INTERNATIONAL JOURNAL OF RESEARCH IN COMMERCE, ECONOMICS & MANAGEMENT

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A MONTE CARLO RISK ANALYSIS OF THE REAL TIME GROSS SETTLEMENT SYSTEM OF FUND TRANSFER IN ZAMBIA

MUDENDA COLLINS
HEAD OF DEPARTMENT
THE COPPERBELT UNIVERSITY
KITWE

KRISTEN KOMBE
BANKER
BANK OF ZAMBIA
NDOLA

ABSTRACT

Risk analysis is a concept that has attracted many researchers and practitioners in both business and project management fields. This is because both businesses and projects aim at avoiding and or minimising losses while maximising gains. This view was adopted when undertaking the current study whose aim was to perform a risk analysis of risks associated with the Real Time Gross Settlement System (RTGS) operated by the Bank of Zambia. The RTGS System is a money transfer system intended to transfer funds safely, quickly and conveniently but the implementation approach in Zambia was done without a comprehensive risk analysis. It is against this background that the researchers undertook to simulate the risks of the RTGS in order to classify risks according to severity on business transactions. Literature relevant to answer the research questions was reviewed. The research design used was descriptive and explorative in which semi structured questionnaires were used to collect data. Responses from users of the RTGS were coded and used to generate descriptive statistics which were in turn used as entry parameters prior to simulation. The simulation outputs revealed that fraud, liquidity, human, settlement, replacement and systematic risks were high risks. High risk meant that they are highly likely to occur with very severe consequences. On the other hand, legal, credit, fire, technology, hacking and operation risks were found to be medium risks. They can occur in as much as they cannot and the consequences range from sever to bearable. Lastly, the only low risk was found to be theft risk. This implies that the chance of losing money through theft when using the RTGS is negligible. Finally, the research has revealed that the RTGS system is not a risk free facility and can yield catastrophic consequences to the business transactions.

KEYWORDS
risk, rtgs, simulation, fund, monte carlo.

INTRODUCTION

Risk management (RM) is in use in almost all industries, from IT related business, automobile or pharmaceutical industry, the construction sector to the banking sector. Each industry has developed their own risk management standards, but the general ideas of the concept usually remain the same regardless of the sector. According to the Project Management Institute (PMI) (2004), project risk management is one of the nine most critical parts of project commissioning. This indicates a strong relationship between managing risks and project success. While risk management is described as the most difficult area within construction management (Winch, 2002; Potts 2008), its application is promoted in all projects in order to avoid negative consequences (Potts, 2008). Risk management uses the risk management process (RMP) to identify analyse and respond to risks (Cooper et al., 2005). In each of these steps, there are a number of methods and techniques which facilitate handling the risks.

The industry at issue, the banking industry, operates in a very uncertain environment where conditions can change due to the sensitivity of each operation (Sanvido et al., 1992), and yet the industry aims at becoming successful therefore risk management can facilitate this aim. However, it should be underlined that risk management is not a tool which ensures success but rather a tool which helps to increase the probability of achieving success. Risk management is therefore a proactive rather than a reactive concept. Many previous studies (Klemetti, 2006; Lyons and Skitmore, 2004; Zou et al. 2006) have been conducted within the field of risk management but each presents a different approach to this study. This work focuses on the banking sector and particularly the newly introduced Real Time Gross Settlement system for funds transfer in Zambia.

The current study seeks to analyse the risk associated with the Real Time Gross Settlement system of money transfer in Zambia. The system is based on real time money transfer whereby the recipient receives the money just after the transfer command no matter the location of the recipient. The system is information technology (IT) based and is therefore susceptible to risks. Common risks suffered by the system include credit risk, technology failure risk, liquidity risk and operation risk.

The computerization of the workplace and the levels of IT dependency that now exist means the risks associated with the failure of IT systems owe one of the most potent sources of operational risk within any organization (Kremljak and Kafol, 2014).

It is important therefore that risk analysis is conducted and mitigation measures highlighted in the risk register to guarantee business operations. The risk analysis that produces a risk register as an output is the methodology that will be mimicked in the current paper.

