A Conceptual Operational Risk Model for SMEs: *Impact on Organisational Information Technology*

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Abstract:-**Building on prior research related to the impact of information technology (IT) and operational risk management (OPM) in the context of SMEs, this paper proposes there is a relationship between IT operational risk management and performances of SMEs. Specifically, a model is developed showing the relationship between IT operational risks, evaluation models, principal causes of IT failure, change management requirements, characteristic(s) of business information and lastly disorganised (chaotic) state of organisation(s) will never lead to the same results of operational risk management (ORM). Conceptual and empirical literature is explained within this model. The discussions are then used to generate research propositions that** represent the models **which in effect provide insight on how the variables are linked**. **Hence, further research can prove empirically the relationships and hence provide a contribution in the area of IT operational risk with regards to SMEs.**

Keywords: ***Operation Risk Management, Information Technology Risk, Small Business Enterprises***

I. INTRODUCTION

Recent studies on information technology risk management (ITRM) in organisations, especially large ones, have witnessed sporadic benefits. Information technology governance institute (ITGI, 2009) suggests that ITRM can be used to understand organisational operations and change management. ITGI (2009:11) defined and operationalised IT risk as;

> … business risk associated with the use, ownership, operation, involvement, influence and adoption of IT within an enterprise. It consists of IT-related events that can potentially impact the business. It includes both uncertain frequency and magnitude, and it creates challenges in meeting strategic goals and objectives as well as uncertainty in the pursuit of opportunities.

However, the success of ITRM in large organisations has shifted focus towards small business enterprises (SMEs) (King III Report, 2009; Allen, 2005; Anderson, 2005; ITGI, 2003). One of the reasons attributable to the shift in paradigm as suggested by researchers and practitioners of ITRM is that it serves as a new venue of improved services and potential benefits for SMEs (Summary of report on Governance for South Africa, 2009: 26-35; King III Report, 2009; Curley, 2004). Yet, a number of studies have suggested that small businesses have not shown a great interest in ITRM, particularly operational risk management (ORM) (King III Report, 2009; ITGI, 2004; Basel Committee on Banking Supervision, 2004). For instance, in South Africa, research **(**Polkinghorne, 2001: 1) suggests that due to underdevelopment rooted "…in the past apartheid system when the majority of the population were actively discouraged from starting small businesses". Polkinghorne (2001: 1) laments that it caused a "…structural problem…". As a result, Polkinghorne (2001: 1) argued that:

> One of the first Acts tabled by the Ministry was the "Small Business Act" out of which two important standpoints emerged: The first was to create a platform for advocacy where small and medium businessmen can articulate their positions. Secondly Government created two support institutions focusing on specific needs identified in the SME sector.

The Basel Committee on Banking Supervision (2004: 2) adopted a common industry definition of operational risk, namely "the risk of direct or indirect loss resulting from inadequate or failed internal processes, people and systems or from external events." Noting that several categorisations of IT risk have been proposed, for the purpose of this paper, the researcher adopts and adapts that of ITGI (2009). ITGI (2009: 11) categorised IT risk as the solution delivery/benefit realisation risk, associated with the contribution of IT to new or improved business solutions, usually in the form of projects and programmes. Consistent with the Basel Committee on Banking Supervision (2004: 2), it is important to note that this categorisation "focuses on the causes of operational risk which is appropriate for both risk management and, ultimately measurement."

Consequently, this paper sets out further details on the effects of operational related IT risk (cf. section 2.0 for details). Review of literature indicates that ORM, a variation

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of the ITRM process, provides a structural form of activity, which has become a popular vehicle for risk managing information in industries such as financial, manufacturing (King III Report, 2009; Kritzinger and Smith, 2008; Lutchen, 2004; ITGI, 2003). In addition to the aforementioned studies, Bayaga (2010:77) highlighted that "as a rising management discipline though, interest and current development of institutional risk management (IRM) varies across industries and institutions." This suggests that ORM is a tool that can be used to evaluate models for understanding the value of IT and for streamlining a company's operation. In support of this view Owen (2009: 32) acknowledged that "operational procedures and responsibilities are required to ensure the correct and secure operation of information processing facilities." It is imperative to note that the concept of ORM is not a new idea.

