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BUSINESS SIMULATIONS: TRANSFORMING MENTAL MODELS

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ABSTRACT

The purpose of the study was to determine whether business simulations helped further systems thinking in individuals. To establish whether improved systems thinking may be a result of participating in business simulation programs, participants needed to be separated from their day-to-day reality and confronted with managing their organisations in a virtual world.

The virtual world in which participants needed to immerse themselves was a customised business simulation designed to capture some of the critical elements of their organisation in a simplified virtual micro-world. This new world allowed participants to engage with and experiment with their organisations in a risk free environment and from a holistic systems perspective. Experimental research was conducted to determine whether it may be possible that individuals participating in these business simulation programs experience a shift in mental models towards systems thinking.

The feedback received from participants showed high levels of agreement with respect to the fact that the simulation tools allowed them to engage with the virtual model from a systems perspective. Approximately a third of all participants reported that their most significant insight during the simulation program was in some way related to their new way of seeing and understanding the system of which they are part.

The study concludes w 

ıould further encourage systems thinking, which will help them deal with the complexity of the environment in which we operate on a day-to-day basis. Furthermore, improved systems thinking may help us overcome some significant barriers to learning and thereby improve our capabilities in respect to dealing with change. Further research is needed to better qualify the specific skill sets necessary for improved systems thinking.

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DECLARATION

I declare that this research report is my own work. It is submitted in partial fulfilment of the requirements for the degree of Master of Business Administration at the Gordon Institute of Business Science, University of Pretoria. It has not been submitted before for any degree or examination in any other University.

_____

Michael Schlosser

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1 DEFINITION OF THE PROBLEM

1.1 Introduction

In order to be competitive in today's rapidly changing environment, organisations need to reinvent themselves on a continuous basis. Sterman (2000) argues that accelerating changes in technology, population and economic activity are transforming our world and are challenging traditional institutions, practices and beliefs. The success of organisations depends on their ability to innovate and change. According to Beer and Spector (1993), today, organisations in almost all industries face much higher uncertainty as a result of intense global competition and deregulation. Survival becomes increasingly difficult for organisations that need to defend themselves against increased rivalry. Prahalad and Hamel (1995) maintain that an organisations ability to change is what enables it to survive over a long period of time.

Due to this increased uncertainty, it is critical that organisations are able to meet changing market demands in order to remain competitive. Organisations often experience great difficulty when it comes to implementing change initiatives and their inability to overcome barriers to change often causes these initiatives to fail. Beer and Nohira (2000) argue that about 70% of all change initiatives fail. One of the main reasons why organisations find it so difficult to change is because the

behaviours of people grained in an organisations culture. If habits therefore have become part of the organisations culture, all change that challenges such habits means fundamental change. Kotter (1995) argues that many organisation have successfully undergone fundamental change which has gone under different banners such as, total quality management, reengineering, right sizing, restructuring, cultural change and turnaround. However, the basic goal of organisations that have managed to successfully implement change initiatives has been the same: “to make fundamental changes on how business is conducted in order to help cope with a new more challenging market environment” (Kotter, 1995, p. 59)

Goldratt, Schragenheim and Ptak (2000) argue that if we make changes in an organisational system, such as implementing new technology for example, we implement that change because we expect that technology to decease an existing limitation. However, because this limitation has always existed in the past, our customs, our habits, our measurements and our rules recognise and consider the existence of that limitation. If we therefore implement this new technology that has the ability to decrease an existing limitation and we fail to address the rules that assume the existence of the limitation, then we will not realise the full benefit of the new technology. When the limitation is removed we continue to accommodate the non-existing limitation. Sterman (2000) argues that policy resistance arises because we do not understand the full range of feedbacks operating in a system. As our actions alter the state of the system, other people react to restore the

balance we have ups e system therefore need to be reflected in changes in our customs, habits and rules. To adapt to a rapidly changing environment therefore means that organisational members have to be able to unlearn old habits and replace them with new ones. We need to change our paradigms, which can be extremely formidable barriers to tear down and replace (Quinn, 1996). In order to challenge existing paradigms, employees need to see their organisations from a different perspective to allow them to understand the necessity for change. Kotter (1995, p. 60) believes that "employees will not make sacrifices, even if they are unhappy with the status quo, unless they believe that useful change is possible."

Getting buy-in to policy change in the organisation is crucial to the organisations future success. Porter (1996) argues that in order to outperform its competition, an organisation must establish a difference that it can preserve. To do so, the organisational members must understand that the competitive value of individual activities cannot be separated from the whole, the organisational system. The compelling argument for the systems approach to gaining a sustainable competitive advantage is that "it is harder for a rival to match an array of interlocked activities than it is merely to imitate a particular sales force approach, match a process technology, or replicate a set of product features" (Porter, 1996, p. 73).

1.2 Motivation

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In order to be able to deal with the challenges we face in a rapidly changing environment we need to be able to understand and deal with these changing dynamics on a continuous basis. Perhaps simulating the systems in which we operate could help us better understand the dynamics of our environment and therefore allow us to make better decisions in the real world. By using simulations as capability building tools, participants would be able to test various decision scenarios in a risk free environment and draw their own conclusions through a process of experiential learning. Should business simulations be effective in changing the way in which people view their organisation, they may be useful tools in aiding strategic change. Besides using simulations, Sterman (2000) argues that the only other way to test conceptual models is by relying on feedback through the real world. However, this feedback can be slow and often ineffective due to dynamic complexity, time delays, ambiguous feedback and defensive reactions. One of the expected outcomes of the simulation experience is that participants may be able to enhance their intuition about complex systems. Though experience-based learning, unlike traditional lectures, Zalatan and Mayer (1999) argue that participants are more likely to internalise, comprehend and recall material learned through active engagement in the learning process, rather than being “passive spectators.”

By making use of bu for us to model complex systems and owing to the high level view and reduction in complexity, participants may perceive the organisation differently and possibly make better decisions due to their improved understanding of the system. As a result of using business simulations, we are trying to get people to discover how complex systems work. At this level, the only alternative to simulation would be experimentation in real systems, which would be infeasible and less useful due to other barriers such as the complexity of dynamic systems, time-delays and imperfect feedback. However, the literature supports the argument that individuals make decisions based on their mental models and how they perceive the situation. If there are flaws, deficiencies or incorrect assumptions that make up these mental models then these mental models may in fact limit their ability to make good decisions. Sterman (2000) offers a broad definition of what mental models are; he claims that different theorists (Axelrod 1976; Cheng and Nisbett 1985; Doyle and Ford 1998; Gentner and Stevens 1983; Halford 1993; Johnson-Laird 1983; Schank and Abelson 1977; Vennix 1990) describe mental models as collections of routines or standard operating procedures, scripts for selecting possible actions, cognitive maps of a domain, typologies for categorising experience, logical structures for the interpretation of language, or attributions about individuals we encounter in everyday life.

If business simulations are in fact able to improve our understanding of the dynamics of complex systems, then the expected benefits to the organisation

include increased bu creased policy resistance, enhanced decision making capability, improved communication, increased tolerance for ambiguity, understanding of complex situations and less focus on local optima. However there is no single model that gives us a satisfactory measure in terms of the cognitive changes that individuals experience after having participated in business simulations. Mumford (1988) argues that, given the objective of formal management development as a process of enhanced learning, it is extraordinary that so little work has been done on the actual learning process itself.

The primary limitation of a business simulation is, that it is only a model that attempts to explain behaviour in the real world that is simplified to include only a few key variables and exclude a variety of others. Furthermore Goosen, Jensen and Wells (1999) argue that the simulation itself may not necessarily reflect mainstream thinking and that the simulation designers are able to employ personal bias in the selection and creation of algorithms.

1.3 The Research Problem and Purpose

The purpose of the research is to find out whether it may be possible that business simulations are able to transform existing mental models of individual participants from compartmentalised silo thinking models to broader holistic systems thinking. According to Sterman (2000, p. vii) “effective decision making and learning in a

world of growing dyna ome systems thinkers – to expand the boundaries of our mental models and develop tools to understand how the structure of complex systems creates their behaviour." In addition to determining whether participants experience a paradigm shift, various simulation tools will be tested to determine whether these simulation tools encourage systems thinking, regardless of the scope of the simulation or the industry for which they are being tested.

Figure 1-1: The Research Framework

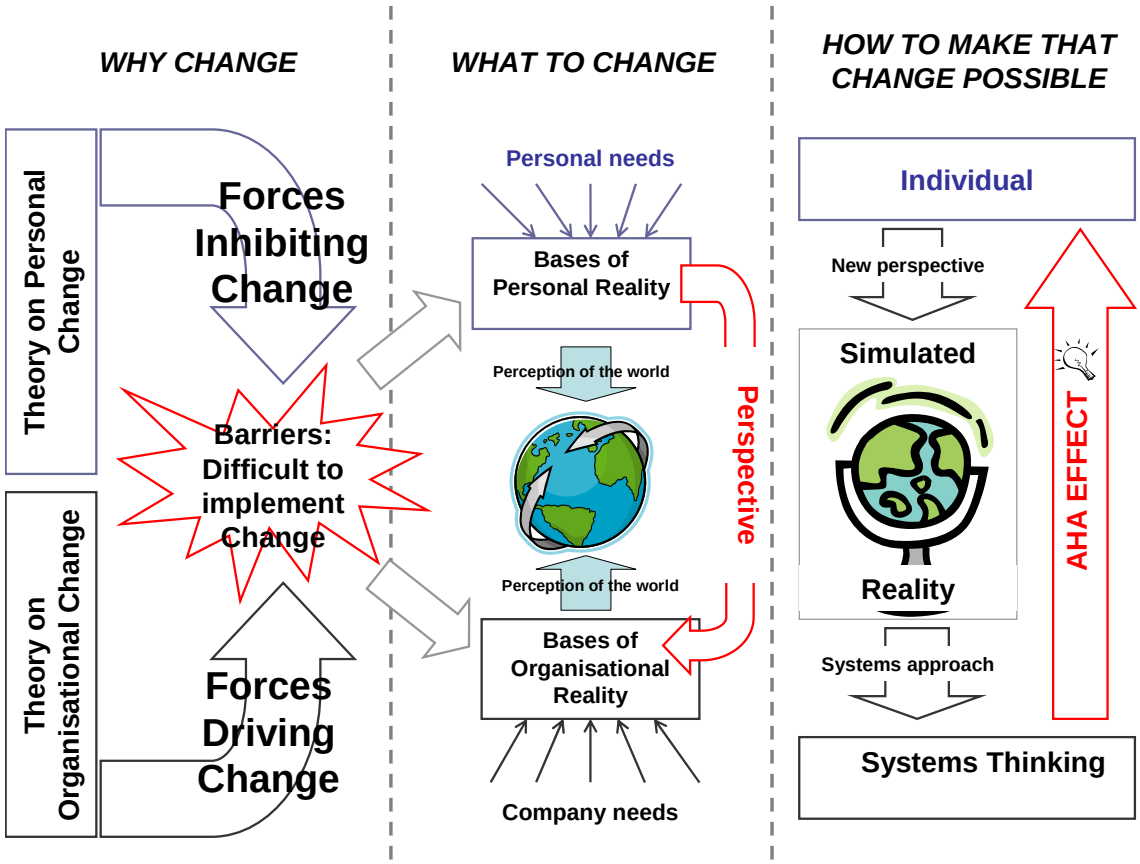


Figure 1-1 gives an overview and the objectives the research aims to achieve. The framework is divided into three parts that addresses some of the challenges that organisations face in rapidly changing environments and proposes solutions of how to deal with such challenges. The first part of the framework, labelled “why change,” deals with one of the fundamental problems that organisations experience in an environment that requires organisations to adapt quickly: what is the need for organisational change and what are the challenges that organisations need to deal with in having to deal with change? Section 2.2 “Forces For and Against Organisational Change” will address the drivers of change and explore some of the reasons for the existence of barriers that impede change in organisations. The second part of the framework is titled “what to change” and deals with perspective. Here the perspective of individuals working in organisations is compared to the vision of the organisation and what is necessary for the organisation to achieve its goals. This section attempts to identify differences in action strategies based on different points of view. Section 2.3 “Creating an Internal Market for Change” will clarify some of the perceived clashes in interest between individual motives and mental models, and the organisations needs and systems thinking. Lastly section 2.4 “Complex Systems and Business Simulation” will deal with the third part of the framework titled “how to make the change possible?” This section suggests that business simulation will allow individuals to view their organisations from a different perspective and as a result of seeing their organisations in a new light, the individuals, participating in the business simulation will experience an “aha-moment” as they begin to understand how the

interrelationships in to create value for the organisation and its stakeholders.

Individuals participating in a business simulation will have different degrees of understanding the system dynamics of the organisation they work in. Some participants may work in general management functions and for that reason may have a much broader understanding of the organisational system, while others may be functional managers with a narrower understanding of the organisational whole. It is however assumed that neither of the participants, be they general managers or functional managers, will fully understand the entire complexity of the organisations dynamics. Sterman (2000) argues that humans lack the cognitive capabilities to make reasonable inferences about the dynamics of the system even if they have perfect and complete knowledge of the system structure. Because we lack the capability of completely understanding organisational systems the simulation can be expected to broaden the views and challenge the mental models even of those participants that have a fairly broad understanding of the organisational system.

1.4 Scope of the Research

The research is of experimental nature. It aims to determine whether it may be possible that a shift in mental models takes place for individuals participating in

business simulations. ıtal models we are looking for should relate to systems thinking. The research does not attempt to quantify the extent to which a shift in mental models may occur, but the interest lies in the fact whether individuals that have participated in a business simulation program may have experienced a possible change in their thinking. Furthermore, it is not within the scope of the research to measure the financial benefits that simulations may have for organisations. Depending on the industry, the organisation and the simulation, the return on investment (ROI) may vary substantially. However, if the business simulations deliver the benefits of increased systems thinking, it may be possible to quantify the value of these benefits and calculate the ROI for different industries, organisations and simulations. However certain organisations may attribute different value to different benefits and therefore it is not possible to make generalised statements about the ROI. It may however make for interesting further research to find out what the average value for the identified benefits is for an organisation and to calculate an average ROI per participant for different simulations or different industries.

1.5 Conclusion

After participating in a business simulation program it is expected that participants will see their organisations from a different perspective. As stated above, it is believed that participants may experience a transformation in terms of their mental

models and may change to their organisation. If the simulation has allowed participants to engage in systems thinking then it is expected that their mental models will have changed as a result of understanding their role differently in context of the larger system of which they are part.