Risk analysis, or 'probabilistic simulation' based on the Monte-Carlo simulation technique is a methodology by which the uncertainty encompassing the main variables projected in a forecasting model is processed in order to estimate the impact of risk on the projected results (Glenday, 1989). It is a technique by which a mathematical model is subjected to a number of simulation runs, usually with the aid of a computer. During this process, successive scenarios are built up using input values for the project's key uncertain variables which are selected at random from multi-value probability distributions (Pouliquen, 1970). The current research will adopt this analytical approach to analyse the risks associated with the Real Time Gross Settlement system to produce a risk profile and risk register

THE REAL TIME GROSS SETTLEMENT SYSTEM (RTGS)

The Real Time Gross Settlement Systems offer a rich set of banking-related services that provide value throughout the financial and real sectors of the economy. Bank and non-bank financial institutions, commercial and industrial firms, and even individuals benefit from use of RTGS services. The terms and conditions under which access to RTGS services is granted have an important bearing on how effectively and efficiently an RTGS system supports the financial and real sectors of the economy. Moreover, the terms of access affect the abilities of the providers and users of RTGS services to manage their payment system risks.

The Real Time Gross Settlement System (RTGS) is a system of fund transfer where transfer of money takes place from one bank to another on a real time and gross basis. Settlement in real time system means payment transaction is not subjected to any waiting period. The transaction is settled as soon as it is processed. The transaction is settled on one to one basis without netting with any other transaction. Once processed, payments are final and irrevocable and this makes the system liable to loss hence risky. The principal goals of the international central banking community in offering RTGS services are to increase safety and efficiency in systemically important payment systems, thereby serving the wider objectives of large-value payment systems across the financial markets and the real economy (Allsopp, et at., 2008).

The World Bank Group (2008) surveyed 142 central banks about their national payment systems. The survey included questions about national large-value and RTGS systems, and also about settlement arrangements for securities and foreign exchange that rely on RTGS systems for final settlement. The central bank respondents indicated that an RTGS is a feature of their national payment systems in 112 of the 142 cases. The central bank is the settlement authority for every RTGS system, and the RTGS system is operated by the central bank in 108 cases. Some countries share RTGS platforms and altogether the survey identified 98 distinct systems. The survey results suggest that central bank operational principles and practices vary greatly across these systems in the areas of access, liquidity and credit, and costing and pricing and this variation is another source of risk (Allsopp, *et at*., 2008).

The analysis of risk in this paper will focus on settlement accounts only and the risks will be analysed using a risk profile generated from the probability of occurrence and impact after occurrence outputting a risk register. This will be determined from the mean, variance, standard deviation, skew and kurtosis of both occurrence and impact.

This is consistent with Allsopp, et al. (2008) who argued that both the IMF review and the Bank of England response focus only on credit risk to the correspondent banks acting as direct access settlement participants on behalf of their respondent bank indirect access participants. This one directional view is presumably motivated by the concern with systemic risk caused by the failure of large financial institutions, a concern which underlies the British Standard Institute (BIS) core principles. There is, however, another type of systemic credit and liquidity risk that posed to the respondent banks through the failure of a large, direct access settlement participant. An unasked "what if" question concerns the implications of broadly transmitted credit and/or liquidity risk from one or more direct access participants to the population of respondent banks and other indirect access participants such as clearing organizations and investment banks.

This type of risk is illustrated by the 1974 failure of Continental Illinois National Bank in the United States. Continental served as a large correspondent bank and gateway to the interbank payment system, and a major financial stability consideration at the time of its failure and intervention by bank regulatory authorities was concerned about the financial standing of the large network of respondent banks.

STUDY OBJECTIVES

The problem in this study is that risks associated with operating the Real Time Gross System in Zambia have not been analysed and documented. This implies that customers make uninformed decisions when using the system because no risk register is available to take calculated risks when using the system. Further, Allsopp (2008) argues that the RTGS is a single point of failure across the entire financial system, in that participants face liquidity impacts from all of their links, as well as settlement links to clearing houses and other elements of financial markets infrastructures, sometimes in multiple countries and currencies simultaneously. In as much as the system is important for easy and fast business transactions, the systems possess inherent and external risks with great potential for huge losses should the risks materialize. The World Bank survey of 2007, revealed risks such as credit and liquidity which are linked to the transmitters of the funds but did not analyse in detail the risks specific and internal to the system. Therefore, there is inadequacy coverage of risks directly linked to the system and risks external to the system and this is what the current study seeks to analyse. This analysis is based on the objective of ascertaining the risk profile of RTGS system in Zambia and determining the risk classification of the RTGS risks in Zambia

LITERATURE REVIEW

INTRODUCTION

This chapter reviews literature relevant to the study. Research interest relating to risk analysis will be discussed within the connotation of the current study. The chapter will present an overview of risk analysis and keep developing the literature around risk analysis with particular focus on the money transfer system.

