markov chain models, cluster analysis, and Bayesian statistics were generally disregarded as they were considered too complicated due to the lack of experience and knowledge surrounding the use of those techniques.

Cheng (1990) detected that some OR techniques such as linear programming, statistical analysis, and simulation are extensively used to analyze and improve the efficiency and productivity of the banking industry. By studying some specific cases the author highlights the potential benefits of using OR techniques in bank management.

Another study by Duffy et al. (2005) examined the application of management science and OR techniques at Merrill Lynch Bank USA and found that a Monte Carlo simulation analyzes the liquidity of the revolving credit bank portfolio. The simulation model included expert systems, stochastic programming, and a Markov process and it is used to evaluate every month the impact of portfolio evolution on liquidity risk. The model is one of the bank instruments for managing liquidity risk and it is maintained in a continual improvement process by the bank simulation management science group.

In the European space, there are two notable studies, one concerning the U.K. (Jeffrey & Seaton, 1995) and the other one focusing on Serbian companies (Nikolić, Savić, & Jovanović, 2010). Both studies were based on surveys and aim at identifying the level of quantitative methods application by practitioners. Although set apart by 15 years and targeting countries with differences in development, the conclusions of the papers were convergent: a little over half of the managers favour OR tools in decision making, the advantages identified are the scientific approach, the broad understanding of complex problems.

The most important issues in the application of quantitative methods could be summarized as the lack of time and the lack of knowledge (Nikolić, Savić, & Jovanović, 2010).

The South and East Asian scholars have also produced two noteworthy studies regarding the use of OR. In India, OR is considered a tool to "transform [the nation] " (*Ravichandran*, 2006). As for the Taiwanese academic's conclusion, the resultsstudy reinforce previous findings regarding ahigh correlation between familiarity with certain OR tools and the tools perceived suitability for a task (Wu & Huang, 2007).

Academics in the United Arab Emirates have also taken an interest in the topic, particularly Yousef, who is one of the most prolific writers where he focuses on the business climate of his country, the implementation of OR in decision making (2008), and even the discussion of academic training in OR

(2009) as a prerequisite for successful OR implementation. Such is similar to Kathawala's thought (1988) who found that the lack of formal training is the main reason for failing to use the appropriate OR tools for a particular situation.

Additionally, Yousef's findings reinforce previous works on the topic as he observes that the most frequently used OR tools are the widely known decision analysis, cost-benefit analysis, computer simulation, and financial modeling. More complicated techniques such as fuzzy theory or game theory are completely disregarded by practitioners (Yousef, 2008).

Supplementary information on the topic can be obtained from the comprehensive analysis of previous studies regarding OR conducted in the Arab world by Yousef in 2011.

Further studies by Rana and Gibbs (2006) revealed that techniques preferred 20 years ago (Statistical Analysis and Linear Programming) are still extensively used and occupy a position in the top techniques. Linear Programming has gained popularity due to technological advances such as data envelope analysis. Data Envelope Analysis (DEA) is a linear programming technique dealing with multiple inputs and outputs for measuring the comparative performance of organizational units (Ali, 1990). Kantor and Maital (1999) found that DEA is used extensively to provide quantitative measures of each branch's efficiency relative to other similar branches. Rana and Gibbs (2006) studied 321 usages and observed that linear programming and statistical analysis were the most frequently used management science (MS) or OR techniques. Linear programming tops the list at 23.99% followed by statistical analysis at 18.07%, MIS/EDP at 10.59% and simulation at 7.48%. Extensive usage of these techniques appears due to the familiarity of the techniques with the managers.

The literature highlights that most of the research relevant to use of OR in the banking sector is on the use of different OR methodologies and their implications for banking efficiency. For example, the methodological development of DEA for over the last thirty years was reviewed by Cook and Seiford (2009). Similarly, DEA application in the case of banks was also studied by Zhou and Poh (2008). The study of Dimitras et al. (1996) focused on the different OR techniques for prediction of business failures, but they only consider the cases of operation managers in industrial firms. Board et al. (2003) studied the operation research applications in financial institutions especially the stock market and their study did not focus the banking sector in general. Smith and Gupta (2000) recommended the use of neural network technologies to improve the efficiency of sophisticated tools of operational research like DEA and frontier analysis.

Berger and Humphrey (1997) reviewed the efficiency of different operational research techniques with specific emphasis on bank manager's capabilities. Burger (2007) recommended bank management to improve their operational efficiency by adopting latest tools such as DEA and stochastic frontier analysis for improved and precise analysis. Kumar and Ravi (2008) highlighted the importance of artificial intelligence tools for bank managers in improving the bank processes and to predict bankruptcy.

With respect to the applications of OR and artificial intelligence (AI) techniques in the world banking system, Fethi and Pasiouras (2010) analyzed 196 journal articles in which OR and AI techniques are employed to estimate different measurements of bank efficiency and performance of several banks of the world. In particular, they examined the applications of DEA and found that it was the most used method to evaluate the efficiency and productivity of the world-banking sector. They also detected that AI techniques such as neural networks were used to predict bank failure, bank underperformance, and credit ratings in some banks of the world. Fethi and Pasiouras (2010) citing Isik and Hassan (2003) consider that

the educational formation of bank employees and Chief Executive Officer and are determinants of bank efficiency. The opinion supports the importance of education and management in the performance of banking systems. It also infers a necessity of training bank personnel in the knowledge of the most common methods applied to assess bank efficiency and productivity such as OR techniques, for example. The knowledge will help to maximize this aspect of banking efficiency.

There are several studies that apply the DEA model in banks of different nations such as the European countries (Tuscan & Stojanovic, 2016), Brazil (Marques Serrano, Rosano Peña, Rosa Franco, Pettenuzzo de Brito, & Damasceno Cunha, 2017), Canada (Paradi, Min, & Yang, 2015), Taiwan (Yang & Liu, 2012), Saudi Arabia (Alkhathlan & Malik, 2010; Abdelkarim, 2013), China (Wang, Huang, Wu, & Liu, 2014) and other settings. To appreciate the general characteristics of these studies, some details of the banks of Saudi Arabia, European countries and Brazil are described.

Alkhathlan and Malik (2010) evaluated the efficiency of a set of 10 Saudi Arabian banks during the 2003-2008 period using the DEA technique. The results indicate that the investigated banks were efficient in the management of their financial resources. The finding confirmed the opinion expressed by the Saudi Arabian Monetary Agency (SAMA) in its Forty-Fourth Annual Report "Commercial banks recorded good growth rates in their financial positions during 2007. This was due to efficient management by commercial banks of their financial resources". According to the authors of the investigation, "The results would provide crucial information about Saudi bank's financial conditions and management performance for the benefit of bank regulators, managers, and bank stock investors". Likewise, Abdelkarim (2013), using DEA techniques, measured the operation of Saudi banking system in the period 2007-2011 and found that the Saudi banks efficiently manage their financial resources. The result is in agreement with Alkhathlan and Malik's (2010) findings and SAMA opinions. Abdelkarim also observed that small sized banks are more efficient than moderate and large size banks.

In relation with the European countries, the review conducted by Tuscan and Stojanovic (2016) estimated the efficiency of the European banking industry using financial indicators and some variations of the DEA method. They investigated the efficiency of 28 European banks belonging to European countries in the span 2008-2012. The results showed how the efficiency of European banks behaved during the years; however, the authors did indicate that the efficiency depends on the method used to calculate it. The authors suggested that the DEA approach is more complete in evaluating the efficiency than the application of financial indicators. It can be used as an instrument to perceive premature signs of different crucial situations such as crisis or business problems.