2 THEORY AND LITERATURE REVIEW

2.1 Introduction

The research intends to explore whether members of an organisation transform their mental models to a systems thinking approach by participating in business simulation programs. This chapter addresses the three questions introduced in figure 1-1: “why do organisations have to change?”, “what is it that organisations need to change?” and “how can organisations make that change possible?” Theory on organisational change and personal change will address the question why organisations and its people need to change. Flaws in perception and barriers to learning will be examined and contrasted against systemic thinking and shared vision to explain what organisations need to change to. Finally, the nature of complex systems will be explored and compared to simulated systems in an attempt to explain, how organisations can make the change possible.

2.2 Forces For and Against Organisational Change

The term “change” used in this paper refers to change within organisations and includes all change initiatives within the organisation regardless of whether it is

planned or unplanned, whether it is done on a large or small scale. All internal change that is necessary for the organisation to interact more effectively with the external environment is included in this definition of change. In order to address the challenges associated with bringing about change, we need to understand the forces that drive change and the forces that resist it.

Organisations need to be able to cope with continuous changes in the environment in order to remain competitive. Simply adapting to the changing environment is not sufficient for organisations to be able to compete successfully in the future. Rapid change requires organisations to be able to learn and change on a continuous basis. Senge (2006) maintains that organisations that discover how to tap people's commitment and capacity to learn at all levels in the organisation, will truly excel in future.

2.2.1 Organisational Change

The purpose of an organisation is to create value for all of its stakeholders. In order to do so, Goldratt (2004) argues, an organisation needs to make money, now as well as in the future. Only if an organisation is able to sustain sufficient inflow of capital is it able to satisfy the needs of all of its stakeholders. The stakeholders of an organisation are its shareholders, suppliers, employees, customers, government and society. All of these stakeholders expect the organisation to meet

their needs. If the ne :eholder groupings are not being met, the organisations survival is threatened. The requirement for shareholders is a return on their investment that at least exceeds the return they would be able to get when investing their money at the risk free rate. The customers require a product or service that adds value to their lives and is at least in some way superior to the product offerings of competitors. This means the organisation must create something economists refer to as consumer surplus. Copeland (1994) defines this consumer surplus as the present value of what customers would be willing to pay for the company's goods and services minus what the company receives in revenues. Suppliers, both of capital as well as suppliers of goods and services, require the organisation to meet its payment commitments within an agreed upon time frame. Employees require fair market based remuneration as well as appropriate job quality. Government requires the organisation to abide to regulatory requirements and to pay taxes. Furthermore the organisation needs to ensure that it creates value for society as a whole if it is going to be accepted as a part of that society.

If the organisation is not able to satisfy the needs of its stakeholders its existence is threatened. Equity holders are the last stakeholder whose interests are met by the organisation; they are the 'residual' claimants on a company's cash flows (Copeland, 1994). When an organisation generates revenues it uses this money to pay its suppliers, remunerate its employees, pay for financing activities and lastly to pay taxes. Only if money remains thereafter does the shareholder receive a

return on the investm ompany. If management of the organisation therefore focuses only on generating a sufficient return on investment for its shareholders, then management has already ensured that the basics needs of all other stakeholders have been met. Copeland (1994) maintains that empirical evidence indicates that increasing shareholder value does not conflict with the long term interests of other stakeholders. He claims that winning companies create greater value for all stakeholders – customers, labour, the government, and suppliers of capital. The benefit for the organisation to generate large returns for its shareholders ensures that the organisation will continue to maintain shareholder interest as a profitable investment vehicle. However, should the organisation no longer be able to generate sufficient return for its shareholders, management needs to identify the reasons for this problem and come up with solutions to address it. If the company's management is not able to do so, suppliers of capital will move their capital to other organisations in search for better returns (Copeland, 1994).

Once management has identified such a problem it needs to determine whether the strategy of producing and selling its product or service fits the external environment. If not, management needs to change the strategic direction of its product offering. It needs to identify a new strategy that will ensure that there will be sufficient demand for its products or services to make its business viable. Clarke (1994, p.28) suggests that "if one regards strategy as the matching of organisation resource to environmental opportunity, then it becomes clear that

every time there is an emphasis, then the different parts of the organisation will also need to change gear." As a result of rapid environmental change this means that, in order to ensure sustainable business success, organisations need to create a learning environment where sharing of intelligence, construction of meaning, and social propagation of ideas and skills is a norm (Wenzler and Chartier, 1999).

2.2.2 Personal Change

Change initiatives are implemented in order to ensure that an organisation continues to be able serve the interests of all its stakeholders. However, one stakeholder grouping may perceive this change as a threat to their interests. From the employee's perspective organisational change is quickly associated with the agony of transformation. Fear of the unknown, threat to status, threat to established skills, threat to self esteem, feeling vulnerable and exposed are just a few of the symptoms associated with organisational change. Clarke (1994) argues that change always raises anxiety levels and encourages avoidance behaviour, particularly when the new change runs against all the accumulation of prior learning based on prior success.

Accumulation of prior learning is part of an organisations history and forms part of the organisations culture. Schein (1984, p. 3) defines organisational culture as "the

pattern of basic ass s invented, discovered or developed in learning to cope with its problems of external adaptation and internal integration, and that have worked well enough to be considered valid, and, therefore, to be taught to new members as the correct way to perceive, think, and feel in relation to those problems." If changes in the environment, such as technological change for example, render these basic assumptions obsolete, individuals need to unlearn old habits and change their existing paradigms. Changing existing paradigms poses a significant challenge however. Senge (2006, p.8) maintains that "many insights into new markets or outmoded organisational practices fail to get put into practice because they conflict with powerful, tacit mental models." Larson, Mc Inerney, Nyquist, Santos and Silsbee (1996) define these mental models as one's way of looking at the world. They call it the framework for the cognitive processes in our mind that determines how we think and act.

Argyris (2002a) argues that most of our mental models are flawed. He argues that few people are aware that the mental models they use to take action are not the theories they explicitly espouse. He differentiates between peoples 'espoused theories', which is the world view that people believe their behaviour is based on and their 'theories-in-use', which is the world view and values implied by their behaviour, or the mental models they use to take action. Furthermore most people are unaware of these theories-in-use or mental models they use to take action and therefore change is not easily implemented on a personal level.

On a personal level our ability to change rapidly, depends on our ability to "expand the boundaries of our mental models so that we become aware of and understand the implications of the feedbacks created by the decisions we make" (Sterman, 2000, p. 11). In other words, we must understand the structure and dynamics of the systems of which we are part. If we can begin to expand our understanding of the structure and dynamics of these systems we can perceive change from a more widespread perspective rather than seeing it from a narrow, personal point of view. We therefore need a change in perspective if we are going to appreciate and understand the benefits of change. If we get to understand our world differently as a result of a change in perspective then we may alter the way that we react to the threat of change. The question is whether we are effective in changing the perspective of individuals using business simulations and whether people change the way they relate to the world as a result of that change in perspective.

2.3 Creating an Internal Market for Change

In order to create an internal market for change, we need to understand what drives people's actions and how these actions impact the organisation. In order to do this we need to examine the system from two different perspectives. Firstly we need to try and understand the personal perspective and what factors cause barriers to change. Secondly, we need to determine whether people can overcome

these barriers and are om a systems perspective. We need to determine whether a change in perspective can alter the way people see and relate to the world.

2.3.1 Personal Perspective

The perspective from which individuals perceive the organisation forms the basis from which they determine and evaluate their actions. However, this perspective may hinder individuals to see their contribution to the organisation as a whole. As a result their actions may be inconsistent with their beliefs.

2.3.1.1 Flaws in Perception

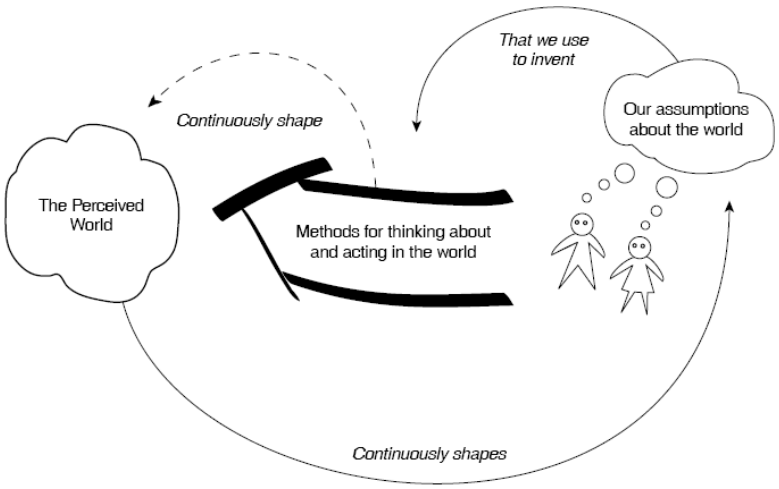
Scientific knowledge has taught us to adopt an analytical method for solving problems which involves breaking problems into components and studying each part in isolation. According to Argyris (2002b), Cilliers (1998), Larson *et al.* (1996) and Senge (2006), fragmenting the world in order to make complex tasks and subjects more manageable is becoming increasingly ineffective in addressing modern-day problems. They argue that the most important issues that we encounter in organisations today are interrelated in ways that defy linear causation. This means that by breaking problems apart we are no longer able to see the

consequences of our [illegible]e of connection to a larger whole (Senge, 2006).

It is typical that work is divided among individuals in organisations, clustered into functions and the organisations resources are then allocated to different functional departments. As a result, each department works towards their specific targets, unaware how their contribution impacts the organisation as a whole. As each of these departments begins competing for the company's scarce resources we get what is called the silo effect. When this occurs, it is often a case of every employee for himself, and no one rowing together for the common goals of the company (Côté, 2002). The symptoms of the silo effect are lack of cooperation, internal competition and breakdown in communication. Côté (2002) maintains that when the silo effect occurs, "lieutenants concentrate on their personal objectives and disregard those of the whole."

In turn the silo's we work in create our mental models, and the assumptions we make about the world around us become our reality. Figure 2-1 shows how our assumptions about the world influence our actions, which in turn shape our perceived world, which reinforces our assumptions.

Figure 2-1: How our ideas are shaped by perception



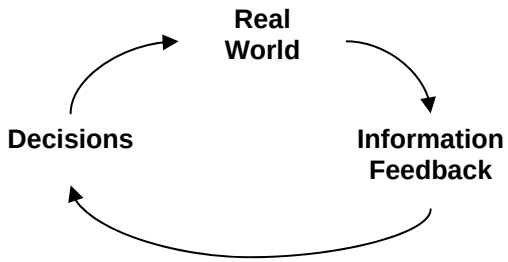
Source: Dooley (1999, p. 5)

The feedback we receive through this cycle consistently shapes and reinforces our mental models. As long as our mental models remain unchanged this cycle is a process whereby we learn to reach our goals in the context of our existing mental models. Argyris (2002b) calls this process single-loop learning.

2.3.1.2 Adaptive versus Generative Learning

"Single loop learning occurs when errors are corrected without altering the underlying governing values." (Argyris 2002a, p. 206) The single feedback loop shown in figure 2-2 describes the most basic type of learning.

Figure 2-2: Single-loop learning



Source: Sterman (2000, p.15)

This is an example of a classical feedback loop. According to Sterman (2000), decision makers compare information about the state of the real world to their goals and where they perceive discrepancies between desired and actual states they institute actions that they believe will cause the real world to move towards the desired state. This means that we make decisions that alter the real world and gather information from the real world that in turn influences our understanding of the world. As we bring our perception of the state of the system closer to our goals, our perceptions of the world are reinforced by the assumptions we made about the world in the first place. As a result, single-loop learning does not result in deep change to our mental models. Senge (2006) calls this form of learning adaptive learning which leads to interventions that focus on obvious symptoms and not underlying causes. As a result one may produce a short-term benefit for the organisation but may actually cause more harm than good over the long-term. The reason is that without a clear understanding of the bigger picture, decision makers

tend to focus only on ns in the workplace, rather than on the systems that caused the problems to occur (McNamara, 1999).

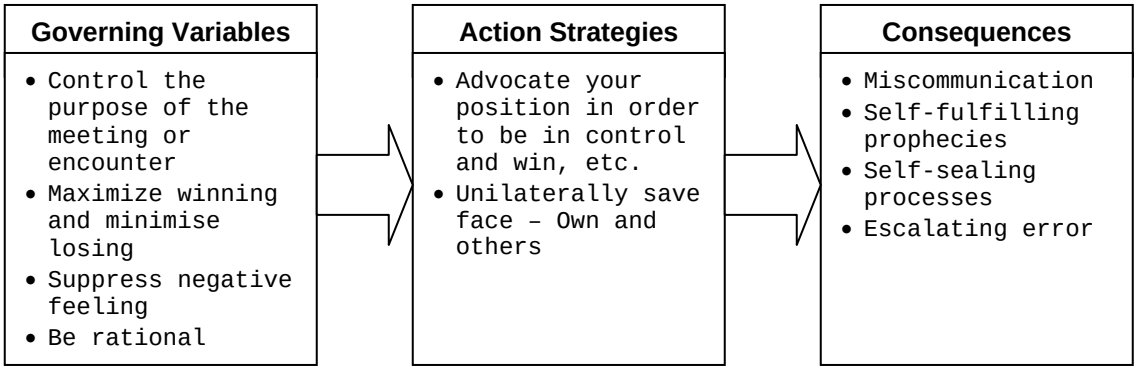
2.3.1.3 Theories-in-Use

The flaws in our perception are a result of the assumptions we make about the real world. According to Argyris and Schön (1978) people operate according to two different theories. They have a theory consistent with what they say and a theory that is consistent with what they do. Argyris and Schön (1978) differentiate between people's espoused theories and their theories-in-use. Espoused theories are those behaviours which they say they live up to, the world view and values that people believe their behaviour is based on. Theories-in-use on the other hand govern our everyday actions. They are the world views and values implied by people's behaviour. They are the subconscious mental models that people use to take action.

Argyris (2002a) calls the theory-in-use that governs people's behaviour, "Model 1" theory-in-use. Model 1 theory-in-use is most prevalent in our social systems, which is consistent among all people regardless of gender, race, culture, education, wealth and type of organisation. Underlying Model 1 theories-in-use are four governing variables. These are: (a) be in unilateral control; (b) strive to win and not lose; (c) suppress negative feelings; and (d) act rationally (see figure 2-3). According to Argyris (2002a) these governing variables are values that a person

will try to keep within goals a person will seek to satisfy and beliefs he/she seeks to defend (Anderson, 1997). As a result of defending these governing variables people will follow action strategies that require the least amount of trade-off in terms of these variables.