Operational risk management emerged in late the 1960s when manufacturing companies started looking for ways to alleviate delivery delays that resulted from large volumes of products and services, the use of ORM however, became popular in the late 1980s and early 1990s (Nicholas and Steyn, 2008). Currently, many large organisations in the USA, Canada, and Europe are using ORM to support their financial and trading activities. Additionally, the adoption of ORM has also progressed rapidly in Australia (Lam, 2006; Richard and McFarlan, 2005).

The growing use of ORM has drawn the attention of several academic literatures (King III report, 2009). A number of success stories published in recent years have claimed a variety of benefits due to ORM adoption, while, several studies also confirmed the attainment of some ORM benefits to a varying extent (King III Report, 2009; ITGI, 2007; Basel Committee on Banking Supervision, 2004).

Nonetheless, in the past, considerable research on ORM was conducted for large business; whereas, studies on small and medium enterprises (SMEs) towards the adoption of ORM is a recent phenomenon (King III Report, 2009; KPMG, 2008; Lam, 2006; South Africa, 2006). Additionally, the majority of these studies are confined to the USA, Canada and Europe. Comparatively less has been researched in Africa and the numbers of studies on ORM adoption in South Africa (SA) remain marginal. Unfortunately, not a single empirical study on ORM adoption was found in the literature undertaken in the Eastern Cape SMEs in South Africa (SA).

Nevertheless, in the recent past, some studies conducted reflected the use of information technology (IT), among SMEs (Owen, 2009; Lam, 2006). But, even these study objectives delineated from the adoption of ORM in the Eastern Cape SMEs (Owen, 2009). Therefore, this conceptual study investigates ORM adoption among SMEs. This paper will cover IT operational risk and SMEs. This includes motivation for the research problem and development of propositions.

II. IT OPERATIONAL RISK AND SMEs

An overwhelming portion of past empirical studies have focused on ORM use in the context of large organisations, and little efforts have so far been used to understand how ORM is actually used by small organisations – which lack ITRM sophistication, suggesting that traditionally, ITRM sophistication of small organisations is relatively low as compared to that of large organisations. However, a report by the Basel Committee on Banking Supervision (2004: 18) suggests that:

> …quantification of operational risk is, for most institutions, at an early stage although progress is envisaged at many banks. Many banks did, however, provide some indication of the relative significance of operational risk within the institution. The data (based on a range of allocation methods) suggests that economic capital allocation for operational risk ranges between 15-25% for the majority of banks.

This trend has not changed in essence in recent years. Several reasons have been attributed to this. Firstly, it has been established that setup and running costs of implementing ORM with direct connection with financial partners can be high especially for small organisations (King III Report, 2009). Moreover, transactions in small organisations lack economies of scale. Thus, the use of ORM in small organisations is less than anticipated. As such, it is therefore necessary to examine the extent of ORM use, factors affecting ORM use, and problems, because the findings of ORM studies in large organisations are likely to be different from those of small organisations (cf. motivation for research and objectives).

Secondly, with reference to the differing dimensions, a dominant portion of past ITRM empirical literature has concentrated on ORM adoption in large organisations. The works of ITGI (2007), the Basel Committee on Banking Supervision (2004) and Committee of Sponsoring Organizations- COSO (2004) fall in this group. In contrast, Owen's (2009) plus Liebenberg and Hoyt's (2003) study is the only reported works that have examined ORM use in small organisations found locally.

Thirdly, a close look at these studies revealed that regardless of organisational context, survey studies and survey design methods were employed to explain how ORM was used within SMEs (Lam, 2006; Liebenberg and Hoyt, 2003). The idea here is not to discount the method, but to investigate from a single standpoint, a case study in order to unearth the internal dynamics of such cases.

Fourthly, a review of ITRM literature indicated that most of the empirical studies on ORM had attempted to identify a set of factors that help researchers distinguish ORM adopters from non-adopters. These factors were drawn from diverse disciplines including IT diffusion and economics. The commonly reported factors were compiled and grouped into three broad categories: business characteristic(s) information, environmental and innovation. However, no established patterns of results emerged from these studies due to contradictory findings reported by the researchers.

It was evident that initially, most of the studies conducted on ORM were confined to the large business and

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produced mixed results (Lam, 2006; Liebenberg and Hoyt, 2003).

