

# Impact of Information and Communication Technology (ICT) Risk Change Management Requirement on Performance of Small and Medium Enterprises (SMEs)

Anass Bayaga

*Faculty of Education, University of Fort Hare, East London, South Africa  
Telephone: +27 (0)43 704 7076; E-mail: abayaga@ufh.ac.za*

**KEYWORDS** Risk Management. Small and Medium Enterprise. Information Communication Technology Risk

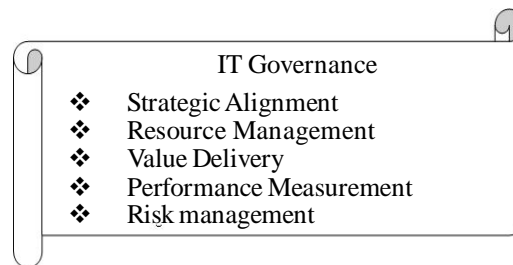
**ABSTRACT** The purpose of the research was to assess the ICT change management requirements for building successful systems-risk monitoring and reporting of Operational Risk Management (ORM) in SME. From the review of literature, an instrument (closed ended questionnaire) was developed with the aim of covering the research purpose. A minimum of N=90 respondents of an SME according to simple random sampling plan was conducted. Multiple regression analysis was utilised to determine the percentage contribution of some of the identified significant predictors of challenges posed by ORM solutions. The distribution revealed that only one variable made significant percentage contribution, thus (how end users deal with implementation of ICT projects)  $\beta = 0.447$ ,  $p < 0.01$ . The results additionally suggested that the variable contributed approximately 88.4% of the variations in level of challenges posed by ORM solutions. The analysis of variance also revealed that the regression coefficients were real and did not occur by chance. The recommendation is that though SMEs are at an earlier adopter stage, the evidence from the current study taken into consideration with the rapid pace of technology development, suggests that SME managers must engage with the concept of the ICT operation model.

## INTRODUCTION

This paper presents the findings of the empirical investigation carried out in this study. In consequence, it addresses findings related to the factors impacting on ICT and operational risk management within SMEs. The paper commences with an overview of the specific research questions, statistical techniques, demographics of respondents and data reduction technique; factor analysis. It concludes with the analysis of each research finding based on the hypotheses/objectives posed.

### Risk and Change Management Requirement for Building Successful ICT related SME

The management side of information system governance is concerned with how the stipulations for information security by executive management are implemented in an organisation (Posthumus and Solms 2004). Many studies have identified strategic alignment, value delivery, risk management, resource management and performance management as some of the most important drivers for Information Technology Governance Institute (ITGI) 2007 (Fig. 1) particularly in large organisations



**Fig. 1. Drivers for IT governance**

(Source: ITGI 2007: 6)

### Risk Management

Risk management requires risk awareness by senior corporate officers, a clear understanding of the enterprise's appetite for risk, understanding of compliance requirements, transparency about the significant risks to the enterprise and embedding of risk management responsibilities into the organisation (ITGI 2007: 6).

ICT risk management is a threat to an information technology, data, critical systems and business processes (King III Report 2009). This suggest that SME management has a responsibility to identify areas of control weakness and respond in a timely fashion to these by improving processes, augmenting controls and even reducing the cycle time between control testing

to ensure the organisation identifies and respond properly to IT risks (King III Report 2009). However, labour and cost constraints mean SME cannot mitigate all risk. There is always some degree of residual risk, either unidentified or known but unmitigated. The problem is that many SME do not understand that managing their IT risk — from the shop floor to the boardroom — is critical to business success. The inherent risks in IT show up in complex and subtle ways, making ICT risk management a difficult concept to communicate and manage effectively (ITGI 2007; King III Report 2009).

By aggregating and reporting on the impact of security risks within IT and understanding how these risks impact the business, professionals can become an integral part of the business decision-making process and help guide the organisation to a more risk-aware culture.