Figure 2-3: Model 1 - Theory-in-Use



Source: Argyris (2002a, p.213)

Argyris (2002b) maintains that the purpose of people defending these variables is that people seek to avoid feeling vulnerable or incompetent. In order to keep these governing variables within an acceptable range, people engage with others in such a way that they attempt to control the purpose of the encounter. People do this subconsciously and engage in actions that advocate their views, making evaluations and attributions in ways that ensure their control. Furthermore people will design action strategies that advocate their position in order to be in a position to win. They seek to maximize their opportunities of winning and not loosing, meaning that they act in order to derive a maximum benefit for themselves out of the encounter. In order to suppress negative feelings and ensure that they are

being rational, their a lly save face, not only for themselves but also for others. Their actions avoid bringing about any feelings of vulnerability or incompetence and a common reaction to a potentially embarrassing situation is avoided through reactions such as: “I could not tell him the truth, it would hurt him too much”. Argyris (2002a) calls these actions defensive routines and argues that “organisational defensive routines are any action, policy, or practice that prevents organisational participants from experiencing embarrassment or threat and, at the same time, prevents them from discovering the causes of the embarrassment or threat.” (Argyris 2002a, p. 213)

The consequences of these actions are miscommunication, self-fulfilling prophecies, self-sealing processes and escalating error (see figure 2-3). These processes are self-fuelling because the use of defensive reasoning prohibits the questioning of defensive reasoning. The deception is therefore reinforced and general learning is inhibited (Argyris, 2002a).

Dick and Dalmau (2003) summarise the relationship between espoused theory and theory-in-use as follows:

- There is a gap between what we think we believe, and the value implied by our behaviour;
- We are blind to this gap;
- Though others may perceive it, they are reluctant to admit that they have, let alone bring it to our attention;
- If they do, we are most likely to react defensively

2.3.1.4 Bounded Rationality

Critical to becoming a more effective organisation is the ability of managers to make improved decisions. If employees have a better understanding of how their actions impact the results of the organisation as a whole, then a critical benefit to organisations is the ability of individuals to make improved business decisions as a result of improved understanding of business dynamics. George and Jones (2003) argue that good decisions result in a course of action that help an individual, group or organisation to be effective, while bad decisions hinder effectiveness and may lead to actions that result in poor performance and negative attitudes at all organisational levels.

However it is often not possible for individuals to weigh up all the benefits and drawbacks of their decisions and the quality of their decision making is therefore not necessarily optimal. Often people are not able to observe the consequences of their action because the consequences of their actions lie in the distant future or in a distant part of the larger system. March and Simon (1993) stress that due to incomplete information, psychological and sociological processes, decision makers often choose satisfactory and not optimal solutions. This means that they make simplified decisions based on an approximate account of the situation. Simon (1997a) refers to this type of decision making as satisficing – that is, people search for and choose acceptable responses to problems and opportunities and not necessarily the best possible responses.

Furthermore, March and Simon (1997a) acknowledge that decision makers are constrained by bounded rationality: “an ability to reason that is limited by the limitations of the human mind itself.” In other words, people’s ability to make good decisions is limited by their own cognitive abilities and their ability to understand the world around them. Sterman (2000) claims that humans are faced with an overwhelming amount of complexity in the real world and because of their limited cognitive abilities people are forced to fall back on rote procedures, habits, rules of thumb and simple mental models to make decisions.

2.3.2 Systems Perspective

Because our vision is constrained when we view the organisation from a personal perspective, we need to widen our perspective to be able to gain a better understanding of the whole.

2.3.2.1 Systems Thinking

In order to overcome barriers to learning we need to become systems thinkers. Instead of focussing our attention on decisions that are aimed to solve problems we need to think about our decisions in ways that ensure they create a desired

future for our organis)4) focussing on creating a desired future turns out to be far more beneficial than simply solving problems, because it actually tends to get the organisation somewhere it wants to be.

2.3.2.2 Shared Vision

Senge (2006) maintains that the leader's role in a learning organisation is that of a designer, teacher, and steward who can build shared vision and challenge prevailing mental models. It is the responsibility of leadership to map out the company's strategic direction. Leaders need to create a shared vision for the organisation that clearly outlines the direction that the organisation intends to follow. According to Senge (2006, p. 9) "a shared vision involves the skills of unearthing shared 'pictures of the future' that foster genuine commitment and enrolment rather than compliance." This vision must not only be articulated by management, but management is also responsible for ensuring that the vision is understood by all. As a result of appropriately communicating this vision to the members of the organisation the organisations' leadership can bring about alignment among different parts of the organisation and can create an internal market for change. Kotter (1990) argues that alignment is more of a communications challenge than a design challenge. The challenge is that visions are not necessarily accepted just because they are understood. Therefore it is important for the leader to get people to believe in the message. Only if there is

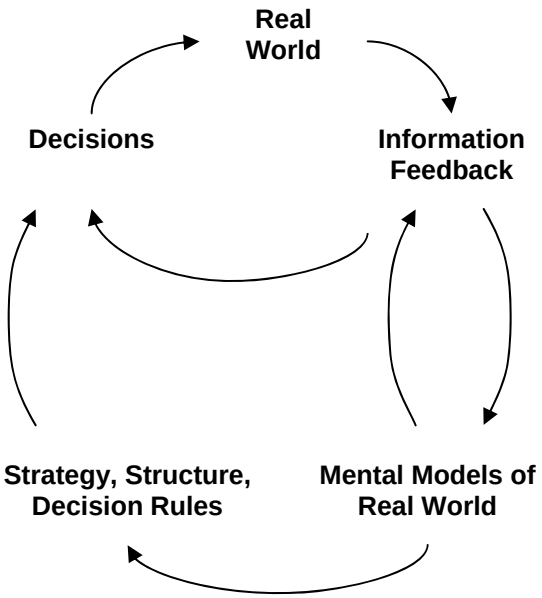
sufficient credible con e to capture the hearts and minds of the organisations employees (Kotter, 1995). To become a learning organisation able to cope with continuous change, creating a shared vision is crucial. Larson *et al* (1996) maintain that organisational learning is possible when groups of individuals who share a system also share a vision about how the components of that system interact.

2.3.2.3 Generative Learning (Double-Loop)

If an organisation is not able to learn continuously, then the view of the organisation is based on adaptive learning, which is about coping (Malhotra, 1996). Coping means dealing with current problems without questioning the underlying fundamentals that give rise to these problems. As stated by Senge (2006) increasing adaptiveness is only the first stage; companies need to focus on generative learning or “double-loop learning” (Argyris, 1977). Senge (2006) says that generative learning is about creating – it requires systemic thinking, shared vision, team learning and creative tension. In order to foster this creative tension we need to see our organisation in a different light. Unlike adaptive learning, generative learning then requires us to look at our organisations from a different perspective. We need to question the underlying assumptions of the existing way of doing work, instead of merely adapting to change and implementing incremental improvement simply to be able to keep up with change. According to Mintzberg (1987) the key is not getting the right strategy but fostering strategic thinking.

According to Argyris, (2002a, p. 206) “double-loop learning occurs when errors are corrected by changing the governing values and then the actions.” Figure 2-4 shows the information feedback as it occurs in double loop learning.

Figure 2-4: Double-loop learning



Source: Sterman (2000, p. 19)

According to Sterman (2000, p. 18) “feedback about the real world not only alters our decisions within the context of existing frames and decision rules but also feeds back to alter our mental models.” This means that as mental models change, so do people. A change in the structure of the system alters the patterns of behaviour of the people within the system. As people engage in this double-loop learning process they replace their narrow view of the world, their “silos”, with a

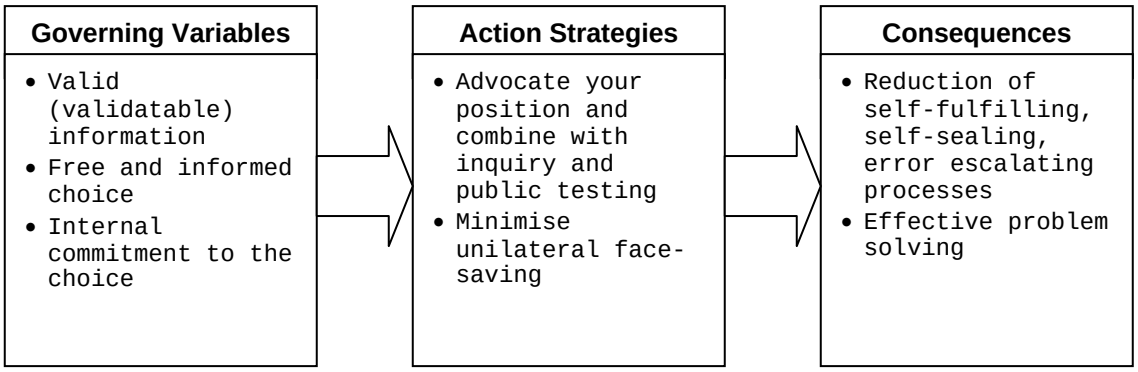
broad, holistic, long-t ble to make decisions and design policies that address long-term system health, rather than searching for quick-fix solutions to obvious symptoms. Argyris says that (2002b, p. 4) “double-loop learning is not simply a function of how people feel. It is a reflection of how they think - that is, the cognitive rules or reasoning they use to design and implement their actions.”

To be able to deal with the fast paced change that we experience in the environment today, this then means that in order to learn effectively in organisations we must be able to cycle around these loops quickly in order to ensure that knew knowledge is generated as soon as existing knowledge about the system and the environment becomes obsolete. Sterman (2000) maintains that delays in learning for many pressing problems in our society remain woefully long and that the rate at which people adopt change remains slow and inadequate.

2.3.2.4 Model 2

For effective learning to occur in organisations, people need to move away from their model 1 theories-in-use (described in section 2.3.1.3) to a different model; a model which Argyris (2002a) refers to as “Model 2” (see figure 2-5).

Figure 2-5: Model 2



Source: Argyris (2002a, p. 214).

In Model 2, the governing values change from a predominantly egocentric view of the world to a more integrative view, and consequently people's action strategies are designed to create value for the whole, rather than just for the individual. The consequences of these actions are important for organisational change as they result in effective problem solving. This view is supported by Basseches (1984. p. 29) who claims that "to think dialectically[1] is, in a certain sense, to trade off a degree of intellectual security for a freedom from intellectually imposing limitations on oneself or other people". As individuals begin to understand the system of which they are part and begin to understand their role within that system, they will engage in action strategies that are more closely aligned to their espoused values. The behaviour associated with Model 1 can be best described as competitive and defensive, while Model 2 can be seen as more collaborative and less defensive. As we become more collaborative and less defensive we can begin to engage in true

[1] Dialectical thinking is closely allied to systems thinking, but has an much longer philosophical heritage (Atkins and Johnston, 2005)

learning. What this sh is is best described by the following quote from Senge:

> At the heart of the learning organisation is a shift in mind – from seeing ourselves as separate from the world to connected to the world, from seeing problems as caused by someone or something 'out there' to seeing how our own actions create the problems we experience. A learning organisation is a place where people are continually discovering how they create their reality. And how they can change it. (Senge, 2006, p. 12)

Our inability to change and learn in organisations is a result of imperfect information about the state of the real world, poor scientific reasoning skills, bounded rationality and defensive routines. All of these learning disabilities are related to our inability to understand the system of which we are part and our inability to come to terms with how our decisions impact that system.

In the following section the nature of complex systems will be explored further to determine why it is so difficult to understand complex systems and what some of the techniques are that can help us to understand the implications of our decisions in an immensely complex world.

2.4 Complex Systems and Business Simulation

To become systems thinkers we need to be able to understand the impacts that our decisions have on the organisation as a whole and we need to find ways in

which we can learn f g of the nature of complex systems and what governs their behaviour is crucial for understanding our roles within that system.

2.4.1 The Nature of Complex Systems

We as humans have learnt to use analytical methods as scientific tools to make sense of the world. However, as has been argued in section 2.3.1, a complex system is not constituted merely by the sum of its components, but also by the intricate relationships between those components (Cilliers, 1998). As such it is not possible for us to break up complex systems into manageable units that can be analysed separately if we want to gain a better understanding of these systems. As put by McNamara (2000), “if you break up an elephant, you don’t have a bunch of little elephants.” However, Sterman (2000) argues that humans do not have the cognitive ability to understand complex systems. This leaves us with the fundamental question of: how can we understand complex systems without breaking them up into their individual components?

Before we can answer that question we need to understand what complex systems are and what governs their behaviour. To do this we need to define complexity. However, according to Cilliers (1998), complexity cannot be given a simple definition. There are a number of characteristics that are necessary in a complex

system that differentiable system or a system that is merely complicated, but not complex. Sterman (2000, p. 22) offers a good description of characteristics that are necessary for a complex system to be complex. Each of these characteristics is a necessary feature as shown in table 2-1, Dynamic Complexity.

Table 2-1: Dynamic Complexity

- **Dynamic:** Heraclitus said, "All is change." What appears to be unchanging is, over a longer time horizon, seen to vary. Change in systems occurs at many time scales, and these different scales sometimes interact. A star evolves over billions of years as it burns its hydrogen fuel, then can explode in a supernova in seconds. Bull markets can go on for years, then crash in a matter of hours.
- **Tightly coupled:** The actors within a system interact strongly with one another and with the natural world. Everything is connected to everything else. As a famous bumper sticker from the 1960s proclaimed, "You can't do just one thing."
- **Governed by feedback:** Because of the tight couplings among actors, our actions feed back on themselves. Our decisions alter the state of the world, causing changes in nature and triggering others to act, thus giving rise to a new situation which then influences our next decision.
- **Nonlinear:** Effect is rarely proportional to cause, and what happens locally in a system (near the operating point) often does not apply in distant regions (other states of the system). Nonlinearity often arises from the basic physics of the system: Insufficient inventory may cause you to boost production, but production can never fall below zero no matter how much excess inventory you have. Nonlinearity also arises as multiple factors interact in decision making: Pressure from the boss for greater achievement increases your motivation and effort – up to the point where you perceive the goal to be impossible. Frustration then dominates motivation and you give up or get a new boss.
- **History-dependent:** Taking one road often precludes taking others and determines where you end up (path dependence). Many actions are irreversible: You can't unscramble an egg (the second law of thermodynamics). Stocks and flows (accumulations) and long time delays often mean doing and undoing have fundamentally different time constraints: During the 50 years of the Cold War arms race the nuclear nations generated more than 250 tons of weapons-grade plutonium (^{239}Pu). The half life of ^{239}Pu is about 24,000 years.