A Marques Serrano et al., (2017) evaluated the efficiency of 21 banks of the Brazilian banking sector in the period between 2010 and 2016 by using data from the Brazilian stock exchange BM&F Bovespa. By using DEA methodology, the investigation revealed that there was a correlation between the efficiency and the size of the banks in such a way that the largest banks are more efficient than the smaller banks. The study showed that the efficiency of some moderate and small sized banks is unstable during the time which may suggest uncertainty and volatility in the operational management of bank resources.

Another study analyzed the application of DEA-based model structures to assess (Rakhshan, Alirezaee, and Mohammadzadeh, 2016). According to the authors, most of the DEA applications in banking studies have concentrated on banks at an institutional level rather than at the branch level. The article examined and classified in several categories the DEA model structures applied at the branch level in 75 papers

published until 2015. From the review, the authors identified several theoretical extensions, combinations and practical applications of the basic DEA model.

Kumar et al. (2012), in a different study linked with the role of OR applications in financial markets, identified the OR techniques applied in the analysis of finance problems related to portfolios, valuation of financial instruments, imperfections in financial markets, funding decisions, trader's decisions, market makers decisions, financial regulators and economic understanding of forces that shapes the financial markets. The investigation revealed that the most common used OR technique was mathematical programming and its different methods: linear, nonlinear, quadratic, integer, goal, stochastic, chance-constrained, fractional, dynamic, and DEA.

The next most commonly applied techniques were Monte Carlo simulation and other methods such as network models, neural networks, game theory, Markov chains and queuing theory.

Likewise, in a work related to the role of OR techniques in financial decision-making Kaur and Ranjit (2014) discussed some decision strategies and applied mathematical programming methodology to resolve some common financial problems such as index-tracking fund, portfolio selection, and bond refunding decision. The authors indicated that the decision problems in financial markets could be analyzed by an appropriate OR model and presented the suitable technique to examine above problems. The index- tracking fund which is a portfolio management scheme used by fund managers to try to equalize the market performance to the performance of a theoretical portfolio was solved by minimizing the tracking error or the deviation between the actual and the theoretical portfolio using quadratic mathematical programming.

Palve (2016) confirmed that mathematical programming is the most used technique for the analysis of financial markets with analogous emphasis to the article published by Kumar et al. (2012). He suggested that the importance of OR techniques in the operation of financial markets possibly tend to grow in the future. In his paper, he examined some finance problems such as funding decisions, strategic problems of traders in stock markets, regulatory and legal issues, and effects of economic forces that shape the financial markets.

Ahmad (2017) also found that mathematical programming was the most commonly utilized procedure to approach the solution of financial problems and examined some common financial problems related to bond returning decisions, funding decisions, imperfections in financial markets, regulatory and legal issues, and strategic problems in stock markets. The analyses of Palve (2016) and Ahmad (2017) were similar to those proposed by Kumar et al. (2012) and Kaur and Ranjit (2014).

Most of the studies on OR use in banking sector focus on the comparison of different methodologies and their effectiveness for bank managers in estimating and improving bank performance. The application of OR in financial decision-making highlights the usage of mathematical programming in the solution of financial problems.

Methodology

Design:

Inspired by previous relevant studies such as those by Jeffrey and Seaton (1995), Wu and Huang (2007), and Yousef (2008), the questionnaire method for assessing the implementation of OR in commercial banks was chosen.

The questionnaire contained two parts. The first part of the questionnaire sought to collects socio-demographic profile of the employees of a commercial bank.
The second part of the questionnaire dealt with the following aspects:

1. Usage and need of decision-making techniques
2. Use of computers and specialized technical programs for decision-making
3. Current status of decision-making techniques
4. Obstacles that limit the use of decision-making techniques
5. Ways to activate the use of decision-making techniques.

The survey used closed-type questions in order to assist respondents in answering the question relevantly and rapidly. The second part of the questionnaire supported a qualitative research approach using a Likert scale to gather the respondent's answers. The responses to the Likert scale were very high, high, moderate, low and nill.
The study encompassed two dimensions of the use of OR: one objective and a subjective one. The objective dimension focused on the familiarity of the respondents with various OR methods, the degree of utilization, and the operational areas which the respondent believed are impacted upon by such techniques. The subjective dimension concentrated on the level of awareness regarding OR, the perceived advantages of OR in the banking and financial sectors, and the main issues on the topic of OR in the management of commercial banks.

Participants

Respondents represent management sections of a target bank, from top managers as well as the other levels involved with the day-to-day operation managers. Fifty-seven respondents were selected to attempt to balance of top managers and day-to-day operations managers. The gender bias was also attempted to be balanced selecting an almost equal number of male and female executives.

Procedure

The questionnaire was distributed to a number of 57 managers from commercial bank branches in Alahsa, Eastern Region, Saudi Arabia. The response rate was 80.7%. The size of the received responses was 46, which is above 30, thus the assumption of a normal distribution of the data can be implied and statistical tests are performed accordingly.
The responses received from the respondents showed that the employees took an interest in the study as they are the direct beneficiaries of the study in their work.
The limitation of the study was given by the fact that the questionnaire was distributed in only one city. The findings could be influenced by the inhabitant’s characteristics of that particular region. Nevertheless, the homogeneity of important features regarding the study such as the management of the banks, the available software, the degree of awareness and use of OR tools made this result valid for at least the whole country. Further inquiry is necessary regarding the generalization of the findings to the whole Arab World.

The main purpose of the present analysis is the evaluation of OR use in commercial banks, concentrating on the tools used and the acquired level of exploitation. The final objective was to investigate factors that influence the use of OR-related approaches by more banks and financial institutions.

Statistical Analyses

The following statistical tools were to be used to test the research hypothesis:

1. Reliability and Statistics validation
2. Descriptive Analysis
3. ANOVA test to analyze the differences between demographic variables and research constructs.
4. Correlation Analysis to estimate the relationship between different variables
5. Regression Analysis to study the impact of dependent variables on independent variables.
6. Neural Network to identify the percent of the importance of the variables in our study.

The motivation for the inquiry lied in previous findings which revealed that although there are numerous OR tools and techniques available, the degree of use remains low and focuses only on well-known tools, which are preferred based on their popularity and not on their adequacy.

The statistical testing targeted the following hypothesis/descriptions:

1. The extent of use of OR in banking management remains low to moderate
2. There are few preferred technologies, which are extensively used.
3. A description of the technologies used and their level of employment
4. There are banking products that do not use OR at all
5. A classification of the main issues in OR implementation.
6. A classification of the main barriers to OR use.
7. A classification of the factors that increase OR use.

To address these research questions, an explanatory analysis was performed, focusing on descriptive statistics (mean, average, skewness), which is appropriate because the study is static, it focuses exclusively on a specific moment and city.

The sole description of the current status is insufficient for a throughout understanding of the phenomenon. A more in-depth analysis is necessary, to facilitate the comprehension between the employee's characteristics and their choice of OR tools, a task best performed through correlation analysis followed by the application of regression analysis. ANOVA will also be employed in order to assess the differences between groups of bank employees.

It is assumed that he low proportion of OR use is due to certain factors such as age, education level, lack of proper training, a situation that could be easily restored through adequate motivation of the bank management staff and sufficient training on the OR topic, during college as mandatory curricula and after hiring as requirement of promotion schemes.

Data

The demographic characteristics of the respondents is described in Appendix A. In Table 2 the reliability of the data which is validated using Cronbach's Alpha, Cronbach's Alpha based on standardized items and Friedman's Chi-Square tests is shown. Also, shown is the significance probability term Sig. The variables considered in the analysis are the usage and need for OR techniques, the usage of computer and specialized technical programs in decision making, the current status of decision-making techniques, the

obstacles in limiting the use of decision-making techniques and the ways to activate the use of decision-making techniques.

