

Experiences in Teaching Systems Thinking

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Abstract

The paper describes a programme in teaching systems thinking at the Graduate School of Business at the University of Cape Town. This programme has been run for the last four years and has achieved good results in getting MBA students to apply systems thinking in problem solving situations. The results are judged significant given the relatively brief exposure to systems thinking and varied background of participants.

The course itself is based on an action learning model, with self application a major mode of learning. Less emphasis is placed on the theoretical input, but students are required to invest significant effort in acquiring this through self study. The course makes extensive and explicit use of group work to structure and support the learning experience.

The course uses systems thinking to deal with general problem solving. The underlying methodology for problem solving used is one based on group inquiry, aimed at building up an appropriately rich and shared model of reality. The process of group learning is structured using Soft Systems Methodology and Systems Dynamics Modelling.

In the end the course is more about changing the way people think than about techniques. Some of the experiences relevant to this type of teaching is reflected on.

EXPERIENCES IN TEACHING SYSTEMS THINKING

INTRODUCTION

The authors were approached by the Graduate School of Business of the University of Cape Town late in 1990 for a course in systems thinking as part of the MBA programme. The course has been presented since 1991 until the present, being repeated twice per year for full and part time MBA programmes. When we undertook the design of the course three issues were paramount in our minds:

- The course had to embed systems thinking in an application area;
- The course had to be usable by corporations and persons outside of the MBA programme;
- The course had to be of practical value to people in organisations.

The application areas considered were general organisation management, planning and problem solving, of which the last was chosen.

COURSE DESIGN ISSUES

The course was conceived as enhancing people's ability to inquire into problem situations using systems thinking to structure the inquiry. Taking the design of the course itself as a problem situation requiring inquiry was a logical step. We used Soft Systems Methodology as an aid to structure our inquiry into this design.

Using SSM as an inquiry structuring aid was valuable in the sense that viewpoints and implication were discovered that otherwise would have remained obscured. For example, attention to the immersion phase of SSM forced a careful reflection on the context in which the course needs to operate. Likewise, explicit use of the labelling process helped to uncover a range of viewpoints from which the course will be viewed and evaluated. This in turn highlighted certain activities that would be important to the success of the course. These included an understanding of the learning process and how it could be facilitated.

DESIGNING A LEARNING PROCESS.

Our experience is that the designs of successful managerial learning processes need to be based on explicit learning models to ensure coherence and consistency. Many of the current management learning models have their roots in Kolb's work (Kolb & Fry, 1975). Kolb's model states that any meaningful learning experience consists of four phases. It starts with a concrete experience followed by observations and reflections associated with the experience. In the third phase abstract concepts and generalisations about the experience are formulated and finally in the fourth phase the implications of these concepts are tested in new situations.

Mumford and Honey (Mumford, 1982, Honey and Mumford, 1986) suggested that each phase in the cycle had a particular leaning style associated with it. The learning styles are: the activist (experience), reflector (reflection), theorist (concept formulation) and pragmatic (testing) styles. Most people, including managers, have preferred learning styles. Honey and Mumford developed an instrument for identifying preferred learning styles.

The implications of this model for the design of the course were:

- The course had to include all four of the phases in the learning cycle;
- As the course had to promote problem solving as a group learning process, group composition had to ensure that all preferred learning styles were present in each of the groups. With small classes this is not always possible.

Group composition is based on the results of the learning styles instruments. The Belbin instrument for measuring preferred organisational roles is used to resolve any further selection difficulties that may arise

Our experience is that group selection is an important determinant of success.

COURSE PURPOSE

The course provides a new conceptual basis for, and experience in, rational inquiry into, and design of complex socio-technical systems

Our aim is to increase the effectiveness and efficiency of participants in general problem solving through increasing their level and use of systems thinking. Part of this aim is for participants to understand problem solving as a social learning process, where the solution is an emergent property of a group inquiry. This inquiry should be based on systems thinking principles and methodologies.

Put in a different way, we can say that the purpose of the course is about changing mental models about how the world works, about management, and about problem solving.

COURSE OBJECTIVES

- The course provides an introduction to systems thinking applicable to understanding of combined technical and people systems.
- The course provides a systematic and systemic way of describing systems such that both deficiencies, and desirable and feasible changes become clear.
- The course focuses on the development of a systems thinking style in participants and the development of a practical level of proficiency in the application of such thinking to decision making and problem solving.