- **Self-organising:** ntaneously from their internal structure. Often, small, random perturbations are amplified and moulded by the feedback structure, generating patterns in space and time and creating path dependence. The pattern of stripes on a zebra, the rhythmic contraction of your heart, the persistent cycles of the real estate market, and structures such as sea shells and markets all emerge spontaneously from the feedbacks among the agents and element of the system.
- **Adaptive:** The capabilities and decision rules of the agents in complex systems change over time. Evolution leads to selection and proliferation of some agents while others become extinct. Adaptation also occurs as people learn from experience, especially as they learn new ways to achieve their goals in the face of obstacles. Learning is not always beneficial, however.
- **Counterintuitive:** In complex systems cause and effect are distant in time and space while we tend to look for causes near the events we seek to explain. Our attention is drawn to the symptoms of difficulty rather than the underlying causes. High leverage policies are often not obvious.
- **Policy resistant:** The complexity of systems in which we are embedded overwhelms our ability to understand them. The result: Many seemingly obvious solutions to problems fail or actually worsen the situation.
- **Characterised by tradeoffs**: Time delays in feedback channels mean the long-run response of a system to an intervention is often different from its short-run response. High leverage policies often cause worse-before-better behaviour, while low leverage policies often generate transitory improvement before the problem grows worse.

Source: Sterman (2000, p. 22)

These ten characteristics of complex systems will manifest themselves in different ways, depending on how we frame the system. In other words when we try to understand a system we need to decide what our distance from that system will be and what level of detail we are going to consider (e.g. we limit our perspective by drawing an imaginary frame around the organisation, although the organisation is of course part of a larger system; i.e. a community, a province, a country, a continent *etc*.). Framing is important if we want to deal with complexity in a more quantitative way, which may help us gain more insight into behaviours in complex

systems. We want to understand the behaviour of the system. Bellinger (2004) defines a model as “a simplification of reality intended to promote understanding.” Cilliers (1998) argues that modelling techniques on powerful computers allow us to simulate the behaviour of complex systems without having to understand them.

2.4.2 Modelling Complexity

In order to be able to improve our understanding of complex systems we need to create virtual worlds that will allow us to experiment and draw conclusions from the feedback we receive. Virtual worlds, according to Sterman (2000) are formal models, simulations, or ‘microworlds’, in which decision makers can refresh decision making skills, conduct experiments and play. They allow us to make decisions where experimentation in the real world would be infeasible or impossible. Some of the virtues of virtual worlds as identified by Sterman (2000), Cilliers (1998) and Senge (2006) include:

- low cost laboratories for learning
- allows time and space to be compressed
- one can stop the action to reflect
- high risk decisions can be taken without having to face consequence
- actions are reversible
- provide high quality feedback
- assumptions are fully known and can be modified

Experimentation in the real world is often not possible because there are high stakes associated with making poor decisions and the impact of decisions can not be seen due to significant time delays. Simulation therefore becomes the only possible alternative to test conceptual models.

In order to design simulations that allow us to make inferences about the real world and that result in feedback from which learning is to occur, we need to have an exceptionally good understanding of the dynamics operating in the system. According to Thatchenkery, Behara and Kenney (1999, p. 144) “a simulation designer must be a careful observer with a highly developed skill for prediction by transforming the simulation into a microcosm of the real world.” According to Simon (1997b) the accuracy of model forecasts is limited mainly by the accuracy of the equations describing economic mechanisms that go into the models. However, Simon (1997b) goes on to say that the questions we want to answer about a system do not always require prediction in detail. We need to find out what is necessary to include in the design of the simulation and leave out the rest. With other words, we must separate what is essential from what is dispensable in order to capture a simplified picture of reality which will allow us to make inferences that are important to our goals (Simon, 1997b). As a result the complexity of our models can be reduced greatly if we are willing to limit the frequency range of the dynamics that interest us. Simon (1997b) maintains that our concern is not to forecast the future but,

(a) to understand the consequences of alternative possible futures, and

(b) to understand which assumptions associated with particular strategies or policy measures.

2.4.3 Experiential Learning

In order to determine whether in fact there is some sort of transformation in the perception of participants in relation to their organisations, it is critical to understand how we engage in the learning process and how feedback impacts how we learn and think. The research is built on the premise that participants will change their perceptions though a process of experience-based learning, rather than by learning as a result of transmission of content using lecture-type teaching methods. Knowles, Holton and Swanson (2005) argue that many of the great teachers of ancient times, such as Confucius, Aristotle, Socrates, Cicero, Evelid and Quintillian perceived learning to be a process of mental inquiry, not passive reception of transmitted content. Knowles (1996) states that adults learn best by active (as opposed to passive) experiences. Working to solve problems facilitates their learning (Anderson and Lawton, 2005). Research done by Lewin and Piaget (Vincent and Shepherd, 1998) found that effective learning occurred in two circumstances: when there was sustained interaction between the learner and the environment, and when there was opportunity to reflect on the experiences in the environment through social interaction. These definitions of learning are very different to the lecture based teaching method to which we are accustomed in a

western society and t ecture-type transmission of content does not feature in any of these definitions of learning. This view of learning is supported by Senge (2006), who argues that taking in information is only distantly related to real learning. According to him, learning involves us to re-perceive the world and our relationship to it, extend our capacity to create and become part of a generative process of life.

2.4.4 An Aha-Moment

It has been argued that it requires a shift in mind for people to become systems thinkers. The question that remains unanswered in the literature is: How do we know when people experience a change in mental models? As per the definition in chapter 2.2.2 mental models are one's way of looking at the world. A shift in mind therefore means that people's cognitive maps or attributions no longer hold true and have been replaced by new mental models.

Experiencing a transformation of mental models should be a significant moment for any person, as it involves replacing a previously held assumption with newly gained insight. A so-called "aha-moment" is the word that best describes the sensation that comes as a result of suddenly understanding the world by looking at it from a different perspective, with a new mental model. Boeree (1998) defines the aha-moment as an epiphanial moment of understanding; seeing something in a

new or different way, re there were none before. In the context of learning about complex systems through business simulation, this is precisely the kind of experience we would expect participants to have when they begin to see their organisation from a more holistic perspective. We therefore want to know whether participants experience such an aha-moment during the simulation and, if an aha-moment occurs, whether it relates to a broader understanding in systems thinking.

2.5 Conclusion

In order to ensure that the organisations in which we work are able to survive over the long-term, we need to ensure that they are able to meet the needs of all of their stakeholders. Organisations need to ensure that they are able to align their resources to take advantage of environmental opportunities. Promoting a culture of change will allow organisations to capture the benefits of change.

In order to take advantage of new opportunities it is critical that all members of an organisation strive towards a shared vision for that organisation. However, organisations face an immense amount of challenges that hinder them from achieving this shared vision. These barriers occur mainly because individuals see the organisation from a personal perspective. Although individuals may make decisions in an attempt to improve the system in which they work, it is possible that

they unknowingly cau eir limited understanding of the system. Due to flaws in perception, single-loop learning, defensive reasoning and bounded rationality most individuals are not able to make informed decisions that will benefit the system as a whole. In order to create awareness of and understand these learning dilemmas, individuals need to view the organisation from a different perspective and ensure they adopt a systems thinking approach. As individuals begin to see themselves as a part of a larger whole, they strive towards a shared vision for the organisation, engage in double-loop learning, reject defensive reasoning and are able to use new mental models to make decisions based on free and informed choice.

To be able to shift our perspective from a narrow personal point of view to a wide holistic perspective we need to model the complex systems of which we are part. Through modelling we are able to take out a lot of the complexity in the system and are able to focus on only a few of the critical elements. This allows us to perceive the impact of our decisions on the system as a whole, without having to deal with the distorting variables that exist in the real world. Simulation allows us to step outside of the boundaries of our world and view ourselves as part of a system.

3 RESEARCH PROPOSITIONS

3.1 Introduction

Business simulations will on the one hand have specific learning objectives such as improving business acumen, improving understanding of financial relationships, improving understanding of the organisations supply chain *etc*. However a part of the learning experience which is generic to all simulations in this research project is the experience of managing an entire system. The research aims to explain possible transformations in terms of the mental models for individuals that participate in the simulation. The simulation is a simplified model of the real world in which the participants are able to make decisions for multiple periods of play and are able to see the impact of their decisions in the simulated environment. Although the simulation is only a simplified version of the real world in which they are required to make business decisions, the simplified model allows participants to get a high level overview of how the system interacts.

3.2 Research Propositions

Three questions aimed to determine whether elements of systems thinking became evident to participants as they engaged with the simulation (see research

questionnaire – Appe ıree quantitative questions was to determine whether the virtual world in which participants made decisions allowed them to interact with the system in ways that encouraged systems thinking. The questions stemmed from the following propositions:

Proposition 1: In order to become systems thinkers, participants need to step outside of their everyday way of seeing the system of which they are part and see the entire system from a holistic perspective.

The first question asked was: “As a result of the simulation, did you get to view your organisation from a perspective from which you had never viewed your organisation before?”

Proposition 2: Secondly, participants need to be able to understand the overarching needs of the organisation separate from their individual goals / targets / needs.

To determine whether participants experienced change in terms of the organisational needs they were asked the following question: “Do you have a better understanding of the things that are important for the entire organisation to survive and grow?”

Proposition 3: Following the simulation the participants need to be able to understand how the individual parts of a system work together to create value for that system.

T ıe three questions: “Do you have a better understanding of how the different functions in the organisation work together and create value for the organisation as a whole?”

One qualitative question aimed to determine whether there was a possibility that participants experienced a change in mental models. It aimed to determine the validity of the following proposition:

Proposition 4: As a result of participating in a business simulation program, participants change the way they think about or relate to their organisation from silo thinking to a systems thinking approach.

To determine whether this shift in mental models occurred, participants where asked the following questions: “Did you at any point during the program experience an aha-effect?” and “If yes, can you briefly explain what this aha-moment was?” An explanation as to what an aha-effect is, was given in the footnote of the questionnaire: “The aha-effect refers to a point in time during the program were you suddenly grasped a particular concept and things that were unclear before started to make sense to you.”

3.3 Conclusion

As discussed in section 1.3, the purpose of the research is to find out whether it may be possible that simulations are able to transform existing mental models of individual participants from compartmentalised silo thinking to broader holistic systems thinking. We attempt to test this proposition (proposition 4) by asking participants to share the experience that was most significant to them in terms of the simulation program. Propositions 1-3 aim to determine whether the business simulation tools used, encouraged individuals to engage in systems thinking.

4 RESEARCH METHODOLOGY

4.1 Introduction

This chapter outlines the research methods used (including advantages and disadvantages) to determine whether the research propositions discussed in chapter 3 hold true. Furthermore, this chapter gives a brief description of the simulation tools used for the research and outlines how the collected data was analysed to derive the results shown in chapter 5.

4.2 Research Methodology

According to Anderson and Lawton (2004), simulation scope constitutes the breadth of the domain the simulation is designed to cover. They differentiate between (a) a specific concept or discipline and (b) an integrated set of discipline. In order to ensure repeatability, the simulations to be used for the purposes of this research vary their in scope. The simulations used for this study included two business acumen simulation, a financial modelling simulation and a process flow simulation. Regardless of the scope of the simulation, the simulations were

designed to simulate ermine whether individuals experienced a change in thinking.

After the participants had completed a one to three day simulation seminar, they were asked to complete a questionnaire in which they were required to answer three questions related to systems thinking that were measured using attitude scales and one open-ended question that required participants to formulate their own response.

The data collected included both quantitative as well as qualitative data. The quantitative data was derived from attitude scales using a method that Welman and Kruger (2001) refer to as the summated or Likert scale. The questionnaire used is attached in appendix A. An open-ended question at the end of the questionnaire provided the qualitative data.

The advantage of using a 5-point Likert scale to measure the validity of the first three propositions was that it was easy for participants to answer and the results could be compared to the program learning points that were measured using the same type of scale. Disadvantages of using this method are that it is possible that participants interpreted the wording of each of the questions differently. For example, the first question asked was: “As a result of the simulation, did you get to view your organisation from a perspective from which you had never viewed your organisation before?” The disadvantage of such a question is that it is possible that

individuals interpret differently. Furthermore participants are limited in terms of their answers and are able to give only a predefined score between 1 and 5. It does however not necessarily mean that one participant's "5" carries the same qualitative value as another participant's "5". Another disadvantage is that a few "strongly disagree" answers are able to draw down the average rating for a question substantially, even if the percentage of participants that "strongly disagreed" was relatively low. Welman and Kruger (2001) refer to this type of inconsistency as the contrast error.

To measure the fourth proposition, participants were asked whether or not they experienced an aha-moment during the business simulation seminar. In order to determine whether this aha-moment was related to the expected shift in mental models participants were asked to qualify their response. The advantage of using an open-ended question was that participants were not led into responding in a certain way. The disadvantage was that participants gave fairly short answers even though they may have been able to share significantly more information with respect to the insights gained. It is possible that their answers were kept brief and were answered hastily due to the fact that the questionnaire was handed to them at the end of the workshop and participants were eager to see the final results concerning the competitive element of the program. Simulations were competitive in that they were designed in such a way that teams competed against each other for market share, improved financial performance *etc.*

4.3 The Simula

The research was conducted using four different business simulation models that required participants to make approximately 40 decisions for each period of play. Examples of the decisions to be made during the simulation included marketing, operations and finance decisions (e.g. pricing, forecasting, promotion, distribution, hiring and firing, borrowing long-term funds *etc*.). Depending on the simulation design, a decision period either represented one year, or three months (one quarter). Participants made decisions over three to four periods. All simulations were custom designed to the applicable business. In terms of the simulation tools used we can differentiate between three different types. Bolt (2005) defines these types as follows:

- **Process flow simulations:** Allow executives to understand a specific business process such as the rate of throughput on a manufacturing line.
- **Financial modelling simulations:** Allow the executive to "what-if" the impact of an interest rate change on a discounted cash flow analysis or other type of financial equation.
- **Business acumen simulations:** Allow the executive to formulate strategy, allocate scarce resources, develop products and services, attempt to meet customer requirements, manage financial metrics, contend with exogenous disruptions, and compete against other managers in a shifting competitive landscape.

The simulation tools used were a retail operations simulation, a banking simulation, a telecommunications simulation and a retail buyer/planner simulation. The retail operations simulation was a process flow simulation that was run over a three day seminar. Both the banking and the telecommunications simulations were business acumen simulations and the seminars were held over one and two days respectively. The retail buyer/planner simulation was a financial modelling simulation run over a three day period.