RISK ANALYSIS

Over the last decades, risk analysis and corporate risk management activities have become very important elements for both financial as well as non-financial corporations. Firms are exposed to different sources of risk, which can be divided into operational risks and financial risks.

In the field of safety and health, risk is linked with possible hazards and dangers, while in finance it is a technical matter of unpredictability in expected outcomes, both negative and positive. In other businesses and political settings, risk is closely associated with the spirit of enterprise and value creation (Power, 2007, p.3).

In today's business, nearly all decisions are taken purely on a financial consequences basis. Business leaders need to understand and know whether the returns on a project justify taking risks, and the extent of these consequences (losses) if the risks do materialize. Investors, on the other hand, need some indication of whether the returns on an investment meet their minimum returns if the investment is fully exposed to the risks identified. Merna (2002) suggests: "we are at a unique point in the market where players are starting to recognize that risks need to be quantified and that information about these projects needs to be made available to all participants in the transaction."

Therefore, identifying risks and quantifying them in relation to the returns of a project is important. Additionally, by knowing the full extent of their gains and/or losses, business leaders and investors can then decide whether to sanction or cancel an investment or project.

Rowe (1977) defines risk as 'The potential for unwanted negative consequences of an event or activity' whilst many authors define risk as 'A measure of the probability and the severity of adverse effects'. Rescher (1983) explains that 'Risk is the chancing of a negative outcome. To measure risk, we must accordingly measure both its defining components, and the chance of negativity'. The way in which these measurements must be combined is described by Gratt (1987) as 'estimation of risk is usually based on the expected result of the conditional probability of the event occurring times the consequences of the event given that it has occurred' Analysis and assessment of risks provides a systematic approach for evaluating the risks that stakeholders identify.

The purpose of risk analysis is to determine the likelihood of occurrence of each identified risks and its impact on the project so as to plan for the appropriate response (Marchewka, 2003, p.179)." According to Passenheim (2009, p. 83), "risk analysis covers a complete and continuous evaluation which should be qualitative as well as quantitative for all identified risks. Its goal is to detect possible interrelationships and enables the project manager to identify some order of importance or prioritization."

Risk analysis can be qualitative based on subjective assessment using experience or intuition. Quantitative analysis on the other hand is based on mathematical and statistical techniques that allow to model a respective risk situation. However, "quantitative techniques operate around some probability rule of the thumb (Marchewka, 2003, p. 200)."

Each approach has its own strengths and weaknesses when dealing with risk and uncertainty but a combination of qualitative and quantitative methods provides valuable insight when performing risk analysis and assessment. However, Passenheim (2009) and Nicholas and Steyn (2008), observed that "in order to do a proper risk evaluation, the level to conduct the evaluation should be defined. For instance, there should be ranges say between (0 -1.0) to give the severity/likelihood a "size" which denotes a range from low, very low, and high to very high, where 0 is "not serious" and 1.0 is "catastrophic and needs attention. Both qualitative and quantitative ratings are based on judgment of managers and experts.

CONCEPT DESCRIPTION

The conceptualized research model represents a decision to implement RTGS tempting the implementer to predict the risk that may come with the money transfer system. This implementation therefore provokes and yields the risk such as liquidity, credit, legal, technology failure, human error, principal, systemic and fraud. Since the implementer is a business party seeking to maximize gain, this gain maximizing desire triggers risk analysis that determines with certainty the probability of occurrence of any of the anticipated risk and the associated consequence after occurrence.

Risk analysis, or 'probabilistic simulation' based on the Monte-Carlo simulation technique is a methodology by which the uncertainty encompassing the main variables projected in a forecasting model is processed in order to estimate the impact of risk on the projected results. It is a technique by which a mathematical model is subjected to a number of simulation runs, usually with the aid of a computer. During this process, successive scenarios are built up using input values for the project's key uncertain variables which are selected at random from multi-value probability distributions. The simulation is controlled so that the random selection of values from the specified probability distributions does not violate the existence of known or suspected correlation relationships among the project

variables. The results are collected and analysed statistically so as to arrive at a probability distribution of the potential outcomes of the project and to estimate various measures of project risk

Risk analysis is simulated using Monte Carlo simulation whereby the highest mean, low kurtosis, low standard deviation and variability relates with low risk situations whereas high kurtosis, low mean, high standard deviation and variability relates with high risk. The simulation is performed over 10,000 times to arrive at accurate predictions of the risk profiles.