SCOPE OF THE COURSE

The course covers conceptual aspects as well as the application of a systems approach. It aims at developing a specific ability to inquire into complex socio-technical systems with a view to identifying desirable and feasible improvements. It is equally applicable to the design of new systems that are imbedded in existing socio-technical systems. It focuses on the development of powerful ways to figuratively look at systems, to describe these systems in ways that promote clarity of insight, communication, and collaboration for interventions.

The course offers a qualitative approach to dealing with the open ended problems that characterise socio-technical systems. Although no specific background is required, the course assumes and builds on practical commercial and industrial experience. Its theoretical basis builds on and integrates the system thinking of people such as Peter Checkland, Russell Ackoff, Peter Senge and Jay Forrester. However the focus is on the application of these ideas that make them accessible and useful to people in business.

CRITICAL COURSE MESSAGES

Partly through experience and partly through the original design, the course has matured in its intended message. We regard the course to have been successful for a participant if the following message came over:

- Problem solving is a collective, social process of inquiry, aimed at building up an appropriately rich and shared model of reality;
- Systems thinking is pervaded by the idea and explicit use of multiple perspectives;
- Systems thinking the poverty of general ideas of causality and uses a rich, including a non-linear and circular, concept of causality in complex systems;

- The explicit and considered use of systems thinking principles can benefit the resolution of many practical problem situations.

It would be fair to say, based on the written responses by students to the question "What have you learned from this experience?", that most students develop in the dimensions listed above. Of the almost 200 student who have taken the course so far, accepting the first message appears to be the most difficult.

COURSE DELIVERABLES

The course is aimed at improving the ability to apply systems thinking. The box below lists the some of the core competencies we believe are required to be proficient in this area. Without claiming 100% success in any one of these areas we aim to develop the participants in all of the areas below. Some areas require basic study while other, e.g. attitudes develop to a greater or lessor extent by undergoing the whole process. The higher numbered core competencies are much more difficult to instil and measuring change in these areas are increasingly difficult.

CORE COMPETENCY AREAS FOR APPLICATION OF SYSTEMS THINKING

- 1. Knowledge**
 - 1.1 Systems vocabulary: Knows the key words
 - 1.2 Linking of concepts: Knows the relationships between word/concepts.
 - 1.3 Interpretation and meaning: Knows the significance of key concepts.
- 2. Problem solving approach**
 - 2.1 Techniques (Knows processes/methods)
 - 2.2 Methodology (Knows principles of method)
 - 2.3 Philosophy ('Knows' appropriate/systems world view)
- 3. Application Fluency**
 - 3.1 Evaluation: Sees/perceives/interprets situations in terms of systems world view
 - 3.2 Diagnosis: Explains situations in terms of systems world view
 - 3.3 Prognosis: Forms anticipation of the (future) unfolding of the situation
 - 3.4 Treatment Prescription: Applies systems methodology to formulate a situation specific method of attack
- 4. Communication Capabilities**
 - 4.1 To listen and hear what others say
 - 4.2 Questioning ability: to prompt/probe & keep conversation live
 - 4.3 One-on-one feedback
 - 4.4 Presentation skills
 - 4.5 Writing skills
- 5. Appropriate Attitudes (Mindset)**
 - 5.1 Belief in inseparableness and interdependence of consultant/researcher/problem solver from problem situation.
 - 5.2 Belief in solutions as open ended processes, and not as structural prescriptions (snap-shot view vs. motion picture view of problems/situations).
 - 5.3 Belief in consultant/client relationship as not an expert/unenlightened relationship, but as equals in a process of inquiry.
 - 5.4 Views of him-/herself as learning facilitator and not as solution discoverer.

COURSE CONTENT DESCRIPTION

The course consists of 15 2-hour sessions, but versions were presented in the form of 10 3-hour sessions or 20 90-minute sessions. One third of these is devoted to laying the required theoretical basis, interspersed with practice sessions.