However, in the mid-2000s researchers started asking how the results of these studies (COSO, 2004; Basel Committee on Banking Supervision, 2004) can support the SMEs (Lam, 2006; Liebenberg and Hoyt 2003). Although many issues related to the adoption of ORM were found to be similar, their contribution (COSO, 2004; Basel Committee on Banking Supervision, 2004) was entirely different to SMEs and they reacted differently to these issues.

It is therefore significant that a study be conducted to investigate the issue of ORM adoption from the SME perspective. Unfortunately, few studies have been conducted on ORM adoption within SMEs. Owen's (2009) work is considered a pioneering effort. Although Owen (2009:47) study was based upon a relatively "small sample size, N=51", it provided an insight in to formulating the propositions for further research, while, Liebenberg and Hoyt's (2003) study adopted a survey approach. For instance Owen's (2009:26) study suggests that intent to adopt ITRM in general was influenced partly by "external parties."

In summary, the ORM adoption has been studied within the context of SMEs using several approaches. From the review of the existing literature it is evident that there is a number of overlapping divergent models that have been shown to potentially explain the ORM adoption decision by examining different factors.

Most of the studies (Lam, 2006; Liebenberg and Hoyt, 2003) within their domain have added to the existing body of knowledge, but are fairly skewed. This is because most of the studies on ORM are based on the survey method which is a good way of developing proposition, but unfortunately makes it difficult to study effects of a single case (cf. section 3). So there is a need to conduct more empirical studies to provide statistical validity with respect to a single case. Additionally, researchers across the globe selected different factors that might necessarily not be suitable to a South African SME context. For this the reason, the research problem and the development of propositions are based on existing South African literature. This will provide the basis for a South African ORM SME-based model. In this study the adoption of ORM is the dependent variable and there are several independent variables. The subsections below highlight the research problem and subsequent propositions plus justification for the inclusion of each independent variable in the model is discussed.

Motivation for statement of research problem and development of propositions

The key issue for most companies, especially smaller ones, is the shortage of resources for establishing and maintaining risk management procedures. The principle 4.4 of King III additionally suggests that management's responsibility for risk management is to "… design, implement and monitor the risk management plan" (King III report, 2009:75). For this reason, King III report (2009) suggests the avoidance of unnecessary complexity so that risk management procedures can be understood and operationalised with minimum cost and disruption. This study is situated within the above context; thus, a model to manage IT/IS operational risk, in this case for a financial service provider. In support of the purpose for the study and to justify the research problem, King III report (2009:78) proposes *what* needs to be done, arguing that "…risk assessments [should be] performed on continual basis". Thus an approach that places the primary focus on, and concentrates training around, risks that are significant, ensures objectives are prioritised and clearly allocates responsibility within the company for the procedures.

However, the justification in this study is *how* it should be done- hence IT/IS operational risk. The objective is somewhat consistent with a report by ITGI (2007:5), who supported that:

> For IT to be successful in delivering against business requirements, management should put an internal control system or model in place. The Control Objectives for Information and related Technology -COBIT[1] control model contributes to these needs by (1) making a link to the business requirements (2) organising IT activities into a generally accepted process model (3) identifying the major IT resources to be leveraged (4) defining the management control objectives to be considered.

On the basis of ITGI's (2007) assertion, and previous ITRM-based studies on the usage of ORM, a normative model should be developed. This model is intended to show a one-stage model that relates independent and dependent variables without any intervening variables. Thus, the relationship would intend to show a model that is associative rather than causal.

In this study, adoption of ORM should be the dependent variable and there would be a number of independent variables (IVs) generated from the propositions and research objectives. Detailed justification for the inclusion of each independent variable in the model is prescribed below.

ORM Models in this study

In IT adoption, understanding 'evaluation models' or ORM modeling plays an important role in the adoption of an ORM (ITGI, 2007). In support of this this view, past literature by the Basel Committee on Banking Supervision (2004: 1):

> … believes that a capital charge for other risks should include a range of approaches to accommodate the variations in industry risk measurement and management practices. Through extensive industry discussions, the Committee has learned that measurement techniques for operational risk, a subset of other risks, remain in an early development stage at most institutions, but are advancing. As additional aspects of other risks remain very difficult to measure, the Committee is focusing

[1] Readers should note that CobiT's measurement is a process maturity model similar to Likert scale of measurement.