#### **Theoretical Framework: Chaos Theory and Dynamical System**

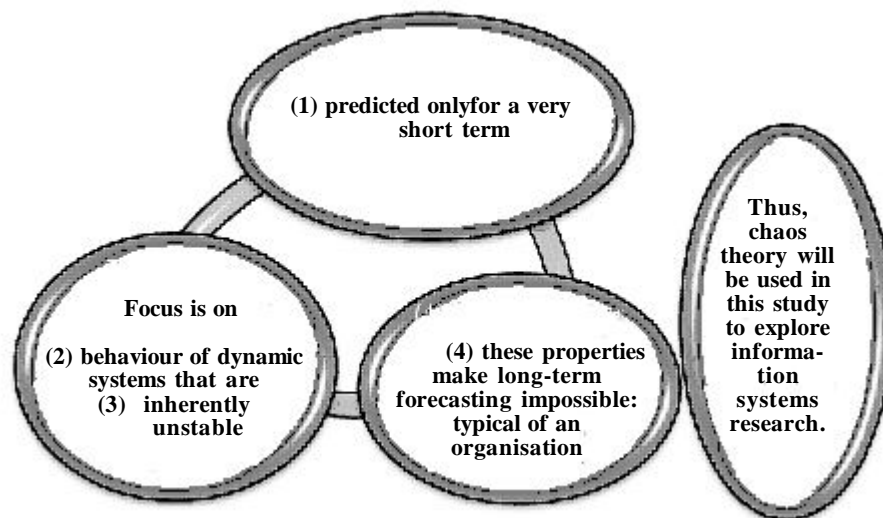
Literature review for this study was conducted for a number of reasons, first being the research purpose and secondly the dominant inferential analysis to reduce the degree of subjectivity to a minimal extent in the organisational context. As Figure 2 suggests, when in a chaotic state, the impact of a variable change can be:

This approach depicted by Figure 2 is consistent with Thiétart and Forgues' (1995) work on Chaos Theory in information systems, neither basic idea of Chaos Theory is unsettling. In simple terms, Chaos is order without predictability. That is, there are systems (dynamical systems), physical and social, that are well understood (in the sense that they can be fully described by means of a finite set of conditions or rules) and yet are fundamentally unpredictable. Thus, chaos is not anarchy or randomness (Fig. 2).

#### **Dynamical Systems**

Considering SMEs as dynamic system is a recent theoretical approach to the study of management of SMEs (Hubbard 2007). In its contemporary formulation, the theory grows directly from advances in understanding complex and nonlinear systems in physics and mathematics, but it also follows a long tradition of systems thinking in biology and psychology (Hubbard 2007). The term *dynamic systems*, in its most generic form, mean systems of elements that change over time.

The more technical use, *dynamical systems*, refers to a class of mathematical equations that describe time-based systems with particular properties. The value of dynamic systems is that it provides theoretical principles for conceptualiz-



**Fig. 2. Properties of chaotic system**

ing, operationalizing, and formalizing these complex interrelations of time, substance, and process (Hubbard 2007). It is a meta theory in the sense that it may be (and has been) applied to different species, ages, domains, and grains of analysis. But it is also a specific theory of how humans gain knowledge from their everyday actions.

Although the terms are used in various ways among the general public, many specialists in risk analysis and other quantitative fields have modeled uncertainty and risk more specifically.

### Research Purpose

The purpose of the research was to assess the ICT change management requirements for building successful systems-risk monitoring and reporting of ORM in SME.

## RESEARCH METHODOLOGY

The view taken in this study was dualistic. Adopting a dual view of the research design allowed constructing a model, which promoted common understanding (descriptive and inferential). Thus, based on the research objectives and data collected, the research used a positivist perspective. Additionally, a combined-mixed design (CMD) facilitated a holistic view and strengthens the reliability of instrument (Creswell 2007). Thus, CMD is built around testing the relationships between factors influencing ORM (see research hypotheses) (Creswell 2007). The study was conducted in a South African based micro finance company with a staff of 1400 members and 90 branches nationally. The company's product range included unsecured loans, secured loans, insurance, cellular and educational products. The products are sold through its various channels: branches, telesale call centres and agents.

### Research Design

This research adopted a case study as well a survey design for different purposes (see sections on case study and survey design).

### Case Study Design

The study was conducted in two phases; one phase followed a case study design, the other-

survey using questionnaire. The 'case' in this study was a financial company in the Eastern Cape. All units within this case form part of the case (managers, implementers, directors, etc). Building on prior research related to the impact of information technology (IT) and operational risk management (ORM) in the context of SMEs, the current research proposes that there is a relationship between IT operational risk management and performances of SMEs. The motive for using case study was to understand the complexity such of as an organisation. It extends experience or adds strength to what is already known through previous research.

### Survey Design

A survey is used to gather large scale data from a sample of population (Creswell 2007). The second phase of the study followed a survey of the units to get their views on the operation of IT risk management strategies as per the objectives. The survey allowed the researcher to see the trends in the way certain aspects of the IT operation risk management strategies have been implemented and ways in which it was improved. Some of the advantages considered included: The virtual elimination of data entry and editing costs (Creswell 2007).

### Sample size and Sampling Technique

The study was conducted at a South African based micro finance company with a staff of about 1400 members and 90 branches nationally.

From the review of literature, an instrument (closed ended questionnaire) was developed with the aim of covering the research purpose. In terms of sample size calculation, Tabachnick and Fidel (2001: 117) recommend a formula for calculating sample size requirements, taking into account the number of independent variables that a researcher wishes to use;  $N \geq 50 + 8m$  ( $m$  = number of independent variables). Due to the hypotheses posed questionnaires were sent to a minimum of  $N = 90$  respondents<sup>1</sup> of the SME according to simple random sampling plan.