The topics include:

- Soft systems methodology: The systems movement, human activity systems, soft systems approach to enquiry and problem solving, methods of action research.
- System dynamics modelling: Modelling regulation and system interaction.
- Images of systems; mechanistic, organismic and social system organisational models, problem solving and planning, the stakeholder view of organisations, effectiveness appraisal.
- An introduction to systems concepts: The concept of a system, relationships, emergence systems hierarchies, classifications of socio-technical systems, human activity systems.
- Inquiry into and description of systems: multiple perspectives, structure, function, purpose, process, regulation, systems causality, analysis, flow tracing, synthesis, system regulation.

The course contents underwent some development and reorganisation as a result of our experience with the course. The basic content however remained fundamentally the same. This can be described in terms of five lanes or sets of activities.

The first set is that of instilling Soft Systems Methodology as a systems approach. There is a two to three session introduction leading up to SSM but then SSM occupies typically 6 out of 15 two hour sessions. Within SSM we cover the mechanics of the process rather quickly and then get groups to apply to methodology to a real but controlled situation. The situations controlled primarily by restricting the immersion phase to a selected set of writings as the description of the real situation. This is done because this initial phase of SSM can be very time consuming and the purpose of this phase is to become familiar with the process, and not to get too hung up on a particular real situation. We have used a set of articles describing business schools and MBA programmes, with current thinking and problems highlighted, as a description of the "real" situation. This puts every group on the same starting basis, whilst been a situation that they are familiar with from own experience. The comparison phase of SSM is done with respect to the Cape Town University Business School, one that they can relate to well, because by the time students do this course they are 75% through the MBA programme. This whole lane of activities is simply to get them in a position where they can apply SSM autonomously.

A second set of activities is System Dynamics Modelling, also taking up about 6 out of 15 sessions. SDM is a very powerful way of looking at the world and an enormously important model for perceiving circular causality in complex systems. We teach SDM more for instilling this world view than for the technique itself. We have also found, in our own consulting work as well as numerous student projects, that SDM has to be preceded by SSM for the SDM models to be appropriate. SDM does not have an inherent immersion phase in its methodology; in fact it is rather weak in the methodology process. Put differently, SSM and SDM complement each other in that SSM helps to arrive at ideas of what should be done, whereas SDM helps to form an anticipation of what would happen if this is done, a static versus dynamic picture of the same situation. When used in this way SDM complements SSM in a way that SSM alone can not be expected to achieve. Furthermore, SDM forces participants to make explicit their collective model of causality of the situation, which is crucial to effective action taking, and which no other methodology properly succeeds in doing. Students are taken into this rather quickly, first of all by requiring a quick SSM on Total Quality Management and the requiring an SDM of the implementation of TQM in a real organisation. This quick exercise is followed by applying SDM to the business school situation to examine the implications of their SSM

developed recommendations. The SDM phase is normally introduced with the Beer Game (Senge,1990).

The SSM and SDM sets of activities is introduced, interspersed and concluded by three sessions that introduces and re-emphasises the theme of problem solving as a group process of learning. The emphasis is to help participants see SSM and SDM as principles for structuring group inquiry. This theme is also illustrated with a case study and examples. As either the first or second session, depending on circumstances, the whole course and most of the core ideas are introduced by the way of the FishBanks game (Meadows et al, 1991). This is a computer assisted board game in the management of constrained resources. We have found this to create an appropriate atmosphere to the topics of the course as well as creating as common reference experience.

The last set of activities is an ongoing one that normally is initiated very early, as early as the second or third session. This is the application of the whole approach, including SSM and SDM, to a topic of choice for the individual or group. We have to be somewhat careful here, because it is not feasible to get 30 individual projects running and supervised. We therefore restrict large classes to work in groups and allow small classes to work on individual projects. Practically this has meant that full time groups worked in groups and that the smaller part time classes worked on individual projects. From the students' perspective there are both pros and cons to both of these approaches.

For most of the course both lecturers are present, and the students get double counselling at, I may add, the price of one lecturer to the business school. It is unfortunately a drawback of the teaching model adopted, that it requires heavy and close monitoring from the facilitators.

TEACHING METHOD

The course relies on experiential learning as its primary mode of teaching. This means that participants are required to apply the methods to systems of their choice if the group is small enough or otherwise to selected case studies after exposure to the theoretical part. The theoretical material is conveyed through self study and class room interactions. The systems approach applications are carried out by participants working in groups and the results are presented and discussed in group sessions.