The risk analysis techniques are based on occurrence probability and impact of occurrence which if combined determines the riskiness of the event. This whole process in turn outputs a risk register that profiles the risk and determines courses of action to respond to the risks.

Proactive responses to risk include aspects of risk avoidance and risk transfer while reactive response provides for risk mitigation and acceptance. However, each response aspect has numerous specific responses to use to make the event safe and event in this work means real time gross settlement system.

METHODOLOGY

INTRODUCTION

This study describes in detail how the research was conducted. It is simply a framework or plan of the study. It outlines the procedures and tools used in collecting, analyzing and interpreting the data. This chapter is used as a guide in collecting and analyzing data. It describes the nature of the data that was used to analyse the risks associated with RTGS money transfer system.

RESEARCH DESIGN AND DATA COLLECTION

To achieve the objectives of the research, an exploratory research was ideal and therefore adopted. During this research, data was collected from bank clients who have used the RTGS system before. This is because parties that have never used it or knows nothing about it would not give reasonable responses. A pilot questionnaire on ten bank clients that have used the system before and ten bank clients that have not used the system before showed a major difference in responses such that clients without experience could not understand the meaning of questions as well as the system itself. Most of them were not aware of the facility.

The research determined one population made up of individual clients equal to one thousand six hundred and seventy-five clients (1675) users of the system. The researcher undertook to administer questionnaires to a sample of 323 clients generated from Yamanes's formula as follows:

n=N/(1+N〖(e)〗^2)

Where n is the sample size, N is the population size, and e is the level of precision which was set at 0.05 (5%) with a confidence level of 95%.

Applying the formula to derive the sample size gives the following;

n=1675/(1+1675〖(0.05)〗^2) = 323

These n = 323 were sampled according to proportion contribution to the population per bank. The researchers administered questionnaires at random at the bank entrance assisted by research assistants until the required number was reached

RESULTS AND DISCUSSION

A 93% response rate was achieved in the study. Responses from bank clients on the risks experienced in their transactions using RTGS shows that technology, fraud and liquidity are the prominent few that affect the system and can potentially disrupt business whereas the rest of the seven risks have little occurrence probability and little effect on the system. After asking what could have caused technology failure, most clients revealed that power disruptions, fibre cut instances and internal failures in the RTGS hardware lead to the technology result of 22% of the failures experienced. Most of the fraud and liquidity risk were intercepted after long lasting verification processes with authorities.

The researchers performed risk analysis from the responses of bank clients to determine the riskiness of each identified risk and produce a profile of each to show the associated variability and kurtosis change. The analysis was done by calculating the mean score and standard deviation from the responses, then calculating the risk level after which the result was simulated using Monte Carlo simulation in Crystal Ball to build the risk profile of each identified risk. The base case for each risk was set at zero (0) to mean a situation of no risk. The researchers used a likert scale of 1 to 7 for both probabilities of occurrence and impact of occurrence of each risk

The impact scale ranged from 1 representing no impact and 7 representing catastrophic impact while the likelihood scale ranged 1 representing highly unlikely to 7 representing highly likely.

MONTE CARLO ANALYSIS OUTPUT

The following outputs per identified risks were generated in Crystal Ball using Monte Carlo Simulation:

FIG. 1: RISK PROFILE OF CREDIT RISK

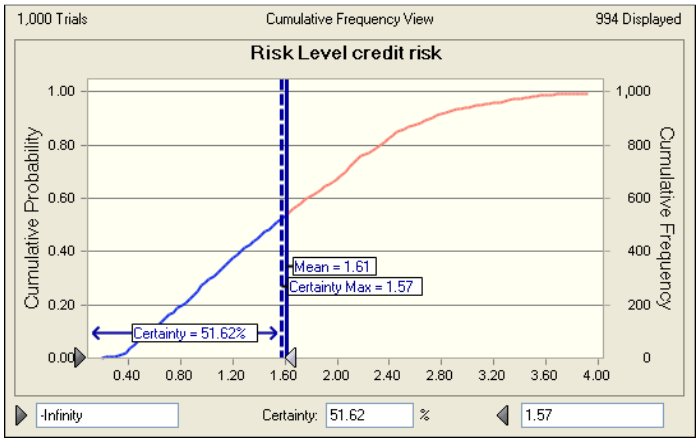


FIG. 2: RISK PROFILE OF LIQUIDITY RISK

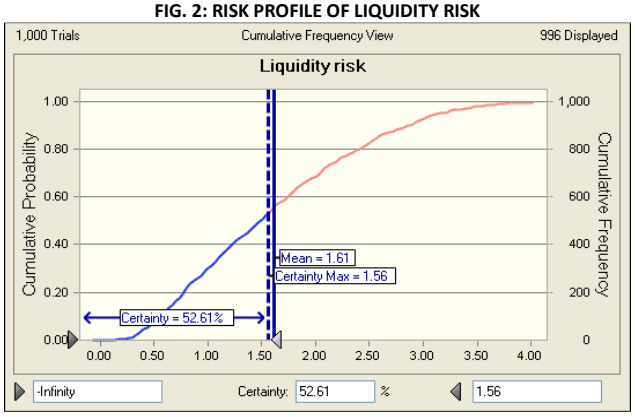


FIG. 3: RISK PROFILE OF SETTLEMENT RISK

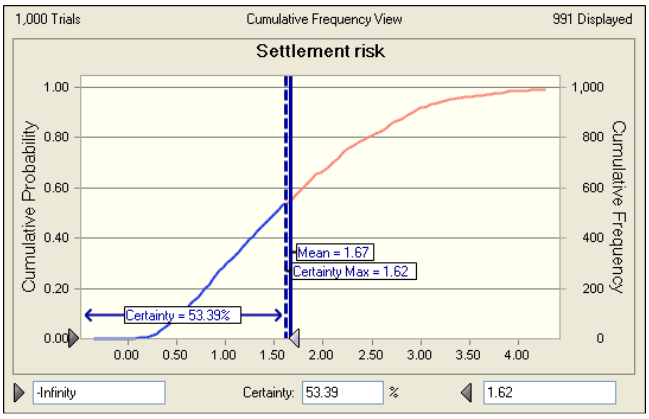


FIG. 4: RISK PROFILE OF SYSTEMATIC RISK

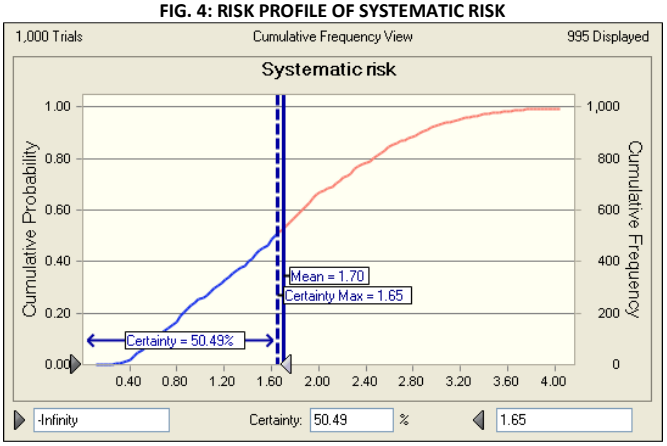


FIG. 5: RISK PROFILE OF HUMAN RISK

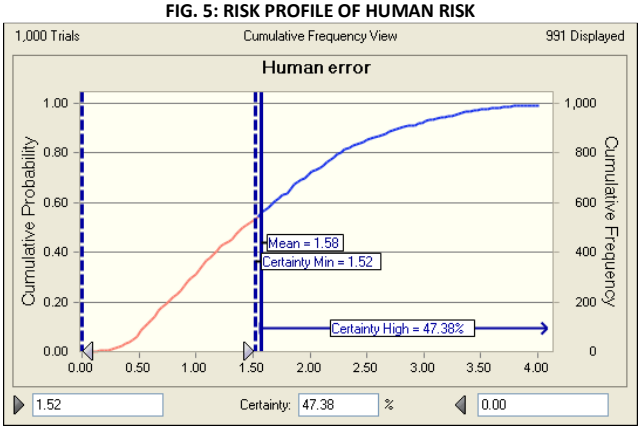


FIG. 6: RISK PROFILE OF FIRE RISK

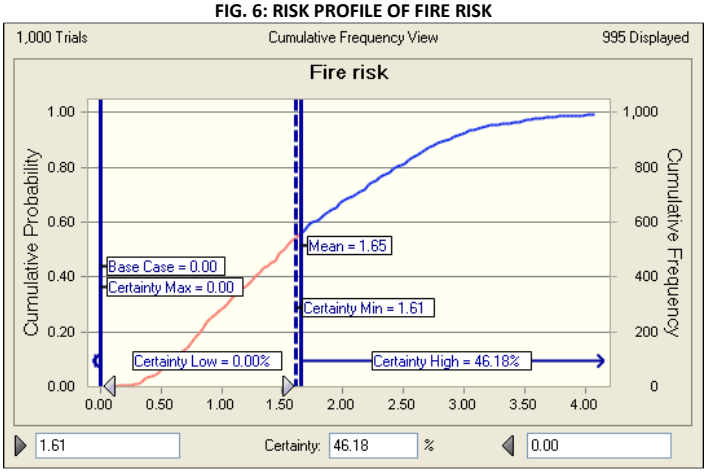


FIG. 7: RISK PROFILE OF THEFT RISK

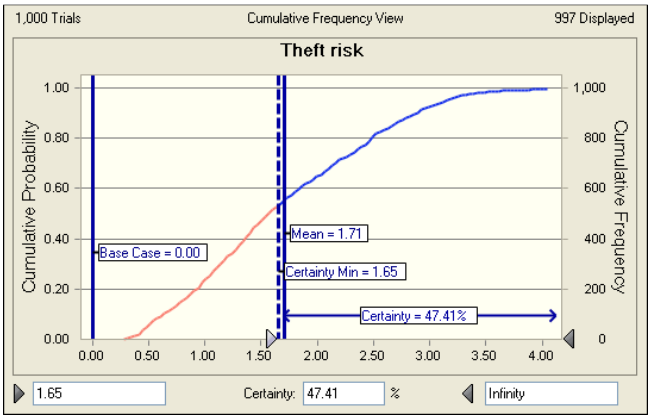


FIG. 8: RISK PROFILE OF FRAUD RISK

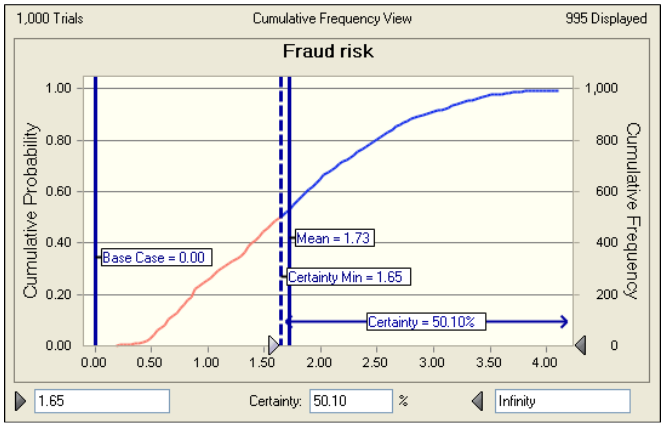