From the table shown following, it can be noted that the Sig. Friedman's Chi-Square is less than 0.05 for all items, the value of Cronbach's Alpha coefficient ranges between 0.568 and 0.789, the value of Cronbach's Alpha based on standardized items oscillates between 0.549 and 0.79 for all items, and Cronbach's Alpha coefficient is 0.775. The data is reliable.

Table 2: Test to verify the reliability and validation of the data

Variable	Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	Friedman's Chi-Square	Sig
the usage and need for MS/OR techniques	0.568	0.549	59.966	0.000
the usage of computer and specialized technical programs in decision making	0.688	0.686	32.913	0.000
the current status of decision-making techniques	0.687	0.708	7.909	0.048
the obstacles in limiting the use of decision-making techniques	0.789	0.79	35.005	0.000
the ways to activate the use of decision-making techniques	0.647	0.691	48.305	0.000
All Items	0.775	0.795	335.338	0.000

Results

Responses received from the respondents were entered in SPSS with question codes. From the SPSS, the number of responses was counted for each class of the response. The percentage of each response was then worked out. The number of responses and percentage are shown in Appendix 1. Based on the interpretation of the data analysis, findings of the research are presented from Table 3 to Table 17.

Table 3 described following presents a critical review of Question 6 related to the usage and need for MS/OR techniques and shows the response to the Likert scale. The responses to the Likert scale were nill, low, moderate, high and very high. In particular, the table indicates the frequency and per cent of the responses to different versions of Question 6: “Knowledge of quantitative methods for decision making” (Q6_1), “Knowledge of decision-making techniques” (Q6_2), The need to use decision making techniques (Q6_3), and “The need to apply decision-making techniques in your work” (Q6_4).

With respect to the knowledge of quantitative methods for decision making (Q6_1), the results suggest more than 50% respondents have a moderate knowledge, 34.8% have a high knowledge and 6.5% have a very high knowledge. It can be observed that a large percentage of respondents (41.3%) are quite knowledgeable in computers.

In relation to the knowledge of decision-making techniques (Q6_2), the results suggest that a large percentage of respondents of about 41.3% are knowledgeable about decision-making techniques.
Also, all the respondents felt the need to apply decision-making techniques (Q6_3) and (Q6_4) in the work.

Table 3: Critical review of the usage and need for MS/OR techniques (Question 6).

<table>
<tr><th>S. No.</th><th>Description</th><th>Critical review</th></tr>
<tr><td>1</td><td>“Knowledge of quantitative methods for decision making” (Q6_1)</td><td>
<table>
<tr><td>Need and use</td><td>nill</td><td>low</td><td>moderate</td><td>high</td><td>very high</td></tr>
<tr><td>Frequency</td><td>1</td><td>2</td><td>24</td><td>16</td><td>3</td></tr>
<tr><td>Percent</td><td>2.2</td><td>4.3</td><td>52.2</td><td>34.8</td><td>6.5</td></tr>
</table>
More than 50% respondents have moderate knowledge and 34.8% have high knowledge and 6.5% have very high knowledge. It can be observed that a large percentage of respondents (41.3%) are quite knowledgeable in computers.
</td></tr>
<tr><td>2</td><td>“Knowledge of decision-making techniques” (Q6_2)</td><td>
<table>
<tr><td>Need and use</td><td>nill</td><td>low</td><td>moderate</td><td>high</td><td>very high</td></tr>
<tr><td>Frequency</td><td>1</td><td>2</td><td>24</td><td>17</td><td>2</td></tr>
<tr><td>Percent</td><td>2.2</td><td>4.3</td><td>52.2</td><td>37.0</td><td>4.3</td></tr>
</table>
The data shows that large percentage of respondents (about 41.3%) which are knowledgeable about decision-making techniques.
</td></tr>
<tr><td>3</td><td>“The need to use decision-making techniques” (Q6_3)</td><td>
<table>
<tr><td>Need and use</td><td>moderate</td><td>high</td><td>very high</td></tr>
<tr><td>Frequency</td><td>3</td><td>28</td><td>15</td></tr>
<tr><td>Percent</td><td>6.5</td><td>60.9</td><td>32.6</td></tr>
</table>
All the respondents felt the need to use the decision-making techniques.
</td></tr>
<tr><td>4</td><td>“The need to apply decision-making techniques in your work” (Q6_4)</td><td>
<table>
<tr><td>Need and use</td><td>moderate</td><td>high</td><td>very high</td></tr>
<tr><td>Frequency</td><td>6</td><td>19</td><td>21</td></tr>
<tr><td>Percent</td><td>13.0</td><td>41.3</td><td>45.7</td></tr>
</table>
All the respondents felt the need to apply decision-making techniques in the work.
</td></tr>
</table>

Table 4 shows the descriptive measures for the usage and need for MS/OR techniques and its variables.

The variables presented in the table are the "Knowledge of quantitative methods for decision making" (Q6_1), the "Knowledge of decision-making techniques" (Q6_2), "The need to use decision-making techniques" (Q6_3), and "The need to apply decision-making techniques in your work" (Q6_4).
The table presents the percent of use and need, the mean, the standard deviation, and the coefficient of variation (C.V) for the described variables.

Table 4: The descriptive measures for the usage and need for MS/OR techniques and its variables (Question 6).

Variables	Mean	percent of use and need %	Std. Deviation	C.V. %
"Knowledge of quantitative methods for decision making" (Q6_1)	3.3913	67.83	0.77397	22.82
"Knowledge of decision-making techniques" (Q6_2)	3.3696	67.39	0.74113	21.99
"The need to use decision-making techniques" (Q6_1)	4.2609	85.22	0.57483	13.49
"The need to apply decision-making techniques in your work" (Q6_4)	4.3261	86.52	0.70093	16.20
the usage and need for MS/OR techniques	3.8370	76.74	0.46313	12.07

By combining the information described in Tables 3 and 4, it can be found that the following results were obtained:
More than 50% of respondents have a moderate knowledge of quantitative methods for decision making, 34.8% have a high knowledge and 6.5% have a very high knowledge. It can be observed that the average of the knowledge of quantitative methods for decision making available is 67.83%.
According to the results, 67.39% of respondents are knowledgeable about the decision- making techniques. In total, 85.22% of respondents felt the need to use the decision-making techniques, and 86.52 % of respondents felt the need to apply decision-making techniques in the work.
For the usage and need for MS/OR techniques, the average was 76.74%.
Using Neural network technique to identify the importance of the variables in the usage and need for MS/OR techniques (y1) follows:
The network uses 65.2% of sample units for training and 34.8% for testing the relationship between the variables and the usage and need for MS/OR techniques which can be represented by two functions shown in Appendix B:
34.2% "Knowledge of decision-making techniques", 32.9% "Knowledge of quantitative methods for decision making", 16.5% "The need to use decision-making techniques", and 16.4% "The need to apply decision-making techniques in your work".

Table 5 analyses the differences between demographic variables and the usage and need for MS/OR techniques using the ANOVA and t-test. The variables considered are: Q6_1, Q6_2, Q6_3, Q6_4, and y1. Also, the table presents the gender, occupation, education, experience, and training courses of the population.

Table 5: Analysis of the differences between demographic variables and the usage and need for MS/OR techniques using ANOVA test and t test.(Question 6).

Variables	Gender		Occupation		Education		Experience		training Courses	
	T	Sig.	F	Sig.	F	Sig.	F	Sig.	F	Sig.
Q6_1	1.303	.199	1.184	0.282	0.484	0.695	1.241	0.309	8.318	0.000
Q6_2	0.741	0.463	1.889	0.176	0.778	0.513	0.760	0.557	6.060	0.002
Q6_3	1.422	0.162	0.848	0.362	0.811	0.495	1.932	0.123	2.930	0.830
Q6_4	1.349	0.184	0.040	0.842	2.832	0.049	1.934	0.123	0.522	0.670
y1	0.103	0.919	0.398	0.531	1.843	0.154	1.771	0.153	4.612	0.007

As shown in the above table (Table 5*),* the application of ANOVA test and t-test indicates that there are significant differences in "Knowledge of quantitative methods for decision making", "Knowledge of decision-making techniques" and the usage and need for MS/OR techniques due to training courses. Also, "The need to apply decision-making techniques in your work" has a significant difference due to education.