A wide range of learning activities are used to support teaching. For the theoretical input we use concept mapping, critiquing, papers, and presentations. The applications of SSM and SDM are monitored by checking the results of various phases in the processes. As far as possible we involve students in doing rather than listening, and help them to make their own synthesis rather than to feed them our synthesis. The course, for example, is ended with a workshop where students individually and collectively have to enumerate and make a synthesis of learning points for themselves. (We use a modified brainstorming technique for this.) This insight has to be captured in a final (individual) statement of what they have learned from the course.

Evaluation of Participants

Evaluation of material such as that covered by this course is very problematical. It is often very easy to judge if student is "in" or "out" but to measure this in any apparently objective manner is difficult at best, if it feasible at all. The following baskets of evaluation approaches are used:

| | % of Final Mark |
|---------------------------|-----------------|
| Class Mark | 20% |
| Group paper on SSM | 20% |
| Group paper on SDM | 20% |
| Individual project report | 40% |

The class mark is based on all individual material to be handed in as indicated in the session program. All hand-ins count; material must be handed in at the start of each session. Late-submissions are not be marked and are not counted towards the class mark. Unfortunately, this and other emphasis is required in the course to speed up and enforce the process.

There is no separate test or exam, although we have used both on occasions. Prescribed reading may be tested in class but generally are not as students who are not up to date with their reading stand out and can easily be picked out (if the class is small enough, less than 16).

The individual or group paper on the main or ongoing application, running throughout the course, is evaluated using criteria like:

Project evaluation criteria:

- Is systems thinking used to express the situation?
- Are the technique(s) used technically correct?
- Have they learnt about the situation?
Useful/new insights gained?
- Has the work made a difference in practice?

It is fair to say that evaluation is problematic. The individual concept maps of material read are very good at showing if a person is "with-it"; the final what-have-I-learned statement is equally accurate in assessing if a student has picked up the essential messages. However, the business school culture is on of emphasis on individual grades and achievement towards these grades. In our experience, many of the students who really developed in the intended course direction did not score particularly high grades, and some who did were clearly still not systems thinkers (at least judged subjectively). Lessening an over-emphasis on evaluation is one of the changes we would like to implement.

EXPERIENCES IN COURSE PROCESS

The need for self-study:

The course uses three main activities for teaching, namely self-study, group and classroom activities. We rely heavily on the self reading component in getting basic concepts instilled in participants. For some personalities this works well, but others have learning style preferences that thwart this approach. Although we do illustrate the techniques in class we rely on individuals and groups to study both the theory and examples using reference books. The reason for this is that the basic course message is derived from experience: It is action learning from start to finish to the extend that we want participants to formulate for themselves a problem solving methodology rather than learn a text book version. These principles, of self and group study, and to synthesise a methodology out of a set of principles, are foreign to business school teaching. The expectation there is much more of a technique that needs to be taught and properly illustrated. This expectation leads to problems in the evaluation of the course by participants

Role of group functioning:

Our whole approach to problem solving is that it is or ought to be a social learning process. Seen as a group process of inquiry, basic personality and group dynamics become important. We use the Kolb learning styles inventory and the Belbin team role identification to identify learning style and team role preferences in participants. This is then used to constitute teams (participants make up their own teams by selecting from different groupings of participants) which become the groups for the course. Initially this approach was optional for the participants but early on we had an experience with and academically top group (self-selected because they did not want to be held back by weaklings) being completely outclassed by a well-balanced group made up of relatively weak individuals. After this we made the approach more or less compulsory. This also demonstrates that a course of this nature really ought to include more organisational and individual psychological input.

It has been our experience that weak students can benefit enormously from being in a well-functioning group. It is almost invariable that if there are learning problems relative to the course objectives, that we find the group concerned to be malfunctioning in some way. We have to remain on the lookout for group malfunctioning as much as for any other problems, and move to correct this, rather than say give an illuminating example. Even academically strong students gain deeper insight in the social dimension of problem solving by having to deal with these issues.