> the capital charge on operational risk and offering a range of approaches for assessing capital against this risk.

One of the most important aspects of the Basel Committee on Banking Supervision's (2004) work is that they successfully linked this dimension of ORM to management practice. Other studies such as COBIT (2007:6) supported the above studies by arguing that:

> Performance measurement is essential for IT governance. It is supported by COBIT and includes setting and monitoring measurable objectives of what the IT processes need to deliver (process outcome) and how to deliver it (process capability and performance). Many surveys have identified that the lack of transparency of IT's cost, value and risks is one of the most important drivers for IT governance.

This suggests that ITGI (2007) describes the central concept of evaluation models as having a coherent set of activities with a set of shared core values. ITGI (2007:17) maintained that "modelling for management and control over IT processes is based on a method of evaluating the organisation, so it can be rated from a maturity level of non-existent (0) to optimised (5)." However, the Basel Committee on Banking Supervision (2004:2), "in reviewing the progress of the industry in the measurement of operational risk" cautioned that "causal measurement and modelling of operational risk remains at the earliest stages."

Inferring from the above caution, it can be established that 'evaluation models' affect the way an organisation operates, its values and its basic underlying assumption to technology diffusion. It is evident that 'evaluation models' of an organisation either facilitate or impede the process of technology diffusion.

However, Liebenberg and Hoyt (2003) studied this variable while looking at the attitudes of end-users, but could not find the support of 'evaluation models' with the attitudes of the end-users, suggesting that the use of this variable in their earlier work on SMEs did not elicit any support for evaluation models impacting on ORM. However, the relevant importance of this variable in inter-organisational decision making has led this study to include ORM adoption.

Apart from evaluation models, the works of Balbas (2007), Committee of Sponsoring Organisations COSO (2004, Casualty Actuarial Society CAS (2003) and King III report (2009) further advocate that success of IT within an organisation can be determined by considering (1) principal causes of IS failure in terms of human resource and infrastructure (2) change management requirements to IT by allocating necessary resources. This suggests that the parameters can be important for the success of IT risk within organisations. In this study the intent may be to measure parameters and find a significant predictor to ORM adoption using multivariate analysis (cf. methodology).

Other studies related to Basel II suggest that at present, several kinds of measurement methods are being developed no industry standard has yet emerged (COBIT, 2007). In this circumstance, basing the capital charge on the banks own methodology will cause comparability problems because the outcome may differ depending on the method used. Further, it is not clear if many banks have the data or methodology to perform the necessary estimations. However, by accepting only those measurement methods that attain a certain level of robustness, over time, it may be possible to establish a set of standards on the basis of which SMEs can secure the overall prudence of the capital model.

Thus, further work is needed by SMEs to develop a better understanding of the key assumptions of internal measurement techniques (e.g. goodness of- fit tests) that can be used by SMEs. Based upon these, the researcher therefore puts forward the following three propositions:

H1. there is a statistical significant relationship between evaluation models and likelihood of ORM adoption.
H2. principal causes of IT failure (human resource and infrastructure) correlate with likelihood of ORM adoption.
H3. change management requirements in terms of human resource and infrastructure are positively associated with likelihood of ORM adoption.

1. Characteristics of business information

The impact of characteristic(s) of business information has been shown to have direct and indirect stimulation on the supply of information that produces faster technology (Posthumus and Von Solms, 2004). This objective may form part of the IT operational risk model, which is aimed at assisting an institution (financial institution) manage IT-related risk. In the process of IT governance, the study will seek to interrogate (1) confidentiality (2) integrity (3) and availability of the IT/IS operation of the institution, and may include concerns such as unauthorised use, access, disclosure, disruption or changes to the information system.

For many organisations, a characteristic(s) of business information has been the source of funding infrastructure (Williams, 2005; Posthumus and von Solms, 2004; Weill and Ross, 2004). This study investigates characteristic(s) of business information involvement and support in ORM adoption in SMEs. Consistent with other studies such as Val IT Model (2006:18); this model suggest that:

> The goal of value governance is to optimise the value of an organisation's IT-enabled investments by; (1) establishing the governance, monitoring and control Model (2) providing strategic direction for the investments and (3) defining the investment portfolio characteristics.