### Data Analysis and Interpretation

The questionnaires received were analysed using SPSS for correlation and multiple regression analysis to predict ORM in SME. In line

with the principles of multivariate data analysis, the researchers conducted a zero-order correlation of the independent and dependent variables. The correlation provided directional support for predicted relationship and showed that collinearity among the independent variables is sufficiently low so as not to affect the stability of regression analysis. This also included the test of various assumptions<sup>2</sup> such as, normality, multicollinearity.

During the analysis, ICT operational risk decomposed into a number of sub risks using business lines and risk categories defined by the institution. In each subsection ORM ICT, data was collected and robust estimation techniques as indicated were used.

**Multivariate Regression**

Generally, multivariate regression explains the relationship between multiple independent or multiple predictor variables and one dependent or criterion variable. In multiple regressions, a dependent variable is modeled as a function of several independent variables with corresponding multiple regression coefficients, along with the constant term (Tabachnick and Fidell 2007). Multiple regression requires two or more predictor variables, and this is why it is called multiple regression (Tabachnick and Fidell 2007). The multiple regression equation explained above takes the following form:

$$y = b_1x_1 + b_2x_2 + \dots + b_nx_n + c. \dots \dots \dots (1)$$

In the multivariate case, when there is more than one independent variable, the regression line cannot be visualised in the two dimensional space, but can be computed just as easily. It could construct a linear equation containing all those variables. In general then, multiple regression procedures will estimate a linear equation of the form:

$$Y = a + b_1 * X_1 + b_2 * X_2 + \dots + b_p * X_p, \dots \dots \dots (2)$$

Here, b<sub>i</sub>'s (i=1, 2... n) are the regression coefficients, which in multiple regression represents the value at which the criterion variable changes when the predictor variable changes.

For the purpose of the current study, there are certain terminologies in multiple regression that help in understanding multiple regression (Tabachnick and Fidell 2007). These terminologies are as follows.

The beta value in multiple regression was used in measuring how effectively the predictor

variable influences the criterion variable (Tabachnick and Fidell 2007). In multiple regression it is measured in terms of standard deviation (Tabachnick and Fidell 2007).

R, in multiple regression is the measure of association between the observed value and the predicted value of the criterion variable (Tabachnick and Fidell 2007). R Square, or R<sup>2</sup>, in multiple regression is the square of the measure of association which indicates the percent of overlap between the predictor variables and the criterion variable (Tabachnick and Fidell 2007). Adjusted R<sup>2</sup> in multiple regression is an estimate of the R<sup>2</sup> if you used this model with a new data set (Tabachnick and Fidell 2007).

**Assumptions of Multiple Regression**

There should be proper specification of the model in multiple regression (Tabachnick and Fidell 2009). This means that only relevant variables must be included in the multiple regression model (Tabachnick and Fidell 2009). This means that in multiple regression the model should be reliable (Tabachnick and Fidell 2007).

Normality was assumed in multiple regression. This means that in multiple regression, variables must have normal distribution. It was assumed in multiple regression that the residuals (predicted minus observed values) were distributed normally (that is, follow the normal distribution) (Tabachnick and Fidell 2001). Again, even though most tests (specifically the F-test) are quite robust with regard to violations of this assumption, it is always a good idea, before drawing final conclusions, to review the distributions of the major variables of interest. In this case the researcher produced the Kolmogorov-Smirnov (KS) test (use KS test) in order to inspect the distribution of the residual values (Tabachnick and Fidell 2007) (Tests of Normality).

**Table 1: Tests of normality**

Position	Tests of normality					
	Kolmogorov-Smirnov <sup>a</sup>			Shapiro-Wilk		
	Stats	df	Sig.	Stats	df	Sig.
Middle mgt	0.39	13	0.00	0.63	13	0.00
Senior mgt	0.38	38	0.00	0.68	38	0.00
Operations	0.31	56	0.00	0.77	56	0.00

<sup>a</sup>Lilliefors Significance Correction

The test for the K-S (see Table 1) test is denoted by D and Middle Mgt,  $D(13)=0.39, p=0.000$ ; Senior Mgt  $D(38)=.40, p=0.000$  and Operations  $D(56)=0.313, p=0.000$ , were all significantly normal. Although, this is so, Fidell (2007) suggests that it is common in large sample size.

*Multicollinearity and Matrix Ill-Conditioning:* This is a common problem in many correlation analyses. Imagine that you have two predictors and then trying to decide which one of the two measures is the better predictor (Tabachnick and Fidell 2007). However, this is exactly what would be done when performing a multiple regression analysis, a dependent (Y) variable (performance of SMEs) and the two (or more) measures of independent (X) variables. When there are many variables involved, it is often not immediately apparent that this problem exists, and it may only manifest itself after several variables have already been entered into the regression equation (Tabachnick and Fidell 2007).