4.4 Population

The population of relevance is managers working in South African businesses. The units of analysis are individuals in senior and middle management positions working in various industries in South Africa, including the retail, telecommunications and financial services industries. The subjects of the study came from a variety of business disciplines. Different businesses across industry sectors have been selected in order to measure the impact of business simulation on systems thinking for all South African businesses.

4.5 Sampling

Non-probability sampling was used as the sampling method. Although random sampling would have been a preferred method, random sampling was not an

option in this case be(rganisations that made use of business simulations had a chance of being selected. According to Welman and Kruger (2001) the sampling method used is called the accidental sampling (incidental sampling) method where the units of analysis are made up of individuals that participate in selected business simulation programs.

The advantages of using the incidental sampling method are that the simulation programs were already pre-arranged and no additional cost had to be incurred to collect the data. The disadvantage of using this method is that the results do not necessarily reflect the opinions of all managers working in South African businesses as only those organisations that selected simulations as an option for capability building had a chance of being selected. In other words the culture of the organisation was already in favour of business simulations as training tools which may have an impact on the attitude with which the individual participants approached the simulation.

4.6 Data Collection

In order to test the four propositions outlined in chapter 3, data was collected using the questionnaire attached in appendix A. BTS, a consulting company that specialises in business simulations conducted business simulation programs for various South African companies during 2006. The managers participating in these

programs were asked to complete the questionnaire. The questions posed in the research questionnaire after they had completed one of these programs. Data was gathered for the period from June – October 2006 and the units of analysis consisted of 106 individuals. The breakdown across industries is shown in table 4-1:

Table 4-1: Data by Industry	**Number of participants**
Retail	42
Banking	23
Telecommunications	41
TOTAL	**106**

The data was collected from five different simulation seminars – two retail industry simulations were used, one banking simulation and one simulation program was used to run two seminars for the telecommunications industry. When discussing the results in the following sections, the different simulation programs will be referred to using the labels shown in the right hand column of table 4-2.

Table 4-2: Simulation Tools	**Industry**	**Label**
Process Flow Simulation	Retail Operations	RT1
Business Acumen Simulation	Banking	BNK
Business Acumen Simulation	Telecommunications	TEL
Financial Modelling Simulation	Retail Buyer / Planner	RT2

These labels, RT1, differentiate between the different simulation tools. For the telecommunications industry the same simulation tool was used for two different seminars. To differentiate between the two different seminars, the labels TEL1 and TEL2 will be used.

Each participant was asked to respond to the questions posed in the questionnaire as well as fill in a program evaluation (an example of a typical program evaluation form is attached in appendix B). The program evaluation measures the quality of program delivery and to what extent the learning points of the program have been achieved. The data collected from the program evaluations was used to compare the results of the quantitative questions against the results of the program learning objectives.

The data collected for each of the five seminars held, is shown table 4-3. As can be seen in the table, a total number of 106 research questionnaires were collected as well as 103 program evaluations. Each seminar had approximately 20 participants.

Table 4-3: Data by Sim	**Questionnaires**	**Program Evaluations**
Program RT1	22	22
Program BNK	23	23
Program TEL1	21	20
Program TEL2	20	18
Program RT2	20	20
TOTAL	**106**	**103**

4.7 Data Analysis

Quantitative data was collected to measure the first three propositions. To measure the fourth proposition, qualitative data was needed. The methods used for analysing these two different types of data are discussed in the following sub-sections.

4.7.1 Analysis of Propositions 1 – 3

Descriptive statistics were used to evaluate the results pertaining to the first three propositions. The first three questions in the questionnaire were measured using a 5-point Likert scale. Each of these questions related to systems thinking and the data collected was used to determine to what extent the simulations achieved to reflect those elements of systems thinking. To be able to draw conclusions on the results of these questions, they were compared to the results of the program learning objectives, which use the same type of attitude scale. The program evaluations measured each learning point on a similar 5-point Likert scale (see table 4-4). Participants were asked the following question related to the learning points of the program:

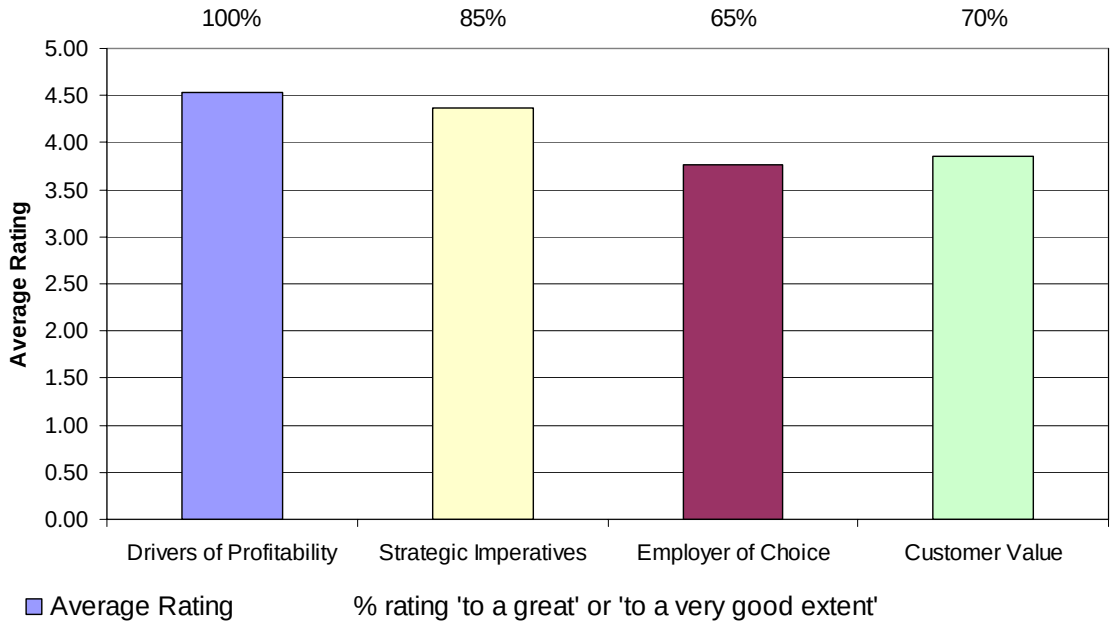
Having comple , would you rate the level of change in your understanding of the following concepts:

Table 4-4: Learning Point Evaluation Scale

	To a great Extent	*To a very good extent*	*To a good extent*	*To a fair extent*	*No change*
Learning Point 1	⑤	④	③	②	①
Learning Point 2	⑤	④	③	②	①
Learning Point 3	⑤	④	③	②	①

For each program, the program evaluation form was used to measure the extent to which the learning objectives had been achieved. Some examples of the learning points that are common to different programs are: Drivers of Profitability, Return on Assets (ROA), Customer Value and Employee Satisfaction *etc.* BTS uses this method to evaluate all of its programs and reports the results for each program to the client. From experience it is generally understood within BTS that a learning point has been significantly well achieved if the average rating for the learning point being measured is above a level 4. This means that in order to achieve an average rating of 4, participants must have on average responded that their level of understanding for the respective learning point has improved to a “very good extent”. Another measure that is useful is the percentage of participants that responded that their understanding of the learning point in question has either improved to a ‘very good’ or to a ‘great’ extent. A typical result of a program evaluation is shown in figure 4-1:

Figure 4-1: Example - Average Rating of Learning Points



In figure 4-1 above the average rating for the second learning point "strategic imperatives" is equal to 4.37. This means that on average participants regarded their change in understanding in respect to this learning point to have improved by more than "a very good extent". The third learning point on the chart, "Employer of Choice" has not been significantly well achieved. The average rating for this learning point is 3.77; only 65% of all participants responded that their level of understanding with respect to this learning point improved to a "very good" or "great" extent.

The research questi determine the impact the simulation had on changes in perspective for the participants. As can be seen in table 4-5, the first three questions are measured using the following scale:

Table 4-5: Research Question Evaluation Scale

	Strongly agree	***Agree***	***To some extent***	***Disagree***	***Strongly disagree***
Question 1	⑤	④	③	②	①
Question 2	⑤	④	③	②	①
Question 3	⑤	④	③	②	①

Based on the argumentation at the beginning of this section, a learning point is considered to be significantly well achieved if it scores an average rating above a level 4.0. In order to determine whether a change in perspective has been significantly well achieved, the same measuring criteria will be used.

4.7.2 Analysis of Proposition 4

The question about the aha-effect was intentionally left open-ended. In order to be able to draw valid conclusions it was important not to lead participants into an “aha-effect” framework, but allow them to talk through their experiences based on their perceptions of what they had learnt. This means that participants were free to interpret the “aha-effect” differently, regardless of whether it related to systems

thinking or not. It was] occur then this shift must have been a significant moment for the individual as he/she replaced an existing paradigm (individually focussed) with a new paradigm (systems focussed). It is believed that the difference between a systems thinking approach and a non-systems thinking approach is so fundamentally different, (in that it requires a paradigm shift) that if asked, a participant would single it out as the most significant insight gained during a training program. The research question therefore needed to determine whether a person had experienced some sort of significant insight during the program and needed to establish what that significant moment was. If the participant refers to this significant moment citing issues related to systems thinking, then it can be deduced that systems thinking is in fact an outcome of participating in business simulations. However, it is important to note that the objectives of each one of the simulations was not to increase systems thinking. Improved systems thinking is believed to be a by-product of using simulations as a tool for capability building. The cited objectives of the simulation were for example improved business acumen, improved understanding of the drivers of profitability *etc*. The participant does not know whether the research is trying to measure the impact of the program objectives or whether it is in fact trying to measure something else such as systems thinking, personal cognitive change, competitiveness *etc.* The participant is merely asked to share whether he/she experienced a moment of clarity during the program. The participant was then asked to explain what this moment of insight was.

The qualitative data collected data by theme. The different responses could be grouped according to five topics - systems thinking, program learning points, personal cognitive change, game playing and unanswered or not relevant responses.

4.8 Potential Research Limitations

The choice of industries and participants in the research study will be based on a convenience sampling process. As a result it is possible that the sample will not be truly representative for all South African organisations.

It is possible that data collection and interpretation is not completely free from interviewer bias, due to the inexperience of the interviewer.

The responses by the participants may be a result of “program high”. Their perception of the quality of the seminar may influence the results and could result in them responding favourably or negatively to the research questions.

There may be other extraneous variables that influence the perceptions of the participants that are not related to the simulation tool or seminar.

4.9 Conclusion

Individuals that participated in different simulation programs were given a questionnaire that measured the extent to which the simulation tool encouraged systems thinking. Participants were then asked to reflect on the experience they considered to be their most significant moment of insight during the program, if any. The research questionnaire provided quantitative data and included one qualitative item. Descriptive statistics were used to analyse the quantitative data while the qualitative data was categorised by theme and the responses were examined by category.

In the following chapter the results are presented for all four propositions. The quantitative data collected for the first three propositions will be measured against the 4.0 hurdle rate that has been set as a criterion for considering the results significant. The qualitative data will be split into different categories and we will differentiate between comments that do or that do not relate to systems thinking.

5 RESULTS

5.1 Introduction

The purpose of the research was to determine whether it was possible that through the use of business simulations individuals experienced a change in mental models, from silo thinking to holistic systems thinking. In order to ensure that participants were able to experience systems thinking the following elements needed to be in place:

1. Participants needed to step outside of their everyday way of seeing the system of which they are part and see the entire system from a holistic perspective.
2. Participants needed to be able to understand the overarching needs of the organisation separate from their individual goals / targets / needs.
3. Participants needed to be able to understand how the individual parts of a system work together to create value for that system.

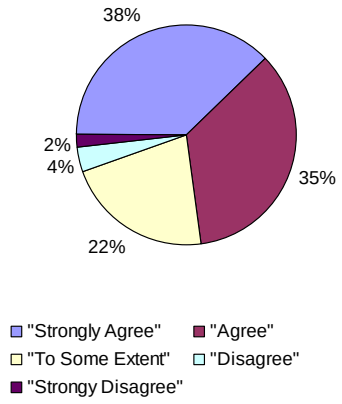
Furthermore participants may have experienced a change in their thinking, which may have been a result of a shift in mental models. In order to determine whether this may be the case,

4. Participants needed to report that they had experienced some sort of significant moment of insight related to systems thinking.

5.2 Seeing a D

Due to the complexity of the real world we usually have difficulty understanding the system as a whole. Sterman (2000) maintains that we as humans lack the cognitive capabilities of understanding even the simplest forms of complexity. A simulation is a simplified model of the real world. As a result of this simplification the model lets us understand some of the systems key dynamics that are difficult or impossible to see or understand in the real world. The simulations used therefore needed to allow individuals to see their businesses from a more holistic perspective. According to Senge (2006) individuals operate in silos and do not generally get to view their organisations from a holistic perspective. By using simulations we therefore attempt to overcome this limitation and view the system (be it in simplified form) from an overarching view. The question was worded as: “As a result of the simulation, did you get to view your organisation from a perspective from which you had never viewed your organisation before?” A summary of the responses that participants gave in respect to question 1 for all five programs is shown in figure 5-1:

Figure 5-1: Response to Question 1

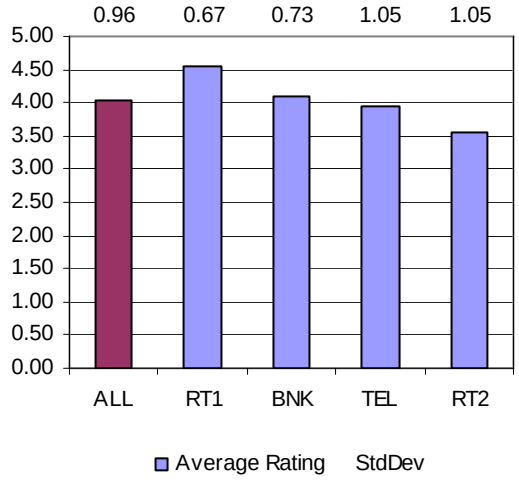


Response	Count	% of Total
Strongly agree	40	38%
Agree	37	35%
To some extent	23	21%
Disagree	4	4%
Strongly disagree	2	2%
TOTAL	**106**	**100%**

Of the 106 participants that completed the questionnaire 94% “strongly agreed”, “agreed” or “agreed to some extent” to the fact that the simulation allowed them to see the organisation from a perspective from which they had never looked at their organisation before. The percentage of participants that “disagreed” or “strongly disagreed” to this statement only amounted to 6%. Based on the 5-point Likert scale used, the average rating for this question was 4.03 (see figure 5-2). This exceeds the minimum criteria of 4.0 as set in chapter 4. Based on the argumentation in chapter 4 the result can therefore be considered significantly well achieved. However, not all of the simulation programs did equally well in terms of achieving the 4.0 target. Figure 5-2 shows the results for all of the four simulations used “RT1”, “BNK”, “TEL” and “RT2”. The column “ALL” shows the results for all participants from all of the simulations. As can be seen in figure 5-2, the telecommunications simulation (TEL) scored marginally lower than the required 4.0 while the second retail simulation (RT2) only scored an average rating of 3.55.