Several researchers in recent years have studied the characteristic(s) of the business information role. KPMG (2008) found that direct intervention of the characteristic(s) of business information can be considered important in promoting ORM, although the degree of influence on business may vary from one SME to another. Posthumus and Von Solms (2004) emphasised that characteristic(s) of business information play a vital role in supporting the pillars of ORM

model. In support of this view, Flowerday and Von Solms (2005: 611) argue that:

> based on quality information, a system of internal controls needs to be in place to provide, amongst others, integrity to the information. For these controls to be continuously effective, the controls need to be audited to ensure operational efficiency and effectiveness.

The above studies suggest that an understanding of the roles of these characteristic(s), of business information, as facilitator for ORM would flourish and mature the strategic model for SMEs. Clearly, subjective evidence has shown that characteristic(s) of business information incentive support ORM adoption. Based upon this, the study proposes the following:

> *H4. Characteristic(s) of business information correlate with ORM adoption.*
> *H5. Similar actions taken by organisations based upon characteristic(s) of business information in a disorganised (chaotic) state will never lead to the same results of ORM.*

Based on proposition five (5), a further literature review was conducted. Proposition five (5) is consistent with both current and past works on chaos theory and information systems (Ivancevic, 2007; Park, 2006; Chen, 2005; Harb, Mothafer and Natsheh, 2005; Li and Chen, 2004; Warfield, 2004; Harb and Abdel-Jabbar, 2003; Thiétart and Forgues, 1995). Thiétart and Forgues (1995: 1) argue that "chaos theory and properties of chaotic systems are used to suggest a new approach to understanding how organisations work. Thiétart and Forgues (1995: 1) maintain that an "organisation is presented as an open, dynamic, nonlinear system subject to internal and external forces which might be sources of chaos". Thiétart and Forgues (1995: 22) argue that chaos theory, which has received a great deal of attention from researchers in the natural sciences, is probably difficult to apply to less structured areas such as management.

However, it seems that the qualitative properties of chaos theory have an explanatory and integrative power that organization theories can use to their advantage". In support of this theoretical model, Thiétart and Forgues (1995: 22) argued that "the qualitative properties [2] evoked by chaos theory-sensitivity to initial conditions, strange attractors, scale invariance, time irreversibility, and bifurcation processes-are powerful enough to offer another perspective from which to view the way organisations work."

Thus, the use of this theory in this study explores the relevance of chaos theory to information systems research. Chaos theory focuses on the behaviour of dynamic systems that are inherently unstable- typical of an organisation. Thiétart and Forgues (1995: 21) suggest that:

> when in a chaotic state, the impact of a variable change can be predicted only for the very short term. This property makes long-term forecasting impossible. In fact, a small initial change, the effect of which multiplies as time passes, can lead to a dramatically different evolution.

McBride (1998: 2) added that the concept of chaos suggests an absence of organisation, a disorder in which uncertainty and unpredictability predominate. This as McBride (1998: 2) elucidates would seem a strange field of study to unite with information systems which is predominately concerned with order. However, McBride (1998: 2) maintains that chaos refers to what might be called ordered disorder, which is a complex system (CS). McBride (1998: 2) has this to say about complex systems indicative of chaotic behaviour:

> … which is not a lack of order, but order of a complexity that is difficult or impossible to describe in simple terms that cannot be broken down into simple equations that requires complex narrative to describe it. The patterns in chaotic behaviour are present, but not regular or easily predictable. While we are considering chaos in the context of organisations, which hold a complexity of human behaviour and action which will give rise to chaotic phenomenon, it should be noted that some of the simplest phenomenon… can give rise to chaotic behaviour in which… changes are chaotic and unpredictable. The concepts of chaos may support a better explanation of organisational behaviour than the more traditional explanations of scientific management because organisations are complex and dynamic phenomenon.