Nevertheless, when this problem occurred it meant that at least one of the predictor variables was (practically) completely redundant with other predictors (Tabachnick and Fidell 2007). There are many statistical indicators of this type of redundancy (tolerances, semi-partial R, etc.) as well as some remedies (for example, Ridge regression). In this case, Tolerance was used to test for multicollinearity and was satisfied.

### Measures to Ensure Trustworthiness

Creswell (2007) defines trustworthiness as the way in which the inquirer is able to persuade the audience that the findings are worth paying attention to and that the research is of a high quality. Creswell (2007) further states that trustworthiness is further divided into credibility – which corresponds with the positivist concept of internal validity – dependability – which relates more to reliability – transferability – which is a form of external validity – and confirmability – which is largely an issue of presentation, these were measures to ensure trustworthiness. De Vos et al. (2005) agree when they assert that the key criteria for trustworthiness are credibility, applicability, dependability and confirmability. These criteria was realised in this study in the following ways: mechanical recording of data and debriefing of the participants via the chief information officer (CIO).

## RESULTS

### Specific Research Questions

Building on prior research related to: (1) impact of information communication technology (ICT) and (2) operational risk management (ORM) in the context of SMEs, the focus of this study was to investigate the relationship between: (1) ICT operational risk management (ORM) and (2) performances of SMEs. To achieve the focus, the research investigated.

❖ Assessing the change management requirements for building successful in SME.

These were based<sup>3</sup> on Table 2.

**Table 2: Change management requirements and ICT ORM adoption**

- |    |   |
|----|---|
| A. | There is a high failure rate among enterprise application projects .  |
| B. | Enterprise applications are difficult to implement successfully   |
| C. | The success of organizational change can be determined by how well information system end users deal with various stages of ICT projects. |
| D. | Organizational change can be determined by how well information systems decision makers deal with various stages of ICT projects.         |

Consequently, an ICT operational risk model for SMEs was discussed and developed. Following the research objectives and the reviewed literature, the hypotheses that emerged included there is a significant relationship between change management requirements and ICT ORM adoption in SME.

### Statistical Techniques

Simple descriptive and inferential statistical methods were incorporated into the SPSS programme for analysing the data. The variables were precoded in preparation for entry into the programme (Tabachnick and Fidell 2007; Tabachnick 2008).

Despite the fact that the variables were descriptive in nature, they were assigned numeric codes to facilitate different statistical analysis (Meyers et al. 2006). Some of the measurement level (scale of measurement) was nominal and others ordinal. After the data had been checked, the codes were entered into the programme and the process of data cleaning ensured.

Appropriate statistical procedures were then performed. Frequency counts and percentages were applied to the data relating to the demographic details of the respondents in order to determine the distribution of gender, age group, position, department and level of education. A bivariate analysis between the respondents' demographic characteristics and the relationship between: (1) ICT operational risk management and (2) performances of SMEs was performed.

In order to understand the degree of association between the performances of SMEs and the independent variables, multiple regression, Repeated-Measures Analysis of Variance<sup>1</sup> RM-ANOVA and Repeated-Measures Multivariate Analysis of Variance - RM-MANOVA were performed (Cody and Smith 2005). Where a significant value was observed, either Betas of multiple regression or significant levels of RM-ANOVA or RM-MANOVA ascertained these differences (Tabachnick and Fidell 2007). The outcomes of these analyses are described in subsequent sections.

One of the objectives of this study was to find the factors predicting ICT operational risk within SMEs. To assess as seen in the questionnaire a construct was used to measure five main support items. The items were adapted after literature and research focus.

### Demographics of Respondents

The demographics of the respondents in gender, department, years of service. A total of 107 HR, IT, finance, operations and support staff participated in the study.

For instance, well over half (62.6%) of the sample was male. IT personnel constituted 60.7%. Among three main positions, only 12.1% respondents were middle management. The majority (52.3%, n=56) constituted operations staff. The majority of age (36.4%) of participants ranged from 26 to 30 years ( $M = 25.5$ ,  $SD = 7.94$ ), with 41 to 45 constituting 2.7% of respondents.

The sample as a whole was relatively old in terms of years of services (More than 5 years, 35.5%, n=38). The least years in service was n= 5 respondents (Less than 1 year, 4.7%). Most (33.6%, n= 36) had a Diploma as a level of educational qualification, noting that 19.6% (n=21) constituted postgraduate employees.

In line with the principles of multivariate data analysis (multivariate data analysis assump-

tions), the researcher conducted a zero-order correlation between the independent and dependent variables. The correlation provided directional support for the predicted relationship and showed that collinearity among the independent variables was sufficiently low ( $> \text{ or } = .6$ ) so as not to affect the stability of regression analysis (Tabachnick and Fidell 2007).