Both of these simula higher standard deviations (shown as StdDev or Sigma [σ] in the following tables and charts) than the other two, RT1 and BNK. This shows that in the TEL and RT2 simulation a larger number of respondents that gave answers that were not close to the mean. Furthermore, the far right column of the table in figure 5-2 headed as "% 3+", shows the percentage of participants that at least agreed to the statement to some extent (i.e. 3 or above on the Likert-scale). In the RT2 simulation 85% of participants responded with a "3+" meaning that 85% gave a score of 3 or above on the Likert-scale, while 15% of respondents "disagreed" or "strongly disagreed" with the statement.

Figure 5-2: Ratings Question 1

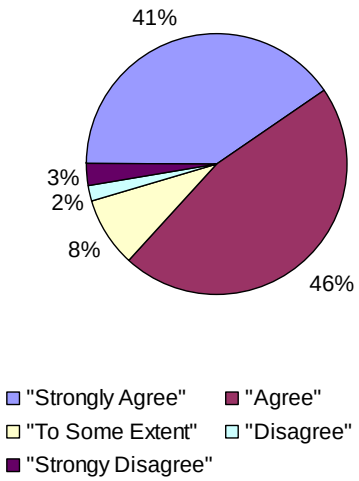


Program	Mean	σ	% 3+
RT1	4.55	0.67	100%
BNK	4.09	0.73	100%
TEL	3.95	1.05	93%
RT2	3.55	1.05	85%
ALL	**4.03**	**0.96**	**94%**

5.3 Understan

Understanding the organisational needs is a necessary condition for understanding the system. Instead of focussing on local optima, participants need to understand that what really matters to the organisation and the customer are the global optima that the system is able to achieve. Achieving a local optimum therefore may be inconsequential to the system as a whole. Therefore an increased understanding in terms of organisational needs is necessary to ensure participants attempt to satisfy the organisational objectives as opposed to working with a mental model by which individuals attempt to satisfy their personal goals or needs. A summary of responses for question 2 is shown in figure 5-3:

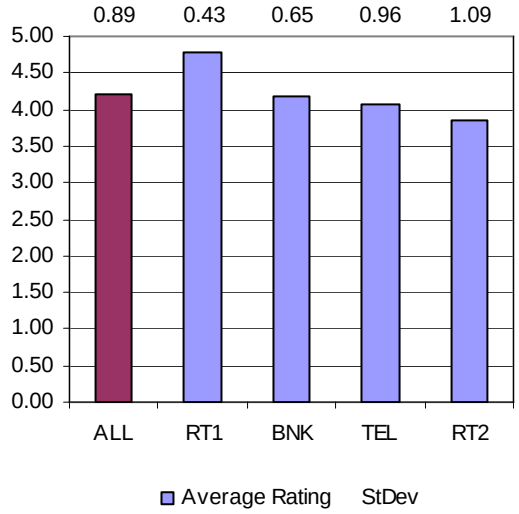
Figure 5-3: Response to Question 2



Responses	Count	% of Total
Strongly agree	43	41%
Agree	49	46%
To some extent	9	8%
Disagree	2	2%
Strongly disagree	3	3%
TOTAL	**106**	**100%**

Most participants agre in the business simulation program they gained a better understanding of the organisations needs. Only 5% "disagreed" or "strongly disagreed". The average score based on the 5-point Likert scale was 4.20, exceeding the required minimum of 4.0 (see figure 5-4). The average rating is therefore high enough to accept that the objective of question 2 was significantly well achieved. Each one of the individual simulations got an average rating of above 4.0, except the second retail simulation RT2, which only scored an average of 3.85. An interesting observation is that although the 4.0 hurdle was not achieved, 90% of people that participated in the second retail simulation, at least "agreed to some extent".

Figure 5-4: Ratings Question 2

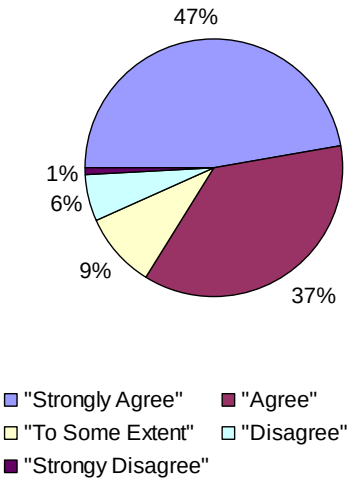


Program	Mean	σ	% 3+
RT1	4.77	0.43	100%
BNK	4.17	0.65	100%
TEL	4.07	0.96	93%
RT2	3.85	1.09	90%
ALL	**4.20**	**0.89**	**95%**

5.4 Appreciati

The third question aimed to determine whether simulation allowed participants to get a better understanding of how different elements in the system work together to create value for that system. In order to ensure that systems thinking can take place, it is important that participants understand the concept of connectedness. Senge (2006) maintains that you can only understand the system by contemplating the whole, not any individual part of the system. According to Cilliers (1998) the interaction between elements in a system is fairly rich and any element in the system influences and is influenced by quite a few others. It is important to understand how these interrelationships between elements can create (or destroy) value for the system. Participants responded to question 3 as shown in figure 5-5:

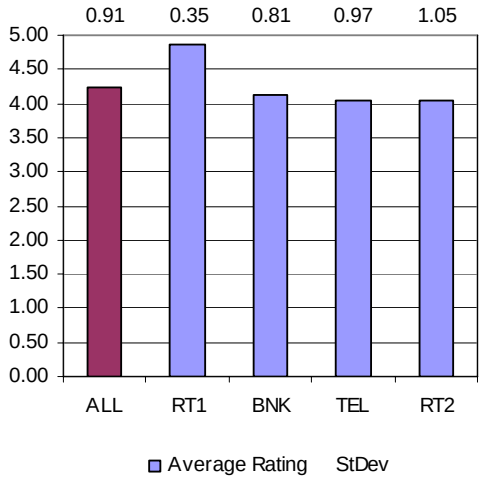
Figure 5-5: Response to Question 3



Responses	Count	% of Total
Strongly agree	50	47%
Agree	39	37%
To Some Extent	10	9%
Disagree	6	6%
Strongly disagree	1	1%
TOTAL	**106**	**100%**

Once again the results show that a large number of participants (93%) at least agreed to this statement to some extent (see figure 5-6). The average rating for this question was 4.24, exceeding the required minimum of 4.0. Each one of the four simulation programs for which data was collected managed to exceed the 4.0 hurdle. Figure 5-6 shows the average rating for each one of the simulation programs as well as the standard deviation. The percentage of participants that "strongly agreed", "agreed" or "agreed to some extent" to this statement is shown in the far right column.

Figure 5-6: Rating Question 3

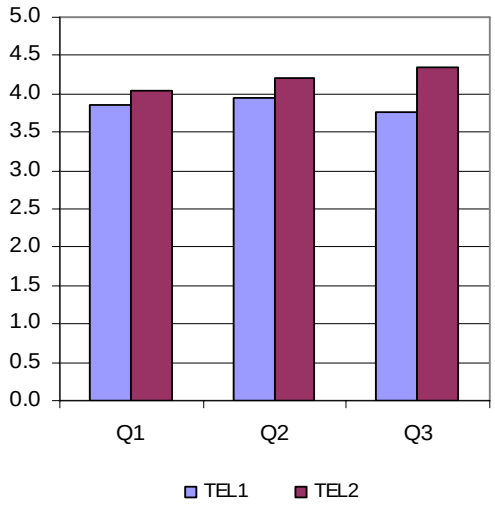


Program	Mean	σ	% 3+
RT1	4.86	0.35	100%
BNK	4.13	0.81	96%
TEL	4.05	0.97	90%
RT2	4.05	1.05	90%
ALL	**4.24**	**0.91**	**93%**

5.5 Seminar D

The telecommunications simulation was the only simulation tool for which data was collected for two separate programs. If we compare the average rating for the two separate programs for which the same simulation tool was used the ratings differ as shown in figure 5-7:

Figure 5-7: The Telecoms Simulation



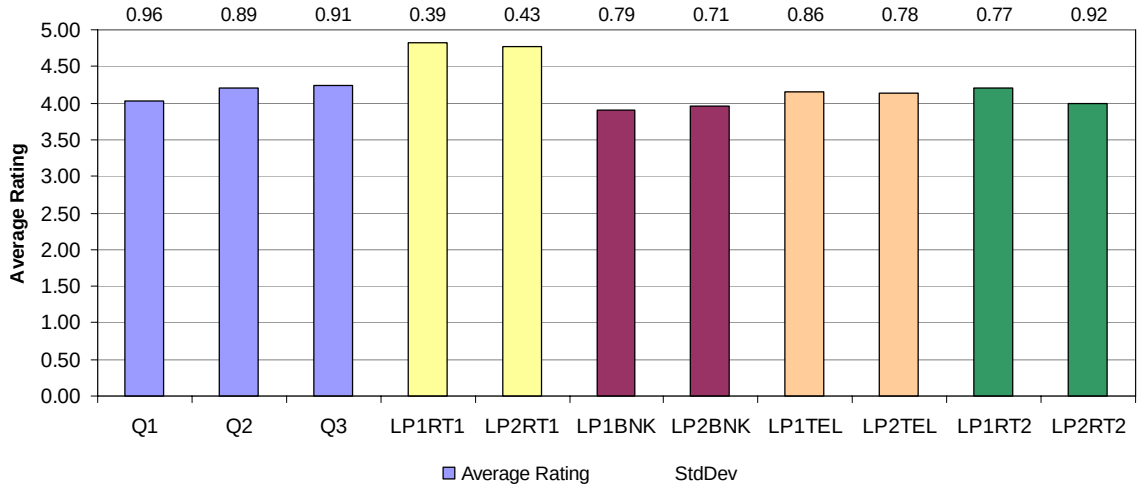
Program	Mean	σ	% 3+
TEL1Q1	3.86	0.96	90%
TEL2Q1	4.05	1.15	95%
TEL1Q2	3.95	0.97	90%
TEL2Q2	4.20	0.95	95%
TEL1Q3	3.76	1.00	86%
TEL2Q3	4.35	0.88	95%

The data shows that for each of the three questions asked the average ratings of responses from seminar “TEL1” are consistently lower than the average ratings from seminar “TEL2”. This suggests that there are other variables besides the simulation tool that influence the responses.

5.6 Comparison of Results

Overall each one of the three questions scored above the 4.0 hurdle rate, even though not each one of the individual programs made the 4.0 target. However, to be able to determine whether these scores are significant, we need to be able to benchmark them against some comparable yardstick. As discussed in chapter 4, BTS designs its simulations in such a way that it is able to achieve certain learning objectives. If the average rating pertaining to the change in perception in regard to the elements of systems thinking is comparable to the average rating for each of the program learning objectives then it is possible that we are able to draw some conclusions on the significance of the results. Figure 5-8 below shows the overall average rating for the three research questions as well as the average rating for the two primary learning points of each of the different simulations used in the study. The first three columns show the average rating for each of the three research questions. The next columns show the average rating of the two primary learning points (LP1 and LP2) for each of the simulations used (RT1, BNK, TEL and RT2).

Figure 5-8: Questions 1-3 vs. learning objectives



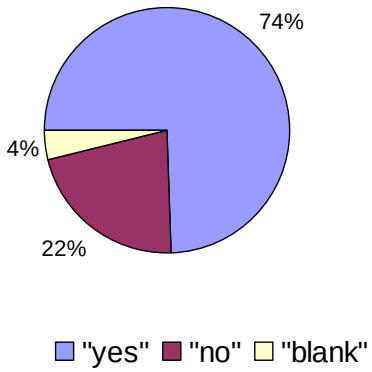
If we compared to the average rating for each of the eight learning points shown in figure 5-8 to each of the three research questions, we get the following results. The average rating in response to question 1 outperforms the average ratings of three of eight learning points. The average rating of question 2 outperforms the learning point average on 5 occasions, while question 3 outperforms the learning point average rating on 6 occasions. The standard deviation (StdDev) for the three learning points is generally higher than the standard deviation for the program learning points. This suggests that the responses in terms of the learning points are more consistent than the responses in terms of the research questions.

5.7 The Aha-Effect

The “aha-effect” question (question 4) on page 2 of the research questionnaire (see appendix A) aimed to establish whether it may be possible that participants

experienced a shift i rticipating in the business simulation. To determine whether this may be true, participants were asked a question that consisted of two parts. In the first part of the question participants were asked whether at any moment during the seminar they had experienced an aha-effect. The aha-effect as defined in the questionnaire is a point in time were a participant suddenly grasps a particular concept and things that were unclear to him/her before started making sense (Boeree, 1998). The results for the first part of the question are shown in figure 5-9:

Figure 5-9: Experienced an aha-moment



Aha-moment	Count	% of Total
Yes	79	74%
No	23	22%
Unanswered	4	4%
TOTAL	**106**	**100%**

As shown in figure 5-9, the first part of question 4 was answered with “yes” by 74% of all participants. Only 22% answered with “no” and 4% of participants failed to answer the question altogether. In the second part of the question, participants were asked to qualify their response. The main purpose of qualifying this response was to determine whether the 74% of participants that did experience an aha-moment may have experienced a shift in mind related to systems thinking. Should

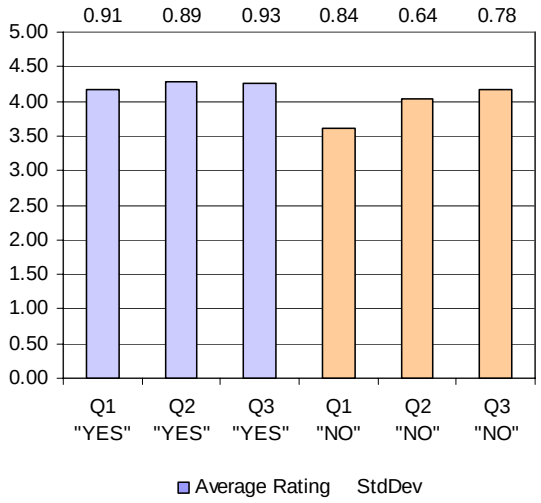
participants have exp expected that they would share it in this section of the questionnaire.