With reference to the works of McBride (2005), Tsoukas (1998), Thiétart and Forgues (1995) and McBride (1998), it can be established that organisations do not manifest fixed, predictable behaviour, rather their behaviour is non-linear and periodic. Similar views have been shared by other researchers on chaos theory and organisational models (cf. Anderson, 2005; Australian Government, 2004; Harb and Harb, 2004; Gattiker and Goodhue, 2004; Zgliczyski and Gidea, 2004). It can therefore be suggested from the authors that chaos theory has application in information systems where the effects of an information system within an organisation is often unpredictable and unintentional. This forms the first basis for using chaos theory as the theoretical model of the paper. In this research, chaos theory provides a means of extending the descriptions of information systems and sensitising practitioners and theorists to some of the problems in information systems (cf. objectives and methodology).

Inferring from Thiétart and Forgues (1995), the term *chaos theory* is used widely to describe an emerging scientific discipline whose boundaries are not clearly defined. The terms complexity theory and complex systems theory as used by McBride (2005) provide a better description of the subject matter; thus, chaos deals with unpredictable complex systems, but the term chaos theory will be used throughout

[2] This paper cannot exhaust the application and relevance of the qualitative properties of chaos theory; for further understanding on the theory and related theories, details are provided in Thiétart & Forgues (1995: 21) and McBride (2005) and McBride (1998).

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this paper as it is more widely accepted as a synonym. The reason is that a complex system is a network of heterogeneous components that interact nonlinearly, to give rise to emergent behavior. The nonlinearity as well shall be discussed shortly as one of the properties of chaos system. The term *complex system* however, has multiple meanings depending on its scope: A complex system is one that by design or function or both is difficult to understand and verify. This suggests that a complex system is one in which there are multiple interactions between many different components. This implies that complex systems are systems in process that constantly evolve and unfold over time. Therefore, for a system to be classified as a chaos system it must be defined by (1) constantly evolving and unfolding over time and most importantly (2) there should be multiple interactions. Thus, chaos system in this study assumes and defines the properties of complex system.

To understand chaos theory in relation to this research, it is imperative to first have a grasp of its roots: systems and the term nonlinear. The first term, *system*, can be defined as the understanding of the relationship between things which interact. To better understand this idea in relation to this study, the researcher will examine the case. The organisation is a system which interacts based upon how it operates.

The above suggests one important phenomenon-that systems can be modeled. In other words, systems can be created which will theoretically replicate the behavior of the original system. Following the case study, one can take a second group of organisation(s) which are similar to the first, model them in exactly the same way as the first, and predict that they will operate the exact same configuration as the first, but the question is, how will it be done? This is where chaos theory could be applied to demonstrate the application of the theory in this study via mathematical modeling, noting that generally speaking, mathematical modeling is the key to modeling systems, although it is not the only way.

The second term, *nonlinear*[3], has to do with the type of mathematical model used to describe a system. Thiétart and Forgues (1995: 20) argue that:

> A nonlinear dynamic system is a system where relationships between time-dependent variables are nonlinear.

Differential calculus [4] (especially stochastic differential calculus) is a mathematical method for showing change in systems within the context of a straight line as a function of time. In a further study though, statistical multivariate analysis (regression analysis) in particular, may be used. The reason should be to convert nonlinear data into a linear format for further analysis and prediction using chaos theory. This is because linear systems are easy to generate and simple to work with, since they are predictable. Moreover, it is consistent with the works on converting nonlinear data into a linear format (cf. Conner and Coviello, 2004; Yeo, 2002; Mahaney and Lederer, 2003). For example, a chosen organisation under investigation could be thought of as a linear system. The researcher could then predict that if the researcher adds a certain number of variables (for instance business characteristics of information) that the researcher will increase the effectiveness of an organisation by a comparable amount (cf. objectives).

As cautioned by Thiétart and Forgues (1995), in practice, organisations do not operate this way. But changing the number of people, inventory, or any other variable in and organisation, one receives widely differing results on a day to day basis from what would be predicted from a linear model. This is true because an organisation is actually a nonlinear system, as are most systems found in life. When systems in nature are modeled mathematically, the researcher finds that their graphical representations are not straight lines and that the system's behaviour is not so easy to predict. This anomaly will be explained from the qualitative properties of chaos theory. The section on sensitivity details the qualitative properties of chaos theory to be used in this research.