The ah-ha time lag:

The material "taught" in the course differs significantly from the more hard approaches to problem solving. Compared to say something like linear programming, the deliverables are very soft. Some of the underlying very important principles are not to be found in the techniques or methodologies. This makes it very hard to grasp, as the student may be taxed to comprehend the use of the methodology in the first place but the actual important point is way beyond the methodology. As an example of this, group learning is the important point in problem solving, and Soft Systems Methodology is just a means to this end. But SSM in itself is quite difficult for many (especially hard oriented people) to comprehend. This deeper level of insight is difficult to reach for most students and comes in most cases towards the end of the course. It is seldom that it is there before the first half is over. The result is that most students undergo a process where the ah-ha is rather late. In some cases this ah-ha is rather fundamental and really changes the outlook of people who gets it, but even for those the process is difficult emotionally and mentally.

Feedback from course participants: like result, hate process:

It is fair to say, on the basis of anonymous feedback from participants, that most, but not all appreciate and value the results of the course for themselves. It would also be fair to say that most, however much they like the result, are less than happy with the process of getting there. Given that we are being measured in the long run by student satisfaction this obviously caused a lot of soul searching on our part. It seems to us that there are fundamental conflicts here. On the one hand the client is always right, in this case the client has to be students in the first place. On the other hand giving in to their demands is counter productive to achieving the mind shift and learning some of the fundamental points. For example, there invariably there is a howl of requests to structure and clarify the problem they have to work on and great conflict in the groups as to what the actual problem they have to deal with actually is. This conflict is then reflected back to the lecturers to resolve (because "the instruction is not clear"). In actual problem solving this is actually the most difficult part of the process and you do not have a lecturer-god who resolves this for you. Furthermore, the methodologies are designed to deal with this. Leaving students to stew further in this condition then is taken as a failure of the teaching process where-as in fact it is operating quite well: It is an enormously important part of their learning experience to first hand experience this confusion, conflict and frustration (coming from their own colleagues) and to experience how they get out of this to a meaningful conclusion by working through the process. Now should one remove this confusion or retain it? It creates a pressure cooker effect that promotes a more rapid mind shift than the clinical presentation of case studies (if these can achieve this at all). The downside is mental discomfort that is formulated on the course feedback forms that are used to evaluate lecturer performance. There is a nice little systems dynamic model hidden in this dilemma.

Demand for, need for and difficulty of ongoing feedback yielding group size limitations:

Group size limitation introduced by the nature of the course material and teaching method is a real problem. Even with two lectures present a group size of 16 is barely tolerable. If numbers creep up from this the learning experience for all concerned starts to suffer. With a group size of 16 we handle four groups of four people each. We have handled up to 44 people, but have laid down a maximum group size of 20. Our preference is for a group size of 12.

Part of this problem is the difficulty that students have in judging their own progress. So much of the course deals with the way people think and requiring them to make a synthesis for themselves on this, that they need lecturer interaction, not for informational input, but rather emotional support, confirmation that they are OK in some sense. Achieving the required ongoing feedback as needed and demanded by students become very problematical in large groups. Whereas there is a real possibility of identifying and helping a struggling student to change in a small class there is virtually no hope of this in a large (30+) group.

In many cases, particularly the full time MBA groups, demand exceeds the group size limitation. This raises an ethical problem, in that selecting students who in some way already demonstrate an inclination to systems thinking, leaves out students who in fact may benefit the most from this kind of exposure, exactly because they are weak in this kind of thinking. The course will have better marks on average with a select group but may have more real world impact by working with less well suited people.

Difficulty in real/actual applications vs. more constrained applications:

From the start the course was conceived as leaving people in a better position to deal with real word problems. One way of doing this is to allow participants to work on real world problems in their applications. This raises a major difficulty in that the timing, clock speed and scope of most real situations do not synchronise with that of the course. It is virtually impossible to take and work through a real situation in an in depth way as part of the course. We have had to use semi-real situations, or cases artificially constrained in some way, to fit into the course programme. Not least of these constraints is that many real situations would require the application of a systems methodology other than that promoted in the course. There is simply not enough time to get to the same level of depth for a variety of methodologies that would be required if the choice of the application area was left wide open. In other words, we have laid down a methodology and approach that is relevant to many organisational problem solving situations but it is not the answer to all possible situations.

Mechanistic mindset: expecting technique vs. enhanced thinking:

It is in this area that we have to overcome one of the major stumbling blocks in the course, namely a mindset of participants that problem solving can be approached and taught as a simple technique. The technique expectation is particularly dominant in the MBA culture and there is a low tolerance for the soft and very subtle issues involved in real world problem solving. The notion that the course is really about enhancing one's thinking rather than about teaching a technique is often missed.