FIG. 9: RISK PROFILE OF HACKING RISK

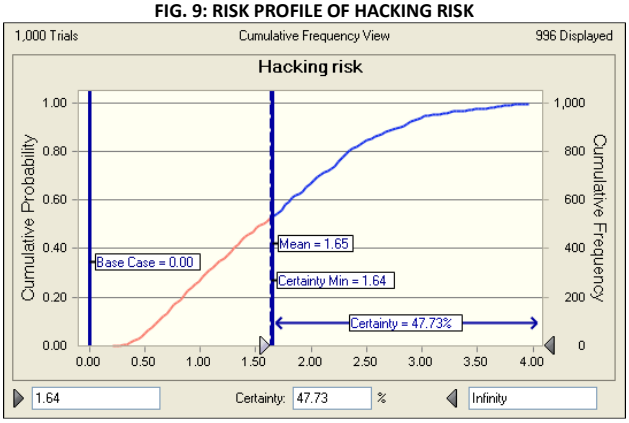


FIG. 10: RISK PROFILE OF REPLACEMENT RISK

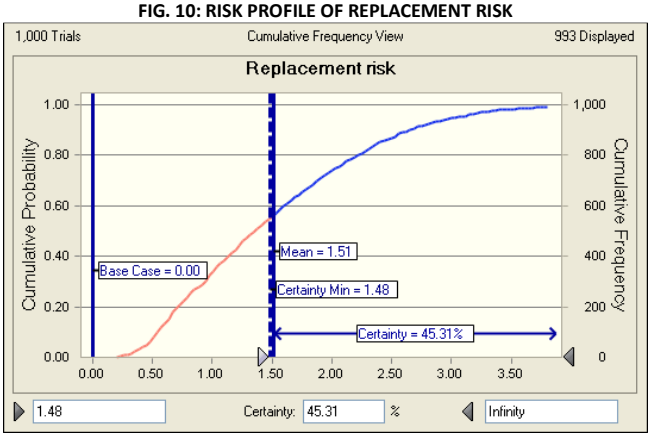


FIG. 11: RISK PROFILE OF OPERATIONAL RISK

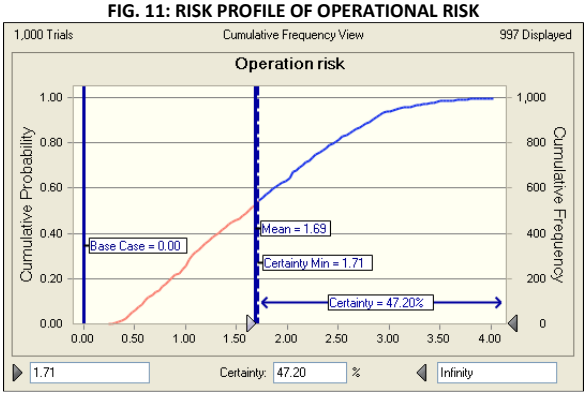


FIG. 12: RISK PROFILE OF LEGAL RISK

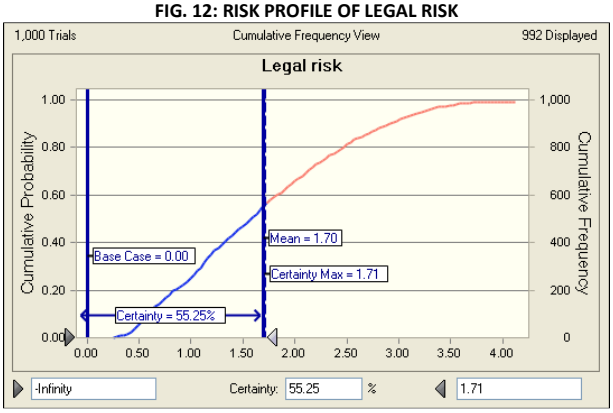
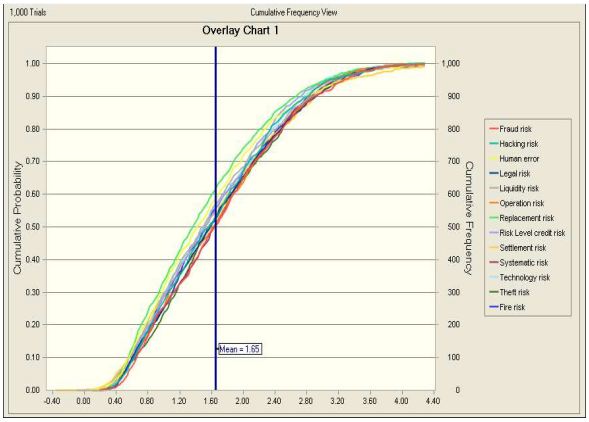


FIG. 13: AN OVERLAY ANALYSIS OF ALL THE RISKS



DISCUSSION OF RESULTS

The implication from these outputs is that errors of entry by operators pose a serious risk to RTGS because once posted, the transaction is irreversible. This is compounded by inadequate knowledge and skills to operate the software and related hardware. This is also related to inaccuracy in the transmission of payment

messages. Errors/mistakes are a potential risk because there is a possibility of causing unnecessary system failure that will result in delaying the settlement of payments to clients

Similarly, inability to settle transactions can seriously impact the business of the recipient as well as put pressure on the remitting bank. Additionally, the replacement risk poses a danger if funds are used for other purposes and must be replaced abruptly as the remitting party may equally have to incur losses in an attempt to replace the funds.