The following table (Table 6) shown presents a critical review of Question 7 linked to the usage of computer and specialized technical programs in decision-making and presents the response to the Likert scale. In particular, the table indicates the frequency and per cent of the responses to different versions of Question 7 such as "Excel" (Q7_1), "Project management program" (Q7_2), "Financial and accounting programs" (Q7_3), "Management programs" (Q7_4), "Statistical programs" (Q7_5), and "Employees affairs programs" (Q7_6).

From the information presented in the following table, it is possible to infer that 43.5% respondents "always" use "Excel" whereas about 26% "often" used it. Usage of "Excel" is quite high. With regard to the use of "project management program", about 28% of respondents rarely used the program and almost 15% never used it. The program is less used relatively.

In relation to the "financial and accounting programs" usage is reasonably high and about 63% of respondents use them. But, 22% of respondents rarely or never used the programs.

With respect to the use of "management programs", 26% of respondents either rarely or never used these programs.

About the usage of "statistical programs", 26.1% of respondents either rarely or never used them. Almost 24% of respondents sometimes use these programs.

In connection with the employee's affairs program, 80% of respondents use this program.

Table 6: Critical review of the usage of computer and specialized technical programs in decision making (Question 7).

<table>
<tr><th>No.</th><th>Description</th><th>Critical review</th></tr>
<tr><td>1</td><td>“Excel” (Q7_1)</td><td>
<table>
<tr><td>Usage</td><td>never</td><td>rarely</td><td>sometimes</td><td>usually</td><td>Always</td></tr>
<tr><td>Frequency</td><td>2</td><td>3</td><td>9</td><td>12</td><td>20</td></tr>
<tr><td>Percent</td><td>4.3</td><td>6.5</td><td>19.6</td><td>26.1</td><td>43.5</td></tr>
</table>
43.5% respondents always use “Excel” whereas about 26% often used it. Usage is quite high.
</td></tr>
<tr><td>2</td><td>“Project management program” (Q7_2)</td><td>
<table>
<tr><td>Usage</td><td>never</td><td>rarely</td><td>sometimes</td><td>usually</td><td>Always</td></tr>
<tr><td>Frequency</td><td>7</td><td>13</td><td>16</td><td>4</td><td>6</td></tr>
<tr><td>Percent</td><td>15.2</td><td>28.3</td><td>34.8</td><td>8.7</td><td>13.0</td></tr>
</table>
About 28% rarely used the program and about 15% never used it. The program is relatively less used.
</td></tr>
<tr><td>3</td><td>“Financial and accounting programs” (Q7_3)</td><td>
<table>
<tr><td>Usage</td><td>never</td><td>rarely</td><td>sometimes</td><td>usually</td><td>Always</td></tr>
<tr><td>Frequency</td><td>1</td><td>9</td><td>7</td><td>12</td><td>17</td></tr>
<tr><td>Percent</td><td>2.2</td><td>19.6</td><td>15.2</td><td>26.1</td><td>37.0</td></tr>
</table>
Usage is reasonably high (about 63%). 22% rarely or never used the program.
</td></tr>
<tr><td>4</td><td>“Management programs” (Q7_4)</td><td>
<table>
<tr><td>Usage</td><td>never</td><td>rarely</td><td>sometimes</td><td>usually</td><td>Always</td></tr>
<tr><td>Frequency</td><td>4</td><td>8</td><td>6</td><td>19</td><td>9</td></tr>
<tr><td>Percent</td><td>8.7</td><td>17.4</td><td>13.0</td><td>41.3</td><td>19.6</td></tr>
</table>
26% respondents either rarely or never used the program used
</td></tr>
<tr><td>5</td><td>“Statistical programs”(Q7_5)</td><td>
<table>
<tr><td>Usage</td><td>never</td><td>rarely</td><td>sometimes</td><td>usually</td><td>Always</td></tr>
<tr><td>Frequency</td><td>3</td><td>9</td><td>11</td><td>14</td><td>9</td></tr>
<tr><td>Percent</td><td>6.5</td><td>19.6</td><td>23.9</td><td>30.4</td><td>19.6</td></tr>
</table>
26.1% are either rarely or never used statistical programs and about 24% sometimes use.
</td></tr>
<tr><td>6</td><td>“Employees affairs programs”(Q7_6)</td><td>
<table>
<tr><td>Usage</td><td>never</td><td>rarely</td><td>sometimes</td><td>usually</td><td>Always</td></tr>
<tr><td>Frequency</td><td>5</td><td>5</td><td>15</td><td>12</td><td>9</td></tr>
<tr><td>Percent</td><td>10.9</td><td>10.9</td><td>32.6</td><td>26.1</td><td>19.6</td></tr>
</table>
80% respondents use the program.
</td></tr>
</table>

Table 7 shows the descriptive measures for the use of computer and specialized technical programs in decision making and its variables. The variables are "Excel" (Q7_1), "Project management program" (Q7_2), "Financial and accounting programs" (Q7_3), "Management programs" (Q7_4), "Statistical programs" (Q7_5) and "Employees affairs programs" (Q7_6). The table presents the mean, the standard deviation, the coefficient of variation (c.v) and the per cent of usage of computer and specialized technical programs for the described variables.

Table 7: Descriptive measures for the use of computer and specialized technical programs in decision making and its variables (Question 7).

Variables	Mean	percent of usage of computer and specialized technical programs %	Std. Deviation	C.V %
"Excel" (Q7_1)	3.9783	79.57	1.14483	28.78
"Project management program" (Q7_2)	2.7609	55.22	1.21445	43.99
"Financial and accounting programs" (Q7_3)	3.7609	75.22	1.21445	32.29
"Management programs" (Q7_4)	3.4565	69.13	1.24198	35.93
"Statistical programs" (Q7_5)	3.3696	67.39	1.19923	35.59
"Employees affairs programs" (Q7_6)	3.3261	66.52	1.23025	36.99
the usage of computer and specialized technical programs in decision making (y2)	3.4420	68.84	.75459	21.92

From the information presented in above Tables 6 and 7, it can be found that that the most used programs are "Excel" and financial and accounting programs where the per cent of usage is 79.57% and 75.22%, respectively. "Project management program" is relatively less used with about 55 % per cent of usage.

It can be observed that the use of management programs, statistical programs, and employees' affairs program is in the middle range and their per cent of usage are 69.13%, 67.39%, and 66.52%, respectively.

Using the Neural network technique to identify the importance of the variables in the usage of computer and specialized technical programs in decision making (y2) follows.

The network uses 76.1% of sample units for training and 23.9% for testing the relationship between the variables and the use of computer and specialized technical programs in decision making which can be represented by four functions which appear in Appendix B:

17.6% "Project management program", 17.2% "Employees affairs programs", 17.1% "Statistical programs", 17% "Management programs", 16.6% "Excel", and 14.5% "Financial and accounting programs".

Table 8 shows an analysis of the differences between demographic variables and the use of computer and specialized technical programs in decision making by using ANOVA test and *t*-test. The table shows the gender, occupation, education, experience, and training courses of the population, and the variables Q7_1, Q7_2, Q7_3, Q7_4, Q7_5, and Q7_6. The table also indicates the t-statistics, the F-ratio statistics and the significance probability Sg.