### Instrument Reliability, Validity and Multi-collinearity

Several techniques were used to assess (a) reliability coefficient Fidell (2009) and (b) assessing face and construct validity.

In order to ascertain face validity, an initial questionnaire was passed through routine editing after it was given to the panel of experts (some of whom included academics, practitioners or business managers and colleagues). They were asked to respond to a questionnaire and based upon their comments the questionnaire was reworded to enhance clarity.

In general, validity refers to the degree to which an instrument truly measures the constructs it is intended to measure. There are several types of validity measures that include the face validity and constructs validity. Fidell (2009) proposed two types of validity: convergent and discriminating validity. Convergent validity is measured by average variance extracted for each construct during the reliability analysis that should be 0.5 or 50 percent or better.

The results showed that all the constructs had a considerable validity support. To further analyse for convergent and discriminating validity of the principal component method with varimax rotation was used to assess the variance explained. In general, results show that both validities are satisfied.

All factors (within SMEs) are significantly correlated with ICT adoption. It was also found that none of the variables are highly inter-correlated, so the problem of multi-collinearity does not exist thus fulfilling Fidell (2009) criterion that says that for variables to qualify for multicollinearity they should have a coefficient of correlation 0.6 or more.

Prior to the regression analysis, data was screened for outliers and cases with a standard deviation greater than two were removed. The result of a stepwise regression analysis was presented in section 4.5. The current chapter con-

firmed the above result of multicollinearity (VIF and Tolerance).

For further analysis, the effect of multi-collinearity was studied by examining the VIF values for each of the regression coefficients (assumptions of multivariate regression). It was found that values for all the coefficients were less than 0.1 (Tolerance) and averages of VIF were close to 1 and as such multi-collinearity would not distort the regression analysis (Field 2007). Additionally, the models that is, regression coefficients) have high and significant F ratio indicating a good fit of the model and statistically significant in explaining the adoption of ICT operation by SMEs. The (beta) (standardised coefficient) indicated the relative importance of the independent variables in explaining the adoption of ICT operation by the SMEs.

### Research Question

This subsection aims at determining the significant relationship between ICT ORM adoption in SMEs. It also sought to interrogate the issue of challenges posed by ORM solutions in terms of its predictors as other research questions. Generally, most respondents (97.2%, n= 104) agree that maintaining an appropriate level of user involvement at all stages of the systems development life-cycle is essential, while 2.7% (n= 3) disagree. The majority (86.9%, n= 93) agree that information system design should be managed as planned organisational change, while, 13.1% (n= 14) disagree. The majority (90.6%, n= 97) agree that people, social and technology (socio-technical design) aims for an optimal blend of achieving both excellent technology and people's work performance, while 9.3% (n= 10) disagree.

### Analysis of Hypothesis

Multiple regression analysis was utilised to determine the percentage contribution of some of the identified significant predictors of challenges posed by ORM solutions. The distribution revealed that only one variable made significant percentage contribution. This is C<sup>22</sup> Identify the challenges posed by ORM solutions

A-Information system design should be managed as planned organizational change.

( $\beta = 0.447$ ,  $p < 0.01$ ). It may thus be inferred that 'C' is the variable prominent in explaining

the variation in level of ICT ORM and performance of SME

The results suggest that the variable contributed approximately 88.4% of the variations in level of challenges posed by ORM solutions. The analysis of variance also revealed that the regression coefficients were real and did not occur by chance.

It may therefore be inferred that relatively, C actively impacts on challenges posed by ORM solutions.

By implication there seems to be enough evidence to suggest that challenges posed by ORM solutions control would become more effective if efforts were targeted towards C. Thus, the fourth hypothesis was accepted.

## DISCUSSION

### Organisational Factors Related to Change Management Requirements and ICT Risk

Change management is an important factor in determining ICT operations in SMEs. This was particularly true as most of the respondents together with the beta value showed significant relationships and percentage contribution. The findings do not only provide empirical support to the previous findings of Froot and Stein (1998), but also support the argument for the influence of change management on ICT operational in SMEs adoption. Additionally, the results of this study are in line with Gattiker and Goodhue (2004) because more SMEs are adopting ICT operation and hence change management could be a significant viable factor in the early stage.

### Chaos System and ICT Operational Risk

As in the case of Lorenz's (1969) works a complex system such as in SMEs reacts to different variables at the outset. The results thus suggest that SMEs are sensitive to initial conditions. This is particularly true in ICT operational risk (Lorenz 1969). Even starting with the same or slightly different variables in a model will result in significantly different outcomes if the system is complex; thus no same context in Chaos Theory terms is time irreversibility.

*Time Irreversibility*- In a complex system such as SMEs, there is never the same context twice. Thus, a college, business (SMEs), or team with essentially identical personnel and similar

characteristics will never perform exactly the same as another (or itself), if the ICT operation factors are instituted (Theitart and Forgues 1995). As applied to management, a strategy or decisions will never be made twice within the same context.