The medium risks of credit include both the risk of loss of unrealized gains on unsettled contracts with the defaulting bank or institution and the risk of loss of the whole value of the transaction referred to as principal risk. Information Technology failure (IT) is sometimes interfered with by unscrupulous and criminal individuals and groups such as terrorist groups. RTGS by its nature can be used or even hacked in order to facilitate the transfer of money for criminal and terrorist activities. This can be mitigated by training staff to acquire skills to detect such activities or even using security sensitive software which is safe and not easily manipulated for criminal activities.

Fire is yet another risk. Fires due to faulty electrical fittings and appliances can result in damage to property, RTGS services would be disrupted resulting in loss of business more especially for foreign business transactions (import and Exports) which needs to be settled immediately.

Theft and fraud in money transfer transactions is an inevitable risk. This may be so when the security code number used in the transaction is exposed to the third party. This increases the transfer to the likelihood of theft and fraud because if an unauthorized person comes in possession of the security code, s/he can withdraw the money using the same pin code where such is used.

CONCLUSIONS

The research has revealed that risks in RTGS include Fraud, liquidity, Human, settlement, Replacement, systematic, Legal, Credit, Fire, Technology, Hacking, operation and theft risk which answers objective one and are classified as shown in table 1.

TABLE 1: CLASSIFICATION OF IDENTIFIED RISKS

Color Code	Classification	Risks
	High Risk	Fraud, liquidity, Human, settlement, Replacement, systematic
	Medium Risk	Legal, Credit, Fire, Technology , Hacking , operation
	Low Risk	theft risk

It can therefore be concluded that RTGS system is risky and potentially catastrophic on bank business and bank clients. It can further be concluded that Fraud, liquidity, Human, settlement, Replacement, systematic risks are high risks which can bring about catastrophic impact on business while Legal, Credit, Fire, Technology, Hacking and operation risks are medium risks whereas theft is a low risk.

The implication in this research is that in terms of governance, the central bank must produce strict policies and procedures for operating the RTGS. Employees working on the RTGS must be given specific and differentiated roles to reduce on human error. Additionally, communication on the RTGS system must be widespread from the implementers to the clients.

For purposes of business continuity, the banks must implement disaster recovery mechanism and alternative hedges against the high and medium risks.

Fraud, hacking and technology risks can be mitigated and avoided by secure information flow through adequate testing and proofing of the system, internal system interlocks and posting prompts and increased awareness of the risks to both users and officials in commercial banks.

Finally, change management can be achieved through scenario planning of simulated risks. The researcher consequently developed a risk register represented by World Bank Group, (2008) Payment Systems Worldwide: A Snapshot (Outcomes of the Global Payment Systems Survey 2008).

TABLE 2: RISK REGISTER DERIVED FROM THE RESULTS

RISK REGISTER

Project Name: Money transfer using RTGS

e Rai	Risk Description		Risk Priority		Proactive Actions	
ID	Risk	Description of Risk	Classification	Priority Rating	Actions	Owner
A	Fraud	Indiscriminate move of funds	High	1	Policies and Procedures	Bank of Zambia
B	Liquidity	remitting bank or institution unable to meet its obligation	High	1	Communication	Shared
C	Human	Error of entry by operator	High	1	Give workers on RTGS specific roles and responsibilities	Shared
D	Settlment	Delay between payment initiation and final transfer	High	1	Communication	Shared
E	Replacement	Inability to replace used funds	High	1	System control	Commercial banks
F	Systematic	Interbank transfer failures	High	1	Implement recovery system	Commercial banks
G	Legal	Litigation by bank client	Medium	2	Alternative dispute resolution insert in contract	Shared
H	Credit	Inadequacy of available funds	Medium	2	System control	Commercial banks
ID	Fire	Damage of RTGS hardware due to fire	Medium	2	Fireproofing, auto switch off and fire alarm system	Bank of Zambia
J	Technology	RTGS system internal and external failure	Medium	2	Disaster recovery system and back up system	Shared
K	Hacking	Intruder accessing and commanding RTGS instructions	Medium	2	System control	Shared
L	Operation	Failures in internal control system	Medium	2	System control	Shared
M	Theft	Absolute loss of funds due to theft	Low	3	No hard cash in use.	Commercial banks

ACKNOWLEDGMENT

The researchers thank the members of staff at commercial banks that participated in the research as well as the bank of Zambia for allowing the study to be undertaken. Further, gratitude goes to the individual bank clients that spared their valuable time to respond to the questionnaires.

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