However, before examining the qualitative data, it may be interesting to determine whether there could be a relationship between the responses that participants gave concerning the elements of systems thinking (questions 1-3) and the aha-moment they may have experienced (question 4, part 1)

5.8 Relationship between Q 1-3 and the Aha-Effect

In order to determine whether a relationship exists between the first three questions and the aha-effect, we needed to split participants into two groups, those that responded to the aha-effect question with “yes” and those that responded to the aha-effect question with “no”. Participants that did not respond to this question were not taken into consideration. Figure 5-10 shows the average rating for each of the three questions, from the participants that did, and those that did not experience an aha-moment. The standard deviation is the value shown above the columns in the chart.

Figure 5-10: Question 1-3 vs. an aha-moment

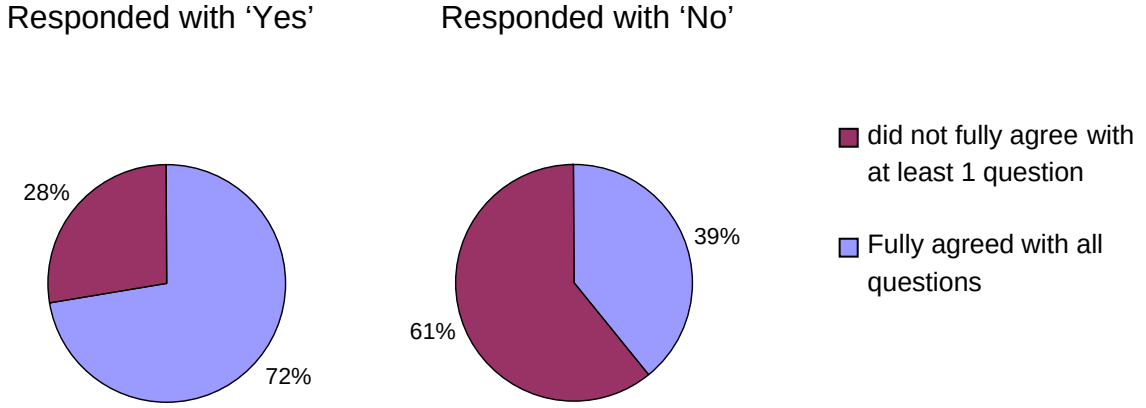


AHA	"YES"	"NO"
Question 1	4.16	3.61
Question 2	4.28	4.04
Question 3	4.27	4.17

As can be seen in figure 5-10, for each of the three questions the participants that did experience an aha-moment had a higher average ranking than the participants that did not experience an aha-moment. However, the differences are not exceptionally large and it is interesting to note that the standard deviation (StdDev) in the responses of the participants that answered "yes" to the aha-effect question is higher than the standard deviation for those that answered "no". In terms of the average ratings, the data does however not show any significant differences between the two groups, with only a 13%, 6% and 2% difference in the average rating for questions 1, 2 and 3 respectively. Perhaps the use of the average rating does not provide the best data to compare differences between participants that did or did not experience an aha-moment.

A better indication of w veen questions 1-3 and the aha-effect question may be to examine whether participants that did not experience an aha-moment may not have fully agreed to either one of the three questions. To do this we must divide the participants into one group that fully agreed ("strongly agree" or "agree") to all three questions and another group that did not fully agree ("to some extent", "disagree" or "strongly disagree") in at least one instance. We then differentiate between those that did experience an aha-moment, and those that did not. The results are shown in figure 5-11.

Figure 5-11: Aha vs. Q 1-3



Of all the respondents that answered "yes" to the aha-effect question, 72% fully agreed to all three of the initial questions and only 28% of these participants did not fully agree on at least one occasion. For the respondents that answered "no" to the aha-effect question, the results look very different. 39% of these respondents fully agreed with the initial three questions while 61% did not fully agree in at least one

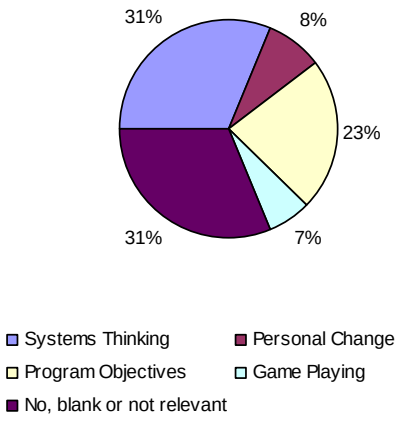
instance. It therefore a link between participants experiencing an aha-moment and their perceived engagement in systems thinking in the virtual world.

However, in order to determine whether participants perceived a shift in mind, determining whether they experienced an aha-moment is necessary, but not sufficient. A shift in mind from silo thinking to holistic thinking requires that the aha-moment they experienced must in some way relate to systems thinking.

5.9 Qualifying the Aha-Moment

Participants were asked to qualify their response to the aha-moment. The question was open-ended and participants were free to respond however they thought was most appropriate. As a result there were a number of types of responses to the question “did you have an aha-moment?” Some of the comments related to systems thinking or to the programs learning objectives while others either remained unanswered or were not relevant to the research. Those that were relevant to the research could be categorised into four main themes - systems thinking, personal change, program learning objectives and game-playing. The breakdown is shown in figure 5-12.

Figure 5-12: Response categories



Categories	Count	% of Total
Systems thinking	33	31%
Personal change	9	8%
Program objectives	24	23%
Game playing	7	7%
None or not relevant	33	31%
TOTAL	106	100%

5.9.1 Systems Thinking

Participants that reported an aha-moment related to systems thinking support the proposition that business simulations may cause a shift in mind from compartmentalised silo thinking to holistic systems thinking. 31% of all participants cited elements of systems thinking as their aha-moment. Some of the key themes mentioned by participants included:

- system alignment and the importance of optimising the system as a whole
- the interrelationship between shareholder, employee and customer value

- synergie ses
- the non-linear impact of decisions and
- how activities in the system feed back on themselves.

The individual comments that participants gave are shown in table 5-1:

Table 5-1: Evidence of Systems Thinking

1. Planning more sales without really going back to assess whether there will be sufficient units to make those sales was a big wake-up. The importance of stock in your business plays a very crucial role.
2. Staff play a big role in a company, which in turn impacts the value created for the customers
3. Very much increased my understanding around financials in the Bank and what it means in terms of the greater picture.
4. Customer Satisfaction and shareholder value is key to the success of an organisation. Key strategic decisions need to be made at the expense of others
5. When you make a change in any parameter of the business it affects overall business outcomes
6. The impact on decisions. Decisions made by our organisation are difficult. A deep respect to the decision makers
7. The link between customer satisfaction and the network
8. During the first feedback session I could see the impact of our decisions. However this faded after the second feedback session because it seemed that I still did not grasp all the concepts.
9. The ease with which complex procedures and processes were simplified and therefore well understood and applied - resultant: effective learning
10. Suddenly you realise how small changes can have big effects on business
11. Analysing competitor info and not just making rash decisions
12. Minor changes to a company structure / pricing policy can have major implications to customer churn. Importance of focussing on customer satisfaction & market share. Thanx
13. What factors influenced performance measures that had a huge impact on the organisation
14. The concept already existed. The program did however elaborate it more and put it into a clearer light & perspective

15. Mostly reaffirmed in showing how to focus the knowledge to maximise leadership potential
16. Cause and effect. What things affect other things in terms of finance - not really understood previously
17. Understanding the dynamics of pricing and investment. It's just amazing to be able to simulate a real competitive market. Congratulations, it really opened my eyes on the interrelationship between variables
18. Yes, I learnt that we need to work at our staff and customer satisfaction
19. The whole simulation actually makes it possible to assess the ripple effect that different decisions have in the daily business operations
20. When we learnt how our decisions / behaviours affect others without us knowing it. The way one makes choices without knowing the impact those choices have on oneself and others too. The best thing to learn is by learning while teaching others and sharing the knowledge.
21. A lot, mostly things I should know already, but I have been reminded in this program that it does not matter how much you want to sell, if you don't have the right product, at the right time, in the right place you will not have sufficient sales, which will therefore affects everything else that you want to achieve, in terms of your GP. I realised my potential to be a planner, if I really put my mind to it. It helped me to really appreciate what planners do on a daily basis
22. To make proper use of your staff in relation to the productivity they deliver and to the level they can perform.
23. We focused so much on getting COS down that we didn't really analyse our constraints. When we completed the third part of the simulation it became clear that we would not reach our productivity target as we assigned the wrong staff in the wrong positions
24. Making your place a compelling place to work and shop you create wealth not only for the shareholders but your employees.
25. The correct staff in the correct place & the correct time make all the difference
26. Gave me a better understanding of how the <organisation> functions as a whole. Useful insight into a simplistic version of Income Statements
27. It all depends on the company's strategies. This together with how you evaluate customers can determine profits.
28. Understanding the impact of customer satisfaction on the company's revenue
29. Several, especially the part about listening and how that assists in growing not only our part in the <organisation> but also creates synergy and understanding between different departments and between staff and management.
30. The interdependency of appropriate stock flow and turn. Thus the effect on cost of sales (markdowns etc.) for aging stock. However, the reliability of suppliers is also key in that

unreliable supplie balance is sought, and when achieved you are able to better meet demand.

31. Understanding of local suppliers and imports and how they cope, and handle volumes
32. After the first season I started focussing on the stores and planned them right. The next season our assortment was almost perfect. When the sales projections were missed most, the possibilities were eliminated therefore it was easy to pinpoint the problem.
33. The one thing that stood out for me was that if the stockroom processes are not 100% it influences the whole store performance

5.9.2 Personal Cognitive Change

Some individuals reported that they experienced a cognitive change, but failed to explain whether this change in their thinking had anything to do with systems thinking. Key themes included:

- perception of improved skills
- information sharing
- team effectiveness and
- career enhancement

Individual comments are shown in table 5-2:

Table 5-2: Evidence of personal change

34. I can now turn around my <place of work> using the skills that I got from this training and from my team.
35. Sharing information - support - solid feedback to take back to ones <place of work> to be able to implement
36. My ideas and actions do make an impact and anything is possible
37. Most of this has been new and I've learnt a lot from this program

38. Program Enlighter
39. How the lessons of leadership impact our personal lives as well
40. The importance of leadership vs. management; effectively working in teams and the importance to respect everyone's opinion
41. Working well in our team and seeing the value of everyone leading in their own way
42. The business simulation was very challenging, and informative. The skills acquired will most definitely assist me in my career and on the job. Great

5.9.3 Program Learning Points

A number of participants cited an aha-moment that related directly to the program learning points. The program objectives are to improve participants understanding in one or more of the following key themes:

- drivers of profitability
- customer and employee satisfaction
- understanding financial reports and ratio's
- optimal asset and resource utilisation

A number of participants responded to the aha-moment question referring to examples of the key themes listed above. Table 5-3 contains the individual comments that relate to the program learning points.

Table 5-3: Evidence of learning objectives

43. That taking risks could be good for an organisation. Being able to interpret the previous years results determined success / failure of future decision making.
44. The results of implementing projects as we managed to increase sales and reduce COS

45. When the compar three objectives, reducing COS, increasing sales and reducing the other expenses. When other team members made small break throughs that helped the company in a big way.
46. That it is very important to keep your staff and customer satisfaction in balance to achieve your COS and growth targets. That other expenses make up only a small % to achieve your COS target.
47. When the team achieved the goal on decreasing COS and increasing sales, and improving customer and employee satisfaction.
48. The impact the special initiatives had on the COS
49. Understanding of how the inputs we made affected our financial reports and impacted our COS
50. Yes, at the point of explaining the income statement and balance sheet. Understanding cost to income ratio and importance of having drivers to control your business
51. What huge effect expenses have on the income statement
52. Point where <facilitator> gave us an overview of how the <organisation> makes its profit. Especially focussing on how my job plays an important role towards this profit
53. The impact that income growth, operating profits, cost-to-income ratios and expenses have on the bottom-line
54. Understanding clearly the financial indicators & ratio's. I always wanted to know how they worked
55. Better understanding of financial statements and ratios allowed me to make better decisions during the simulation in day 1
56. Price vs. demand; features introduced vs. operating margin
57. The feedback session was surprising each time. What you put in is what you get out. Great!
58. Optimal resource / asset use
59. Competitor knowledge is key
60. My aha moment was understanding the bottom line effect and understanding the ratio's we do have
61. The effect customer satisfaction has on the bottom line
62. The GP matrix was never completely clear to me, during the training. I had a light bulb moment and understand it very well now.
63. Understanding the correlation between GP and stock turn for different products. i.e. high stock turn + low GP = high GP + low stock turn
64. Yes, when impacting the variables on the GP matrix, effects are now clear and concise
65. Understanding issues on GP matrix that effect the top line. (e.g. how markdowns and clearances effect on the GP%)
66. Better understanding and application of the GP matrix

5.9.4 Game Playing

Some individuals viewed the simulation as a game and failed to relate the learning points back to the real world. The statements in table 5-4 support this observation. However, besides focussing mainly on the competitive value of the simulation, participants also mentioned some positive cross-field outcomes such as improved team effectiveness and improved negotiation skills.

Table 5-4: Evidence of game playing

67. The time of the Aha moment was the time when I thought we had won the second stage of the competition
68. Working as a team. Having climbed from last to first in the 3rd quarter. Finding ways of improving variables in the simulation.
69. How some scenario-planning helped us to make decisions. We mapped out the different costs and benefits and then looked at those before making a decision
70. The relationship between pricing set by the competing groups. After year one we saw that we could increase price without affecting market share too much, and therefore increase earnings
71. After constantly being let down by our suppliers I wasn't sure whether we could enforce discounts / penalties due to short deliveries. However, when I learned that it was possible, I took advantage of it.
72. Yes, we (the team) worked quietly, but very hard together. The highlight was on the second day when we got the results - we came first… it was a good feeling
73. How to tackle negotiations with local suppliers

5.9.5 None or Not

Thirty-three questionnaires could not be used for further analysis. Twenty-six questionnaires remained unanswered. Of these twenty-six unanswered questions, three participants claim to have experienced an aha-moment, but failed to qualify it. The remaining seven individuals responded to the aha-moment question, but the response they gave was not relevant to the research proposition. Table 5-5 lists the seven responses that were not relevant to the research.