The appeal of Chaos Theory is the view that organisations such as SMEs are complex adaptive systems that have behaviours similar to those found in nature that is different stages of stability and chaos. Rather than control an organisation, a manager is prompted to take advantage of its complexity. Theorists in management and social organisation now believe that organisations are also non-linear dynamic systems, having the same characteristics as natural phenomena (Conner and Coviello 2004).

An organisation is often seen as a complex adaptive system comprised of formal and shadow systems, and in this way the analogy is made between chaos in natural systems and social organisation. Similarly, the long-term behaviour of the organisation is ICT operations. As discussed McBride (2005) addresses this issue by stating that managers learn how to manage the ICT failures that are on the edge of chaos. McBride (2005) ends with optimism, believing that although long term outcomes are impossible for ICT operation in SMEs, dealing effectively with change and challenge on a daily basis will ultimately result in success. Chaos Theory is often used as a way to conceptualise management theory and other social systems. Therefore, the efficient manager will plan for and expect constant change in the environment. His or her goals become not a set of results but a series of contingency scenarios to which he or she can react in the short term at some later date in the future.

The foregoing sections articulated fundamental changes in decision making and processes associated with the present formulation and operation of SMEs. The evidence suggests that the primary impact is in terms of (2) assessing change management requirements and ICT operation.

#### **ICT ORM Change Management Model for SMEs**

The same principle applies to SMEs, thus, tiny changes in one of the variables studied can, on occasions, lead to major changes as a whole in SMEs.

The empirical evidence presented indicates that a significant proportion of aforementioned variables impacts on the performance of SME. Therefore, the premise of the model in the current study is that there is potentially far greater strategic impact in terms of the ICT operation and SME performance. The evidence was supportive of the strategic recognition or development by the respondents towards the wider implications of ICTs operational risk.

This is contrary to the evidence reported in relation to the larger organizations who have for a longer period engaged in the wider implications of ICT operation.

The evidence also available for the smaller organisation would indicate that SMEs may be advanced in their strategic thinking about the potential use of the ICT operations, though in most cases, this is primarily focused on the marketing communications and sales strategies rather than say procurement or other business-to-business relationships.

The data suggests that there is indeed reason to the pattern and structures of relationships within the ICT operation in SME. Additionally, there is evidence that the pace of adoption of ICTs and the associated competitive pressures are increasing rapidly evidence available for the SME sector suggests a pace of change and competitive pressures, though most small businesses are still at a much earlier stage of ICT adoption and development (Lam 2006).

Though SMEs are at an earlier adopter stage, the evidence from larger organisations taken into consideration with the rapid pace of technology development suggests that SME managers must engage with the concept of the ICT operations model.

This suggests that there will be a need for SME managers to manage a multitude of relationships. Thus, internal processes and procedures, such as production time, order processing, delivery methods, etc., will have to be geared to achieve the different expectations driven by the change management requirements and ICT risk. Ignoring the challenges and opportunities presented by the ICT operational model could lead to the failure of some SMEs.

For example, geographical location may no longer guarantee preferred supplier status; there could be competition from a greater number of businesses, both domestic and international, and custom-built orders may increasingly become the norm.



**Chaos Theory: A Guide to Manage SMEs**

Chaos Theory extends to both analysis and intervention to the way in which managers understand SMEs. Most managers assume that, given enough information, they can anticipate what is going to happen in a particular situation, and thus can determine how best to act so as to promote, defer, deflect, or divert it, as may be desired.

Chaos Theory suggests that, on the contrary, some systems are inherently risky as in SMEs and can never be fully understood, no matter how much effort or expense is devoted to trying (McBride 2005). Probable suggestions that follow is that, gathering more information or constructing more elaborate models about chaotic systems can become pointless. In fact, ‘research’ can even be counter-productive if it creates a false sense of security about planning and what it can do (McBride 2005). Moreover, in such cases, planning strategies that depend on foresight are inappropriate and sometimes misleading. Instead, managers must get used to working not with one or two forecasts of the future, but rather with an ‘ensemble of forecasts’ (Pflug 2006).