Table 8: Analysis of the differences between demographic variables and the use of computer and specialized technical programs in decision making by using ANOVA test and t-test. (Question 7)

Variables	Gender		Occupation		Education		Experience		training Courses	
	t	Sig.	F	Sig.	F	Sig.	F	Sig.	F	Sig.
Q7_1	2.027	0.049	0.162	0.689	0.339	0.797	1.440	0.238	7.259	0.000
Q7_2	0.063	0.950	0.187	0.667	1.295	0.289	1.499	0.220	3.106	0.036
Q7_3	0.303	0.763	0.855	0.360	0.620	0.606	0.703	0.595	0.985	0.409
Q7_4	1.432	0.159	0.256	0.615	0.749	0.529	1.621	0.187	0.754	0.526
Q7_5	0.456	0.651	0.117	0.734	0.660	0.582	0.806	0.529	2.522	0.071
Q7_6	0.279	0.782	0.133	0.717	0.435	0.729	0.159	0.958	0.711	0.551
y2	1.020	0.313	0.005	0.946	0.870	0.464	1.570	0.201	4.535	0.008

From the above table, it can be observed that there are significant differences in "Excel", project management program and the usage of computer and specialized technical programs due to training courses. Also, there is a significant difference in "Excel" due to gender.

With regard to the relationship between the usage of computer and specialized technical programs in decision making and the usage and need for MS/OR techniques, it can be found that that the correlation coefficient is 0.354, which means that there is a direct relationship between them. Also, sig F is 0.016 from ANOVA table, which is less than 0.05, indicating that there is a relation between the two variable. In contrast, R-square is 0.125, which means that the usage and need for MS/OR techniques effect by 12.5% in the variation of the usage of computer and specialized technical programs in decision-making.

The information described in Table 9 following outlines a critical review of Question 8 related to the current status of decision-making techniques and presents a sketch of the response to the Likert scale. The table indicates the frequency and per cent of the responses to different versions of Question 8 such as The GFC contributed to increasing the use of decision-making techniques when preparing relevant study of customers (Q8_1), The GFC contributed to increase the use of decision-making techniques when making decisions of investment projects(Q8_2), Future will witness more orientation towards the use of decision-making techniques(Q8_3), and Applying decision-making techniques will be part of the qualifications of the employees and managers of banks(Q_4).

Table 9: A critical review of the current status of decision-making techniques (Question 8).

<table>
<tr><th>S. No.</th><th>Description</th><th>Critical review</th></tr>
<tr><td>1</td><td>The GFC contributed to increasing the use of decision-making techniques when preparing relevant study of customers (Q8_1)</td><td>
<table>
<tr><td>agreement</td><td>disagree</td><td>moderate</td><td>agree</td><td>strongly agree</td></tr>
<tr><td>Frequency</td><td>1</td><td>3</td><td>24</td><td>18</td></tr>
<tr><td>Percent</td><td>2.2</td><td>6.5</td><td>52.2</td><td>39.1</td></tr>
</table>
</td></tr>
</table>

<table>
<tr><td></td><td></td><td>A large number of respondents 39.1% have strongly agreed whereas 52.2% respondents agreed with the reason for increased use of decision-making techniques.</td></tr>
<tr><td>2</td><td>The GFC contributed to increasing the use of decision-making techniques when making decisions of investment projects(Q8_2)</td><td>
<table>
<tr><td>agreement</td><td>disagree</td><td>moderate</td><td>agree</td><td>strongly agree</td></tr>
<tr><td>Frequency</td><td>1</td><td>7</td><td>15</td><td>23</td></tr>
<tr><td>Percent</td><td>2.2</td><td>15.2</td><td>32.6</td><td>50.0</td></tr>
</table>
50% of respondents have strongly agreed whereas 32.6% respondents agreed with the reason for increased use of decision-making techniques when making decisions of investment projects.
</td></tr>
<tr><td>3</td><td>Future will witness more orientation towards the use of decision-making techniques(Q8_3)</td><td>
<table>
<tr><td>agreement</td><td>moderate</td><td>agree</td><td>strongly agree</td></tr>
<tr><td>Frequency</td><td>3</td><td>18</td><td>25</td></tr>
<tr><td>Percent</td><td>6.5</td><td>39.1</td><td>54.3</td></tr>
</table>
54.35% of respondents have strongly agreed whereas 39.13% respondents agreed that in future the orientation towards the use of decision-making techniques will increase.
</td></tr>
<tr><td>4</td><td>Applying decision-making techniques will be part of the qualifications of the employees and managers of banks(Q_4)</td><td>
<table>
<tr><td>agreement</td><td>disagree</td><td>moderate</td><td>agree</td><td>strongly agree</td></tr>
<tr><td>Frequency</td><td>3</td><td>8</td><td>16</td><td>19</td></tr>
<tr><td>Percent</td><td>6.5</td><td>17.4</td><td>34.8</td><td>41.3</td></tr>
</table>
41.3% of respondents have strongly agreed whereas 34.8% respondents agreed that decision-making techniques will be part of the qualifications of the employees and managers of banks.
</td></tr>
</table>

According to the information described in above table, 39.1% of respondents strongly agreed whereas 52.2% respondents agreed that the GFC contributed to increasing the use of decision-making techniques when preparing a relevant study of customers.

Also, 50% of respondents strongly agreed whereas 32.6% of respondents agreed that the GFC contributed to increasing the use of decision-making techniques when making decisions of investment projects.
Similarly, 54.35% of respondents strongly agreed whereas 39.13% of respondents agreed that in the future the orientation towards the use of decision-making techniques will increase
With respect to the last question of the table, 41.35% of respondents strongly agreed whereas 34.8% of respondents agreed that the decision-making techniques will be part of the qualifications of the employees and managers of banks in the future.

Table 10 presented following shows the descriptive measures for the current status of decision-making techniques and its variables. The table displays the mean, the percent of current status, the standard deviation the C.V , and the following variables: The GFC contributed to increasing the use of decision-making techniques when preparing relevant study of customers (8_1), The GFC contributed to increasing the use of decision-making techniques when making decisions of investment projects(8_2), Future will witness more orientation towards the use of decision-making techniques(8_3), applying decision-making techniques will be part of the qualifications of the employees and managers of banks(8_4) and the current status of decision-making techniques(8_5).

Table 10: The descriptive measures for the current status of decision-making techniques and its variables (Question 8).

Variables	Mean	percent of current status %	Std. Deviation	c.v %
The GFC contributed to increasing the use of decision-making techniques when preparing relevant study of customers (8_1)	4.2826	85.65	0.68841	16.07
The GFC contributed to increasing the use of decision-making techniques when making decisions of investment projects (8_2)	4.3043	86.09	0.81294	18.89
Future will witness more orientation towards the use of decision-making techniques (8_3)	4.4783	89.57	0.62322	13.92
Applying decision-making techniques will be part of the qualifications of the employees and managers of banks (8_4)	4.1087	82.17	0.92444	22.5
The current status of decision-making techniques (8_5)	4.2935	85.87	0.55353	12.89

By analyzing Tables 9 and 10, it can be seen that 85.65% of respondents agreed that the GFC contributed to increasing the use of decision-making techniques when preparing a relevant study of customers.