We suspect it is part of the nature of this type of material, more focused on mindset and worldviews, that is fundamentally at odds with a view that presupposes simple answers and techniques. It again illustrates the problem of satisfying demand or of working to a more appropriate world view. Perhaps professionalism in teaching precludes satisfying all demands (but now we will probably be accused of arrogance). Our defence has steadfastly been that these approaches have worked for us in practice. We make no absolute claim for these approaches to be better in every case, but simply that these principles have practical value in a context where many problems occur as a result of holding onto the opposite worldview. The course in essence is structured and evaluated in such a way that participants are in a position to discover this for themselves and in fact are not required to accept this as a condition for passing.

Implications of MBA mindset and time limitations:

There appears to be an MBA culture, compared to say a science Masters culture, which looks for 80% of the answer quickly and that answer must be simple. Perhaps the best way to describe this is to say that 80% of an answer that rapidly gives results is good enough. There is not real concern that it is the remaining 20% of the answer that is not considered which is the source of 80% of your future

problems. While this is a blanket generalisation it does describe a pronounced attitude that we have experienced.

The full time course at the University of Cape Town MBA programme is very full, leaving extremely little time for students to really sink their teeth into any topic. This aggravates the demand for quick and simple methods giving clearly distinguishable results rapidly.

Both these factors militate against the contents and teaching method of this course. The material or nature of the deliverables, as well as the nature of the learning process, differs from what participants are used to. They often perceive that they need a different approach. We perceive the KISS expectations to be the death kiss for complex problem solving and systems thinking. We also believe, and have experienced this in practice many times over, that many managers do not suffer from a lack of information but rather from a lack of principles to structure their own learning in rapidly changing circumstances. It is improving this learning ability that the course is all about in the end.

Again as a generalisation, we have found the part time students to be more receptive to this course and its contents. There certainly is a maturity factor coming into the picture, in that the full time students generally are older, and have more senior position experience. In addition, there is less time pressure and more of a concern with learning than with finishing the course.

In this and other systems thinking related courses we have found that persons with a soft (humanities) background take more easily to these approaches. People with a hard science or quantitative, including e.g. finance and auditing, background often have a harder time in acquiring this world view. There are however many individual exceptions to these generalisations.

REFLECTIONS ON TEACHING SYSTEMS THINKING

One of the developments out of this course for us has been the simultaneous use of SSM and SDM as a combined methodology. Just before we started teaching these methodologies we used it in a practical situation in this way and have used this double punch on many subsequent occasions. What has emerged is that compared to e.g. SSM, SDM has a very weak or underdeveloped methodology underlying it. One of its weakest points is that it does not have an immersion phase as part of the process. We believe that these two methodologies form a natural pair and should be looked at seriously in any situation where one of them would be considered.

We have several times commented on the difficulty in "teaching" a mindset. Systems thinking is in the first place a way of seeing (perceiving) the world, and this way of seeing lays down certain principles for inquiry about the world. When successful this brings a marked change to students; they regard themselves as *being* fundamentally different for having undergone this experience, as opposed to having learned something useful. Achieving a mindset change is a deeper process and fundamentally different from what we have come to regard as the norm in teaching other subjects. We may be far from understanding how to achieve this in an efficient manner. The results observed with this course, in terms of helping people to develop meaningfully, makes the effort worthwhile.

It is however important to realise that the course is an introduction to help people get onto a particular type of mental route. If they stop the course without further use of the approach, the level of systems thinking used in their everyday problem solving will tend to decline. Some level of continued exposure is required. One way of doing this in the MBA environment is to make a systems approach the basis of their (optional) research report. This tends to give more exposure and experience in the use of a systems approach, leaving students in a position to more easily apply it in future.

CONCLUSION

The MBA course in systems thinking at the University of Cape Town succeeds in bringing most participants to a position where they can apply these principles. The principles are based on using a combination of two classical systems methodologies to structure a group learning process in a problem situation. The teaching of this material requires a mindshift which most participants experience as emotionally stressful. A gratifying result for born again pragmatists is that many of our students have gone on to use this approach to make significant improvements in their organisations¹.

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¹ The views expressed in this paper do not necessarily reflect those of the Graduate School of Business of the University of Cape Town.