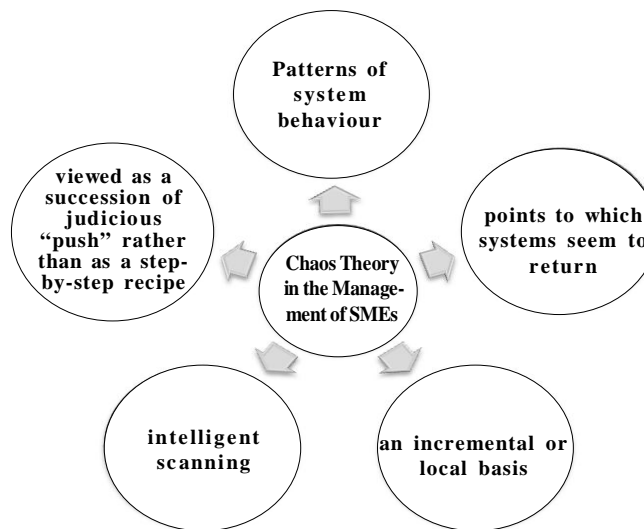
**Requirements of Chaos Theory in the Management of SMEs**

Managers seek understanding not as an end in itself but as a means to an end as a basis for

making informed judgments about the effects of intervention. Rather than looking for even more detailed information on more accurate models of their systems, managers should look instead for (1) patterns of system behaviour and (2) points to which systems seem to return (which mathematicians call ‘attractors’), even if not in any ICT operation (see Fig. 3).

Chaos reinforces the need for what authors called intelligent scanning (Thiéart and Forgues 1995). The fundamental implication that can be drawn from Chaos Theory is that managers must learn to rethink some of the deep-rooted beliefs in the virtues of order of chaos and disorder. In other words, managers must learn to accept the possibility that a chaotic operation, for instance, may be preferable to and ‘healthier’ than an orderly one. It may even be that managers need chaos in order to survive—that chaos is an essential part of ICT operation in SMEs.

Finally, and perhaps most important of all for managers, is the fact that chaotic systems for ICT operation should be seen only as (4) an incremental or local basis (Thiéart and Forgues 1995). On a global or comprehensive basis, operation of ICT in chaotic systems will normally result in cumulative effects of various kinds of feedback. But, on an incremental or local basis, the effects of feedback from one time period into the next are often perfectly clear. This should be the dominant argument for planning strategies that are incremental rather than comprehensive in



**Fig. 3. Requirements of Chaos Theory in management of SMEs**

scope, and that rely on a capacity for adaptation rather than on blueprints of results.

Related to this is the fact that, for chaotic systems, the shortest distance between two points is not always a straight line (Tsoukas 1998). In other words, even when managers are satisfied that a particular goal is desirable, the best way of getting there may not always be the most direct one. Instead, it may be easier to plan for a chaotic system by deliberately 'over-shooting, or 'under-shooting' the goal, or even by a sequence of such steps, than by going straight towards it.

Planning for chaotic systems may be more successful when (5) it is viewed as a succession of judicious 'push' rather than as a step-by-step recipe. For in chaotic systems, relatively small changes in inputs can have a dramatic effect on system behaviour. This was consistent with the result. The findings in chapter four also revealed that significant differences were accounted for from particularly variables.

The implication suggests that the parts of a system communicate with one another. The system has an environment with which at least one of its parts communicates, thus the system is always changing. This is a beneficial reminder that, in managing, the details can be just as important as the broad strokes. For these reasons, Chaos Theory promises a revolution in managing at least as profound as that entailed in the current trend towards an information society (Tsoukas 1998). As Lorenz (1969) noted, the view that order emerges from an underlying formless chaos and that this order is recognised only by periodic patterns was the predominant view in dynamics system.

The results answered the two questions posed. The model, which included four sub variables<sup>3</sup> explained 55.2 percent of the variance of ORM adoption within SMEs. Of the four sub variables, extensive organisational change that is often resisted by members of the organization made the largest unique contribution ('A') ( $\beta = 0.291$ ,  $p < 0.05$ ); although the rest made some contribution, they did not reach statistical significance in terms of contributions ( $p > .05$ ). It may therefore be inferred that relatively, A actively impacts on change management requirements and ICT Risk.

## CONCLUSION

The study was based upon a survey design to collect the primary data from 107 respondents

in an SME, based upon simple random sampling plan. A one stage normative model associative in nature was developed based upon reviewing the previous researches and further in line with the research objectives; the model elicited five factors. Based upon the multiple regression analysis of the data, the findings indicated that factors such as change management requirements affecting ICT adoption within SMEs were significant determinants of ICT operational risk in SMEs.

The findings supported similar other studies and increased the generalisability of the previous researches.

All four operational risk variables of SMEs of the current study had evidence to support the notion that there was a relationship between IT operational risk management (ITRM) and SMEs performances.

The empirical evidence presented indicated that a significant proportion of variables impacted the performance of SME. Therefore, the premise of the model in the current study is that there is strategic impact in terms of the ICT operation and SME performance. The evidence was supportive of the strategic recognition or development by the respondents towards the wider implications of ICT operation.

## RECOMMENDATIONS

The recommendations are divided into two: For practice of ICT operation in SMEs, and further research on ICT within SMEs.