Also, 86.09% of respondents have strongly agreed that the GFC contributed to increasing the use of decision-making techniques when making decisions of investment projects.
In the same way, 89.57% of respondents have strongly agreed that in the future the orientation towards the use of decision-making techniques will increase.
Similarly, 82% of respondents indicated that decision-making techniques will be part of the qualifications of the employees and managers of banks in the future.
According to these findings, the thrust for the decision-making techniques is the result of the GFC. The use of these techniques is going to be increased in coming days and knowledge of these techniques will be one of the essential requirements in the selection of bank employees.
Using neural network techniques to identify the importance of the variables in the current status of decision-making technique (y3) follows:
The network uses 78.3% of sample units for training and 21.7% for testing the relationship between the variables and the current status of decision-making techniques which can be represented by three functions which appear in Appendix B:
28.2% Applying decision-making techniques will be part of the qualifications of the employees and managers of banks, 27.6% The GFC contributed to increasing the use of decision-making techniques when preparing relevant study of customers, 25.8% The GFC contributed to increasing the use of decision-making techniques when making decisions of investment projects, and 18.4% Future will witness more orientation towards the use of decision-making techniques.
Table 11 following illustrates an analysis of the differences between demographic variables and the current status of decision-making techniques by using ANOVA test and *t*-test. The table describes the gender, occupation, education, experience, and training courses of the population, and the variables Q8_1, Q8_2, Q8_3, Q8_4, and Q8_5. The table also specifies the t-statistics, the F-ratio statistics and the significance probability Sg.
From the table, it is possible to infer that the GFC contributed to increasing the use of decision-making techniques when making decisions of investment projects.
Also, the information suggests that there is a relationship among the usage of computer and specialized technical programs in decision making, the usage and need for MS/OR techniques and the current status of decision-making techniques**.**

Table 11: Analysis of the differences between demographic variables and the current status of decision-making techniques by ANOVA test and t test (Question 8).

Variables	Gender		Occupation		Education		Experience		training Courses	
	t	Sig.	F	Sig.	F	Sig.	F	Sig.	F	Sig.
Q8_1	-.518	0.607	.504	0.482	1.311	0.283	.934	0.454	1.071	0.371
Q8_2	1.354	0.183	.484	0.490	3.654	0.020	1.454	0.234	.447	0.721
Q8_3	-.717	0.477	.042	0.838	.277	0.842	2.239	0.081	.772	0.516
Q8_4	1.761	0.085	.069	0.794	.497	0.687	.798	0.533	2.115	0.113
Q8_5	1.604	0.116	.041	0.841	1.787	0.164	.962	0.439	.966	0.418

Table 12 shows the correlations between the current status of decision-making techniques and the usage and need for MS/OR techniques and the use of computer and specialized technical programs in decision making. The table also displays the correlation coefficient between the specified variables.

Table 12: The correlations between the current status of decision-making techniques and the usage and need for MS/OR techniques and the use of computer and specialized technical programs in decision making (Question 8).

Correlations		
Variables	**the usage and need for MS/OR techniques**	**the usage of computer and specialized technical programs in decision making**
the current status of decision-making techniques	0.299*	0.359*

*Correlation is significant at the 0.05 level (2-tailed).

From the above table, the correlation coefficient indicates that there is a direct relationship between the current status of decision-making techniques and the usage and need for MS/OR techniques and the use of computer and specialized technical programs in decision making.

Table 13 shown following presents information which exhibits a critical review of Question 9 related to the obstacles limiting the use of decision-making techniques and presents the response to the Likert scale. Also, the table indicates the frequency and per cent of respondents to different versions of Question 9 such as Lack of adequate financial support (Q9_1), Lack of specialists (Q9_2), Lack of interest and the conviction of senior managers (Q9_3), Difficulty of dealing with decision-making techniques (Q9_4) and Nature of work environment does not help using these techniques (Q9_5).

According to the information displayed in the table, about 28% of the respondents do not agree that lack of financial support is an obstacle in limiting the use of decision-making techniques.

Also, 69% of the respondents considered that the lack of specialists is an obstacle in limiting the use of decision-making techniques.

About 42% of respondents supported that the lack of interest and the conviction of senior managers are obstacles in limiting the use of decision-making techniques. 33% of respondents are opposed to the opinion, and 24.44 % were neutral.

With respect to the difficulty of dealing with decision-making techniques, 41 % of respondents disagreed that it is an obstacle limiting the use of decision-making techniques. 30.4 % of respondents are opposed to this view, and 28.3% had neutral opinions.

In total, 50% of respondents disagreed that the nature of work environment limits the use of decision-making techniques. 28.3% of respondents are opposed to the opinion, and 21.7 % had neutral views.

Table 13: Critical review of the obstacles limiting the use of decision-making techniques (Question 9)

<table>
<tr><th>No.</th><th>Description</th><th>Critical review</th></tr>
<tr><td>1</td><td>Lack of adequate financial support (Q9_1)</td><td>
<table>
<tr><td>agreement</td><td>highly disagree</td><td>disagree</td><td>moderate</td><td>agree</td><td>strongly agree</td></tr>
<tr><td>Frequency</td><td>2</td><td>11</td><td>15</td><td>12</td><td>6</td></tr>
<tr><td>Percent</td><td>4.3</td><td>23.9</td><td>32.6</td><td>26.1</td><td>13.0</td></tr>
</table>
About 28% of the respondents do not agree that lack of financial support is an obstacle in limiting the use of decision-making techniques.
</td></tr>
<tr><td>2</td><td>Lack of specialists (Q9_2)</td><td>
<table>
<tr><td>agreement</td><td>highly disagree</td><td>disagree</td><td>moderate</td><td>agree</td><td>strongly agree</td></tr>
<tr><td>Frequency</td><td>2</td><td>6</td><td>6</td><td>20</td><td>12</td></tr>
<tr><td>Percent</td><td>4.3</td><td>13.0</td><td>13.0</td><td>43.5</td><td>26.1</td></tr>
</table>
69% of the respondents consider the lack of specialists as an obstacle in limiting the use of decision-making techniques.
</td></tr>
<tr><td>3</td><td>Lack of interest and the conviction of senior managers (Q9_3)</td><td>
<table>
<tr><td>agreement</td><td>highly disagree</td><td>disagree</td><td>moderate</td><td>agree</td><td>strongly agree</td></tr>
<tr><td>Frequency</td><td>3</td><td>13</td><td>11</td><td>11</td><td>8</td></tr>
<tr><td>Percent</td><td>6.5</td><td>28.3</td><td>23.9</td><td>23.9</td><td>17.4</td></tr>
</table>
This reason as an obstacle is supported by 42% and opposed by33% of the respondents. 24.44% respondents were neutral.
</td></tr>
<tr><td>4</td><td>Difficulty of dealing with decision-making techniques(Q9_4)</td><td>
<table>
<tr><td>agreement</td><td>highly disagree</td><td>disagree</td><td>moderate</td><td>agree</td><td>strongly agree</td></tr>
<tr><td>Frequency</td><td>2</td><td>17</td><td>13</td><td>11</td><td>3</td></tr>
<tr><td>Percent</td><td>4.3</td><td>37.0</td><td>28.3</td><td>23.9</td><td>6.5</td></tr>
</table>
41% respondents disagreed with this and 30.4% supported it. 28.3% had neutral views.
</td></tr>
<tr><td>5</td><td>Nature of work environment does not help using these techniques(Q9_5)</td><td>
<table>
<tr><td>agreement</td><td>highly disagree</td><td>disagree</td><td>moderate</td><td>agree</td></tr>
<tr><td>Frequency</td><td>5</td><td>18</td><td>10</td><td>13</td></tr>
<tr><td>Percent</td><td>10.9</td><td>39.1</td><td>21.7</td><td>28.3</td></tr>
</table>
50% respondents disagreed with this and 28.3% supported it. 21.7% had neutral views.
</td></tr>
</table>

Table 14 shows descriptive measures for the obstacles limiting the use of decision-making techniques, it can be observed that this table presents the mean, the percent of obstacles limiting the use of decision-

making techniques, the standard deviation, the coefficient of variation (c.v), and the following variables: lack of specialists, lack of adequate financial support, lack of interest and the conviction of senior managers and difficulty of dealing with decision-making techniques.