- *Sensitive: Dependence on Initial Conditions*

One of the most essential elements in a complex system is unpredictability. The generator of this unpredictability is what Lorenz (1969) [5]calls *sensitivity to initial conditions*, otherwise known as *the butterfly effect*. This concept means that with a complex, nonlinear system, very (infinitely) small changes in the starting conditions of a system will result in dramatically different outputs for that system. This phenomenon is commonly known as the butterfly effect. Due to extreme dependence on initial conditions, the general rule for complex systems is that one cannot create a model that will accurately predict outcomes. However, one can create models which simulate the processes that the system will go through to create the models, noting that the concept of sensitive; dependence on initial conditions has strong mathematical [6] roots (Conner and Coviello, 2010; Kritzinger and Smith, 2008; PricewaterhouseCoopers, 2007; Chen, 2005; Thiétart and Forgues, 2005; Richard and McFarlan. 2005; Gattiker and Goodhue, 2004; Lutchen, 2004; Zgliczyski and Gidea, 2004; Mahaney and Lederer, 2003).

This realisation impacts on many activities in business. For example, it raises considerable questions relating to the value of creating organisational visions and mission statements. McBride's (2005) suggestion demonstrates that no matter how close two conditions start out, after only a few iterations, minor differences will be blown out of proportion.

[3] this system has three types of equilibrium. For further details cf. Thiétart & Forgues (1995: 20); this is out of the scope of this paper.

[4] these are various forms: ordinary differencial equations (ODE), partial differencial equations (PDE), delay differencial equations (DDE), stochastic differencial equations (SDE) and differencial algebraic equations (DAE)

[5] cf. Lorenz E. (1969). How much better can weather prediction become? *Technology Rev.*, July/August**,** 39-49. Related work on the prediction of weather as chaos theory originated from the study of weather patterns using mathematical model.

[6] For details cf. Casdagli, M. (1992). Chaos and Deterministic versus Stochastic Non-Linear Modelling, *Journal of the Royal Statistical Society*. 54(2), 303-328

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This means that even if initial numbers are entered into a computer with precision, there will still be a certain amount of decimal error. After iterating, McBride (2005) maintains that one quickly notices that the very small error is magnified so that the computed result is considerably different from the actual results. Thus, a very tiny error in the initial conditions makes a very large difference to the outcome.

Inferring from the works of McBride (2005), Thiétart and Forgues (1995), and McBride (1998), this paper summarises the qualities of a chaotic system to be used in the research, consistent with that of Casdagli (1992). Thus, a chaotic system has these simple defining features: Chaotic systems are deterministic- they have some determining equation ruling their behavior; chaotic systems are sensitive to initial conditions- even a very slight change in the starting point can lead to significantly different outcomes; chaotic systems are not random, nor disorderly, truly random systems are not chaotic; chaos has a sense of order and pattern, hence organisations equally have predictable behaviour that can be modeled.

These properties should be used to further explore IT ORM in a SME context bearing in mind the propositions generated as summarised. Thus, possible factors that may influence the adoption of ORM are the following and is identified based on the literature study:

H1. there is a significant relationship between evaluation models and likelihood of ORM adoption.
H2. principal causes of IT failure correlate with likelihood of ORM adoption.
H3. change management requirements are positively associated with likelihood of ORM adoption.
H4. characteristic(s) of business information correlate with ORM adoption.
H5. similar actions taken by organisations based upon characteristic(s) of business information in a disorganised (chaotic) state will never lead to the same results of ORM.

III. CONCLUSION

In conclusion, the conceptual and empirical literature on the impact of IT ORM on SMEs has been proposed with regards to the relationships of the variables. By testing the propositions, the relationships and associations can be found among the variables. Moreover, the factors that influence operational risk management practices of an SME by examining the financial institution specific characteristics in relation to its business performances; i.e. evaluation models, principal causes of IT failure, change management requirements, characteristic(s) of business information and lastly disorganised (chaotic) state of organisation(s), will never lead to the same results of ORM. In addition, the influence of IT operational risk management practices can be determined. Further research needs to prove empirically the propositions suggested. Hence, several contributions can be achieved in the aspect of IT OPM and SMEs especially for South Africa. In the realm of academia, the empirical evidences of the relationships are important to add value to literature by supporting previous findings and theories. Finally, this paper would at least contribute to filling the gaps in the area of applying IT ORM to South Africa's' SMEs.

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