### For Practice of ICT Operations in SMEs

Chaos Theory suggested that some systems are inherently risky as in SMEs and can never be fully understood, no matter how much effort or expense is devoted to trying. The suggestion is that gathering more information or constructing more elaborate models about chaos systems can become pointless. Instead, managers must get used to working, not with one or two forecasts of the future, but rather with an ensemble of forecasts. Hence, it is recommended that tiny changes in one of the variables studied can, on occasions, lead to major changes as a whole in SMEs.

However, key barriers to the pace and success of adopting ICT operation was identified as insufficient or improper user participation in the systems for which managers need to take notice.

Thus ICT operations managers of SMEs should look instead for; change management requirements affecting ICT adoption within SMEs to leverage the institution's performance.

### For Further Research

However, further research is needed to monitor these changes more closely to measure the changing strategies and the associated issues of insufficient or improper user participation in the systems development process, lack of management support, high levels of complexity and risk in the systems development process and poor management of the implementation process, which have been identified as potential barriers to the effective adoption and implementation of ICT operations.

Additionally, further researches are needed to prove the hypotheses established in SMEs other than financial related. Hence, several contributions can be achieved especially to the various stakeholders of SMEs, namely the regulator, shareholders, management team, depositors and the general public.

Though SMEs are at an earlier adopter stage, the evidence from the current study taken into consideration with the rapid pace of technology development, suggests that SME managers must engage with the concept of the ICT operation model. By recognising the opportunities presented by such an ICT operation model, there is potential for SMEs to increase their customer base and engage in both local and international markets. The study has a practical significance as it provides help to the management of SMEs concerning factors contributing towards ICT, the event that they may wish to capitalise on ICT operation adoption.

### NOTES

1.  $N > 50 + 8m$  ( $m=5$  number of independent variables)=90: Note that it was anticipated that more cases were used to cater for any possible skewness for dependent variable such that the distribution of data satisfies the assumptions of multiple regression related to sample size.
2. For details see Tabachnick and Fidell (2007).
3. A. There is a high failure rate among enterprise application projects because they require extensive organizational change that is often resisted by members of the organization.
- B. Enterprise applications are difficult to implement successfully because they usually require far-reaching changes to business processes.

- C. The success of organizational change can be determined by how well information system end users deal with various stages in the implementation of ICT projects.
- D. The success of organizational change can be determined by how well information systems decision makers deal with various stages in the implementation of ICT projects.

### REFERENCES

- Cody RP, Smith JK 2005. *Applied Statistics and the SAS Programming Language*. Upper Saddle River, NJ: Prentice Hall.
- Conner FW, Coviello AW 2004. Information Security Governance: A Call to Action. The Corporate Governance Task Force. From < [http://www.cyberpartnership.org/ Info SecGov](http://www.cyberpartnership.org/InfoSecGov). 2004> (Retrieved Jan 9, 2010).
- Creswell JW 2007. *Qualitative Inquiry and Research Design: Choosing Among Five Traditions*. 2<sup>nd</sup> Edition. Thousand Oaks: Sage.
- Curley M 2004. *Managing Information Technology for Business Value*. US, NY: Press. Intel.
- De Vos AS, Strydom H, Fouché CB, Delport CSL 2005. *Research at Grassroots: For the Social Sciences and Human Service Professions*. 3<sup>rd</sup> Edition. Pretoria: Van Schaik.
- Fidell A 2009. *Discovering Statistics with SPSS*. London: Sage.
- Hubbard D 2007. *How to Measure Anything: Finding the Value of Intangibles in Business*. USA: John Wiley and Sons.
- ITGI 2007. *IT Governance Institute ITGI- . CobiT 4.1, Executive Summary*. US, NY: ITGI.
- King III Report 2009. *King Committee on Governance: Code of Governance. Principles for South Africa*. South Africa: King Committee Press.
- Lam J 2006. *Emerging Best Practices in Developing Key Risk Indicators and ERM Reporting*. Japan: James Lam and Associates.
- McBride N 2005. Chaos theory as a model for interpreting information systems in organizations. *Information Systems*, 15: 233–254.
- Pflug GC 2006. Subdifferential representation of risk measures. *Mathematical Programming*, 15: 108–116.
- Posthumus S, Von Solms RA 2004. Framework for the governance of information security. *Computers and Security*, 23: 638–646.
- Standing C, Guilfoyle A, Lin C, Love PED 2007. The attribution of success and failure in IT projects. *Industrial Management and Data Systems*, 106(8): 1148–1165.
- Thiéart RA, Forgues B 1995. Chaos theory and organization. *Organisation Science*, 6(1): 19–31.
- Tabachnick BG 2008. *Multivariate Statistics: An Introduction and Some Applications*. Jacksonville: FL: Boston Press.
- Tabachnick BG, Fidell LS 2009. *Using Multivariate Statistics*. 5<sup>th</sup> Edition. Boston: Allyn and Bacon.
- Tsoukas H 1998. Chaos, complexity and organization theory. *Organization*, 5: 291–313.