Table 14: The descriptive measures for the obstacles limiting the use of decision-making techniques and its variables. (Question 9)

Variables	Mean	percent of obstacles in limiting %	Std. Deviation	C.V. %
Lack of specialists	3.7391	74.78	1.12417	30.07
Lack of adequate financial support	3.1957	63.91	1.08770	34.04
Lack of interest and the conviction of senior managers	3.1739	63.48	1.21663	38.33
Difficulty of dealing with decision-making techniques	2.9130	58.26	1.02905	35.33
Nature of work environment does not help using these techniques	2.6739	53.48	1.01224	37.86

From Tables (13) and (14), it can be found that:
63.91% of the respondents agree that the lack of financial support is an obstacle in limiting the use of decision-making techniques.
74.78% of the respondents consider the lack of specialists as an obstacle in limiting the use of decision-making techniques.
63.48% of the respondents believe that the lack of interest and the conviction of senior managers is an obstacle is in limiting the use of decision-making techniques.
In the same way, 58.26% of respondents agreed that the difficulty of dealing with decision-making techniques is an obstacle limiting the use of these techniques.
Likewise, 53.48% of respondents said that nature of work environment is an obstacle in using these techniques.
The results indicate that lack of specialists and lack of financial support are the main reasons as obstacles in the use of decision-making techniques whereas lack of interest and conviction among senior managers, difficulties in dealing with the techniques and the nature of the work environment are obstacles to some extent.
Using Neural network techniques to identify the importance of the variables for the obstacles limiting the use of decision-making techniques (y4) follows:

The network uses 65.2% of sample units for training and 34.8% for testing the relationship between the variables and the obstacles in limiting the use of decision-making techniques which can be represented by two functions which appear in Appendix (2):
24.7% for Difficulty of dealing with decision-making techniques, 18.9% for Lack of specialists, 18.9 % for Lack of adequate financial support and 18.9% for Lack of interest and the conviction of senior managers, and 18.5% for Nature of work environment that does not help using these techniques.

The information displayed in Table 15 described following presents a critical review of question 10 related to the ways to activate the use of decision-making techniques and presents the response to the Likert scale. The table indicates the frequency and per cent of respondents to different versions of Question 10 such as Establishment of a specialized training center in quantitative methods and decision-making techniques (Q10_1), Establishment of a specialized department in quantitative methods and techniques in decision-making (Q10_2), Get external consulting continuously (Q10_3) and Nominating employees and managers to training programs for decision-making techniques (Q10_4).
From the information displayed in this Table, it can be noted that 98% of respondents agreed for establishing a specialized training center in quantitative methods and decision-making techniques to enhance the use of decision-making techniques.
89% of respondents consented for establishing a specialized department in quantitative methods and techniques in decision-making to enhance the use of decision-making techniques.
70% of the respondents favored getting external consulting to enhance the use of decision-making techniques.
And, 98% of the respondents agreed to send employees and managers to training programs for decision-making techniques to enhance the use of decision-making techniques.

Table 15: A critical review of the ways to activate the use of decision-making techniques (Question 10).

<table>
<tr><th>S. No.</th><th>Description</th><th>Critical views</th></tr>
<tr><td>1</td><td>Establishment of a specialized training center in quantitative methods and decision-making techniques (Q10_1)</td><td>
<table>
<tr><td>agreement</td><td>moderate</td><td>agree</td><td>strongly agree</td></tr>
<tr><td>Frequency</td><td>1</td><td>15</td><td>30</td></tr>
<tr><td>Percent</td><td>2.2</td><td>32.6</td><td>65.2</td></tr>
</table>
98% respondent agreed for establishing a specialized training center in quantitative methods and decision-making techniques to enhance the use of decision-making techniques.
</td></tr>
<tr><td>2</td><td>Establishment of a specialized department in quantitative methods and techniques in decision-making(Q10_2)</td><td>
<table>
<tr><td></td><td>moderate</td><td>agree</td><td>strongly agree</td></tr>
<tr><td>Frequency</td><td>5</td><td>20</td><td>21</td></tr>
<tr><td>Percent</td><td>10.9</td><td>43.5</td><td>45.7</td></tr>
</table>
89% respondent agreed for establishing a specialized department in quantitative methods and techniques in decision-making to enhance the use of decision-making
</td></tr>
</table>

<table>
<tr><td></td><td></td><td>techniques.</td></tr>
<tr><td>3</td><td>Getting external consulting continuously(Q10_3)</td><td>
<table>
<tr><td>agreement</td><td>disagree</td><td>moderate</td><td>agree</td><td>strongly agree</td></tr>
<tr><td>Frequency</td><td>2</td><td>12</td><td>19</td><td>13</td></tr>
<tr><td>Percent</td><td>4.3</td><td>26.1</td><td>41.3</td><td>28.3</td></tr>
</table>
70% of the respondents favored getting external consulting to enhance the use of decision-making techniques.
</td></tr>
<tr><td>4</td><td>Nominating employees and managers to training programs for decision-making techniques (Q10_4)</td><td>
<table>
<tr><td>agreement</td><td>moderate</td><td>agree</td><td>highly agree</td></tr>
<tr><td>Frequency</td><td>1</td><td>6</td><td>39</td></tr>
<tr><td>Percent</td><td>2.2</td><td>13.0</td><td>84.8</td></tr>
</table>
98% of the respondents favored sending employees and managers to training programs for decision-making techniques to enhance the use of decision-making techniques.
</td></tr>
</table>

Analyzing Table 16., it can be noted that it shows the descriptive measures for the ways to activate the use of decision-making techniques and its variables. Also, the table provides the mean, percent of ways to activate the use, the standard deviation, the coefficient of variation (C.V.) , and the following variables: nominating employees and managers to training programs for decision-making techniques, establishment of a specialized training center in quantitative methods and decision-making techniques, establishment of a specialized department in quantitative methods and techniques in decision-making, and get external consulting continuously.

Table 16: The descriptive measures for the ways to activate the use of decision-making techniques and its variables (Question 10).

Variables	**Mean**	**percent of ways to activate the use %**	**Std. Deviation**	**C.V. %**
Nominating employees and managers to training programs for decision-making techniques	4.8261	96.52	0.43738	9.06
Establishment of a specialized training center in quantitative methods and decision-making techniques	4.6304	92.61	0.53161	11.48
Establishment of a specialized department in quantitative methods and techniques in decision-making	4.3478	86.96	0.67387	15.5
Get external consulting continuously	3.9348	78.7	0.85381	21.7

From Tables 15 and 16, the following can be noted:
96.52% of respondent purported to agree for establishing a specialized training center in quantitative methods and decision-making techniques to enhance the use of decision-making techniques.

92.61 of respondents would support the establishment of a specialized training center in quantitative methods and decision-making techniques.
86.96% of respondent agreed for establishing a specialized department in quantitative methods and techniques in decision-making to enhance the use of decision-making techniques.
78.7 % of the respondents favored getting external consulting to enhance the use of decision-making techniques.
These results point out that a large percentage of respondents favored the establishment of a specialized training center and a specialized department, getting external consultancy and training to employees and managers to enhance the use of MS/OR techniques in decision-making.
Using Neural network to identify the importance of the variables in the ways to activate the use of decision-making techniques (y5) follows:
The network uses 67.4% of sample units for training and 32.6% for testing the relationship between the variables and the ways to activate the use of decision-making techniques which can represent by two functions which appear in ***Appendix 2***.
35.5% Get external consulting continuously, 22.4% Establishment of a specialized training center in quantitative methods and decision-making techniques, 21.6% Establishment of a specialized department in quantitative methods and techniques in decision-making, and 20.4% Nominating employees and managers to training programs for decision-making techniques.
Considering Table 17 in which appears the correlation between the current status of decision-making techniques and the ways to activate the use of decision-making techniques we note that the table displays the correlation coefficient between the specified variables.

Table 17: The correlations between the current status of decision-making techniques and the ways to activate the use of decision-making techniques. (Question 10)

Correlations				
variables	**Establishment of a specialized training center in quantitative methods and decision-making techniques**	**Establishment of a specialized department in quantitative methods and techniques in decision-making**	**Get external consulting continuously**	**Nominating employees and managers to training programs for decision-making techniques**
the current status of decision-making techniques	**0.452***	**0.361***	**0.182**	**0.399***

From above table, it can be found that that there is a direct proportion between the current status of decision-making techniques and the establishment of a specialized training center in quantitative methods and decision-making techniques, and the establishment of a specialized department in quantitative

methods and techniques in decision-making and nominating employees and managers to training programs for decision-making technics.

To determine which ways to active the use and effect of decision-making specialized training center in quantitative methods in the current status of decision-making techniques, multiple stepwise regression was used. It was found that the only way is the establishment of a specialized training center in quantitative methods and decision-making techniques with F-statistic value 11.315, significant probability 0.002, correlation coefficient 0.452 and R-square 0.205. The model excluded other ways due to the mulitecolinearity problem.

Conclusions

Although the available knowledge of quantitative methods for decision-making techniques is limited and there is a great need to apply them in banking works. The literature review showed that some commercial banks are using MS/OR techniques to support strategic decision-making and to estimate the efficiency and performance of large and small banks around the world.

According to the results of this study, a high percent of respondents indicated that they felt the need to use and apply decision-making techniques in their work. A low percentage of the use and application of these techniques was reported and found to be due to age, the level of education, lack of adequate training, lack of specialists and lack of financial support. Evidently, the situation can be improved by motivation and sufficient preparation on the subject during the university studies and training courses promoted by the bank managers after the recruitment process. In relation to the issue, most respondents are in agreement with the establishment of a specialized training center to enhance the use of MS/OR techniques in decision-making. They believe that the use and application of these techniques will increase progressively in the future and will be a part of qualifications of bank employees. Furthermore, training courses can have a significant effect on knowledge of quantitative methods for decision-making, knowledge of decision-making techniques and the usage and need for MS/OR techniques. In addition, the need to apply decision-making techniques in the bank work has a significant difference due to education. In general, knowledge, education and information combined with managerial awareness are determinants of bank efficiency and performance.

With regard to the use of computer and specialized technical programs in decision making such as Excel, project management program, financial and accounting programs, management programs, statistical programs and employees affairs program, the results show that the extension of the usage is reasonable and there is a scope of specialized technical programs for increasing their usage. The findings also indicate that the most used programs are Excel and financial and accounting programs while Project management programs are relatively less used. By increasing the skills in the usage of MS/OR techniques and the use of computer and specialized technical programs in decision making, the current status of decision-making techniques will improve due to the direct relationship between them.

The main obstacle in limiting the use of decision-making techniques is the lack of specialists and the lack of financial support. The main ways to activate the use of decision-making techniques are nominating employees and managers to training programs for decision-making techniques and the establishment of a specialized training center in quantitative methods and decision-making techniques.

There is no relation between the current status of decision-making techniques and to get external consulting continuously, which means that banks need to interact with the external consulting to increase

their knowledge about the decision-making techniques and their suitable uses in order to maximize the efficiency of decision-making process. Establishment of a specialized training center in quantitative methods and decision-making techniques can explain the variability in the current status of decision-making techniques.

The main limitation of this work is that the survey was applied in the selected region of Alhasa, Saudi Arabia, so that the results could be predisposed by the features of that specific area. However, the similarity of important characteristics of the banking system of Saudi Arabia such as the management and organization of the banks, the software and the application of standard OR tools make these results usable for at least this country. More investigation is necessary to complete and extend these results to the entire Arab world.

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Appendixes

Appendix A

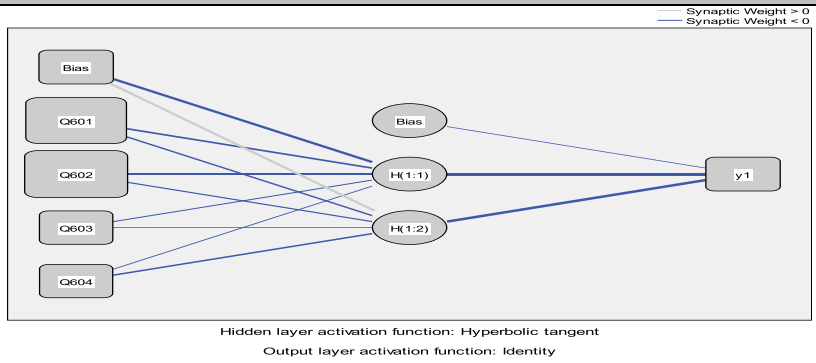
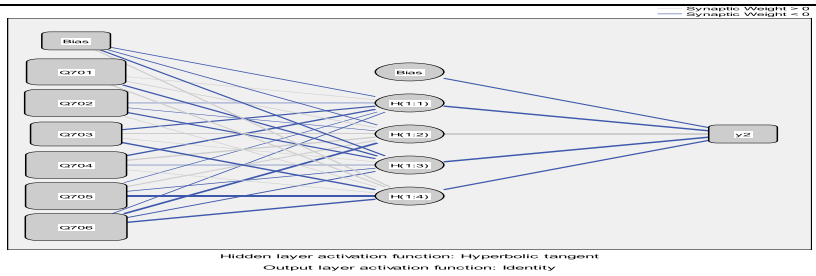
Appendix A: The demographic characteristics of research's respondent

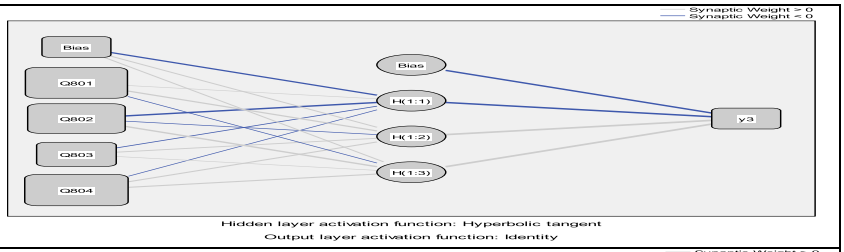
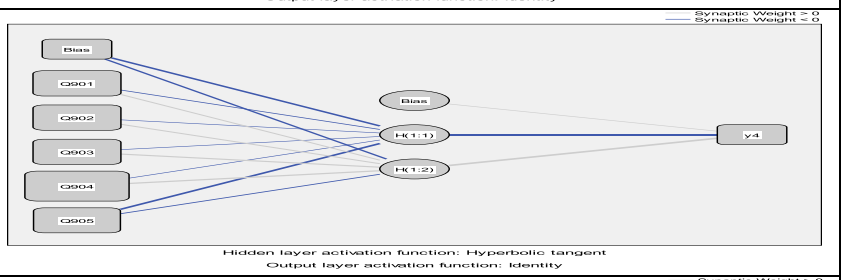
Variables		**Frequency**	**Percent**
Gender	male	22	47.8
	female	24	52.2
Occupation	Branch Manager	26	56.5
	others	20	43.5
Education	secondary	3	6.5
	Diploma	6	13.0
	Bachler	36	78.3

	High Studies	1	2.2
Experience	less than 5 years	19	41.3
	5 -10	15	32.6
	11 - 15	6	13.0
	more than 15 years	6	13.0
Training courses	1 - 2	7	15.2
	3 - 4	10	21.7
	more than 5	25	54.3
	null	4	8.7

Appendix B

Appendix B: The results of neural networks

Variables	Neural network output
the usage and need for MS/OR techniques	
the usage of computer and specialized technical programs in decision making	

the current status of decision-making techniques	
of the obstacles in limiting the use of decision-making techniques	
the ways to activate the use of decision-making techniques	