Table 5-5: Responses not relevant to the research

74.	Some very good ideas and input from delegates and informative input from the trainers
75.	The time limit and drive felt to accomplish deadlines. Moving from position 5 to position 1 on day two.
76.	Solving problems using the simulation method.
77.	During the second day when <facilitators> were discussing Leadership
78.	I had to skip a large part of the simulation which was unfortunate. I think it may have been beneficial to have a facilitator with us when we where in our breakaway groups to explain the broader ramifications of our actions while we were making decisions.
79.	I've realised that <company name> is a great company to work for.
80.	Being in finance most of the modelling / forecasting was very familiar territory. I did thoroughly enjoy the simulation nonetheless.

5.10 Conclusion

The first three propositions suggested that business simulations would allow participants to see their organisation from a different perspective, improve their understanding of the overarching needs of the entire system and increase their

understanding of how [illegible] its within the system can determine the effectiveness of the system as a whole. On average participants agreed to all three of these statements, with each question scoring an average rating above 4.0 on the 5-point Likert scale. The fourth proposition suggested that participants experience a shift in mental models as they change their views from a silo thinking to a systems thinking approach. This proposition was supported in the comments of 31% of all participants. Another 31% did not respond (or did not respond appropriately) to the question asked, while 7% failed to link the learning in the virtual world to the real world and perceived the simulation as a game. The remaining 31% cited either improved understanding of programs learning points or personal cognitive change as their moment of aha. In chapter 6 we will examine in how far the responses that participants gave support the idea of a shift in mental models.

6 DISCUSSION OF RESULTS

6.1 Introduction

The research problem as defined in chapter 1 was to determine whether it may be possible that business simulations are able transform existing mental models of individual participants from compartmentalised silo thinking models to broader holistic systems thinking. In order to attempt to determine this, two things needed to be done. Firstly, it was necessary to find out whether the business simulations used, allowed to participants to see and understand the functioning of the system as a whole. It was proposed that the simulations allowed participants to see their organisation from a new perspective, allowed them to understand the system needs and to understand the interrelationships within that system that need to work together to create value for the system as a whole. Participants were asked whether they agreed that the simulation tools were successful in demonstrating these elements. Systems thinking is of course the theme of the fourth proposition that suggests that participants experience a shift in mind away from compartmentalised silo thinking towards holistic systems thinking.

6.2 Elements o

6.2.1 Change in Perspective

Quinn (1996) maintains that a change in perspective can fundamentally alter the way we relate to the world. The first research proposition suggested that during the business simulation seminars participants got to see their organisation from a different perspective, a perspective from which they had never viewed their organisation before. This means that the simulation tool needed to allow participants to step outside of their everyday way of seeing the system of which they are part and distance themselves from their narrow views and appreciate the broader view of the system as a whole. Senge (2006) explains that instead of being part of the system with a window looking out we need to distance ourselves from the system and look in from the outside. When we shift that perspective we are better able to understand our own roles within the system, as our vision is not distorted by self imposed boundaries and frames.

In chapter 5 (figure 5-2), it was shown that based on the overall feedback collected from 106 participants the average rating for this question was 4.03, as measured on the 5-point Likert scale. This means that on average participants agreed with this statement, while only 5% of all participants indicated that they did not agree that this was the case. As explained in chapter 4, the criteria for accepting that this point was significantly well achieved was that the average rating needed to exceed

an average rating of based on past experience with program evaluations. Because the research questionnaire and the program evaluations use a similar 5-point Likert scale, the average ratings for the research propositions could be compared to the average ratings of the program learning points.

6.2.2 Understanding the Overarching Needs

Argyris and Schön (1978) argue that too often we are concerned with our personal agendas and the legitimate needs of other people are pushed aside and the goals of the organisation become secondary to winning. If however we are able to distance ourselves from the system and understand to overarching needs of the system as a whole, we will realise that winning can only be achieved if it translates into winning for the entire system of which we are part. The second research proposition therefore suggested that as a result of participating in a business simulation participants would be able to understand the overarching needs of the organisation separate from pursuing their individual agendas. As a result of the shift in perspective and no longer seeing oneself as constrained within the system but as part of the system, winning is more likely to mean inquiring, understanding and compromising. If we pursue winning from an individualistic perspective, it is possible that as a result of us pursuing winning, we destroy value for the organisation as a whole. The fight for scarce resources within organisations is only

beneficial to us if thro e a system constraint. If we as individuals begin to understand this, then we are engaging in what Argyris (2002a) refers to as double-loop learning. As we attempt to understand the root causes of the challenges we deal with in organisations, winning for the individual becomes secondary to winning for the system. To be able to visualise this phenomena better we can take a manufacturing process as an example. The argument is that if we focus only on our area of responsibility and look after what is important to us as individuals then our pursuit of attempting to optimise processes (which from a systems perspective are only sub-processes) would not necessarily benefit the organisation as a whole. If a single manufacturing process in an organisation operates at its optimal level of performance, this optimisation may result in additional problems for other processes within the system. Goldratt (2004) argues that if a process is optimised and this process is not the critical constraint in a system, focussing on creating a local optimum is likely to cause more harm than good for the system as a whole. In our manufacturing process example, improving the performance of a task, which is not the critical constraint of the manufacturing process, will result in additional work in progress (WIP) inventory to build up in front of the function that is the critical constraint of that process. The output of the system (in this example the manufacturing process) is limited to the maximum capacity of the critical constraint in the system. Improving the performance of any function that precedes this constraint will only result in additional inventory build up in front of the constraint. More WIP inventory results in additional capital being tied up in the organisation, which could have rather have been invested in elevating the

system constraint th g process to increase its throughput. However, by focussing on localised optimum performance on sub-processes that precede the critical constraint, we build up WIP inventory in front of the critical constraint. As a result the pressures on the constraint increase, failure to ship orders on time results in crisis management, frustration, additional system down time and loss of control. When managers get into this routine of managing problems they are engaging in what Argyris (2002a) refers to as single-loop learning. They begin to fight symptoms, while the underlying cause of the problem was the optimisation of sub-processes that were not the systems critical constraint. This is just one example of how the individual pursuit of winning can harm the system as a whole and it is therefore critical that everyone in the organisation understands the overall needs of the system. Often the company vision is an attempt to communicate this overall need and can help align people and processes in such a way that they attempt to focus on winning for the organisation as a whole.

Figure 5-4 indicated that participants felt that they did understand the system needs and what was important for the system to be able to survive and grow. The average rating based on the 5-point Likert scale was 4.20 and only 5% of all participants disagreed with this statement.

6.2.3 Interrelations

Cilliers (1998) maintains that a complex system is not constituted merely by the sum of its parts, but also by the intricate relationships between these components. If we therefore want to be able to better understand how complex systems create value, we can not adopt the analytical method and look at each system component separately. We need to understand how the interactions between individual components of the system influence other parts of the system, feed back on themselves, interact with their environment and react to information received from their immediate neighbours. The third proposition suggested that individuals participating in business simulations are able to understand how the individual parts of a system work together to create value for that system. The results shown in figure 5-6 indicate that 93% of all participants at least agreed to this statement to some extent. The average rating based on the 5-point Likert scale was 4.24, indicating a high level of agreement in response to this question.

If we disregard the relationships between elements in a system, our actions are unlikely to support the overall goals of the system. If we adopt the analytical method and evaluate system performance only by looking at the performance of each system component individually then we will soon realise that system performance does not primarily depend on the performance of the individual elements but rather on the relationship between those elements. Kofman and Senge (1993) maintain that in order to understand the source and solutions to

problems we face in y, linear and mechanistic thinking must give way to non-linear and organic thinking, where the primacy of the whole is acknowledged. This requires us to not operate in silos, but rather focus on the relationships between system components in order to ensure that our efforts are channelled in a common direction, allowing us to create value for the system as a whole.

6.2.4 Differences in the Results

Overall the responses given to the questions that were based on the first three propositions showed high overall levels of agreement, exceeding the 4.0 benchmark set in chapter 4. However as can be seen in figures 5-2, 5-4 and 5-6, there were some differences in the overall rating between the different simulations used. Reasons for differences in the results may be explained by the following factors:

- **Nature of the simulation:** Although the average rating for each one of the three questions exceeded the 4.0 hurdle, not all simulations did equally well. For example, the average rating for the responses to question 1 for the telecommunications simulation (TEL) and the second retail simulation (RT2) only scored an average rating of 3.95 and 3.55 respectively. For question 2 the second retail simulation (RT2) only managed to get an average rating of 3.85. As discussed in chapter 4.3 the different simulated systems were framed

differently meani ·om which we viewed the system differently (i.e. two simulations were total enterprise simulations and two were process based simulations). It is therefore possible that the way in which the simulations were framed in the simulation design had an impact on how the participants responded with respect to the first three questions.

- **Other extraneous variables:** The telecommunications simulation, which was the only simulation used for two different seminars, showed that other variables may have influenced participants' responses with respect to the first three propositions. As shown in figure 5-7 the second telecommunications simulation (TEL2) shows higher average ratings for all three responses than the first telecommunications simulation (TEL1). Furthermore the average rating for TEL1 is below 4.0 on all three counts (Q1: 3.86, Q2: 3.95 and Q3: 3.76) while for TEL2 it can be seen that the average rating exceeds the 4.0 hurdle on all three occasions (Q1: 4.05, Q2: 4.20 and Q3: 4.35). With the simulation tool, the facilitators and the program design being the same for both programs, the differences in these results show that other extraneous variables had an impact on the way in which participants responded to the questions asked.
- **Duration:** As discussed in chapter 4.3, the seminars for which the propositions were tested ranged from 1 day to 3 day programs. The duration of the seminar for the banking simulation was one day, the telecommunication simulation programs were 2 days long and the two retail simulations were both 3 day programs. It is possible that being able to interact with the simulation for longer

periods of time w get a better understanding of the system.

- **Culture of the organisation**: The culture of the organisation for which the different simulation programs are run can differ substantially. For example, some organisations may encourage inquiry while others have a strong culture of following rules and procedures. It is therefore likely that the way in which participants engage with and learn from the simulation can differ substantially due to the different cultures inherent in their organisations.
- **Content:** It was explained in chapter 4 that each of the simulation programs was designed to accomplish certain learning objectives. How strong the focus is on a particular learning objective or how well the balance has been struck between different learning objectives may influence the extent to which participants are able to engage in systems thinking. The extent to which participants need to focus on long-term objectives is also likely to play a role in terms of systems thinking.
- **Facilitators:** It is possible that different program facilitators have a greater or lesser focus on different aspects of the simulation program. While some facilitators may be more focused on ensuring that the program objectives are met, others may be more determined to ensure that participants engage in a process of inquiry and problem solving through experience based learning.

6.3 The Aha-M

By testing the first three propositions we explored whether the simulation tools used were successful in allowing participants to engage in systems thinking. Engaging in systems thinking and exploring elements of systems thinking is however not sufficient for us to determine whether in fact participants may have experienced a shift in mental models. The fourth proposition suggested that as a result of having to manage an entire system within a virtual environment, participants may have experienced a shift in mind.

It is however difficult to find out whether participants think about the organisational system differently post-simulation without asking the question directly. If one were to ask whether in fact participants understand the organisational system differently after participating in the business simulation one may lead them to conclude that fact, even though they may not have necessarily have experienced a profound change in the way they understand the system and their role within it.

In order to get around this dilemma we had to make an assumption. It was assumed that should a participant experience a shift in mental models then this shift would have had a profound impact on his/her way of looking at the world. Senge (2006) argues that when you ask people about being part of a team that strives towards a common goal for the system of which they are part, people talk about something larger than themselves, of being connected, of being generative.

If this is the case an nulations is in fact able to bring about such a shift in mental models then it can be expected that participants will share that moment of epiphany without being asked about systems thinking at all. For that reason the question that aims to determine whether participants experienced a shift in mind is very simple: “did you experience an aha-moment?” Whether or not this aha-moment that participants may have experienced relates to systems thinking becomes evident by asking the question: “If yes, can you briefly explain what this aha-moment was?”

The results to this question have been extraordinary. Of the 106 participants questioned, 79 claim to have experienced some sort of aha-moment during the program. Some of the responses do not support the claims of the research proposition, some comments can not be directly associated with systems thinking and some comments fully support the concept of systems thinking. The different results are discussed in the following sub-sections.

6.3.1 Comments not Supporting the Research Proposition

Of the 79 participants that reported to have experienced an aha-moment only 66 participants provided comments that can be used for further analysis. The reasons are:

- Four participants [illegible]nments on what the aha-moment that they experienced was
- Seven participants provided comments that were not relevant to the research proposition and
- Seven participants did not relate the observations in the simulation back to the real world. These participants commented on improvements in their understanding of the simulation "game", but did not give evidence to suggest that they experienced a fundamental shift in mind that related to the real world or their organisation. These participants seem to have been more concerned with winning in a competitive simulation and their reported moments of "aha" therefore tend to relate to moments were they believed that they had figured out how to best impact the variables in the simulation program that would allow them to get the best results in the competition.

6.3.2 Comments without Evidence of Systems Thinking

For the remaining 66 responses, it is not possible to draw any conclusions related to systems thinking on 33 of the comments as these comments did not address issues that are specific to systems thinking. These comments can be categorised as follows:

- Twenty-four participants cited aha-moments that relate directly to the program objectives. The high response rate relating to this category should be expected

as the primary grams is to improve the understanding of participants in these areas. Learning points for each of these programs vary. Some typical examples are improved understanding of financial statements and financial ratios, improved understanding of the drivers of profitability or improved understanding of asset utilisation. All of these elements are of course also important in a systems thinking environment but they do not necessarily require systems thinking. A good understanding of financial statements and financial ratios does not necessarily make us systems thinkers. To be systems thinkers we need to understand what drives value rather than being able to analyse how value was derived. With other words, we can have an excellent understanding of the drivers of profitability and never the less be oblivious to the underlying causes of value creation. Some typical comments from participants that cited an aha-moment relating directly to the program objectives contained the following type of statements:

- I understand the GP (Gross Profit) matrix better
- I know how to decrease COS (Cost of Selling)
- I understand ROA (Return on Assets)

However, we are also not able to conclude that a shift in mental models did not take place for these participants based on their responses. A possible explanation may be the following: If for example a participant had always struggled to understand financial ratio's and one of the program objectives was to improve participants understanding of financial ratio's, then it is likely that this participant would have expressed his/her improved understanding of

financial ratio's a this does not necessarily mean that the participant did not experience a shift in mind in terms of systems thinking. There are two possible explanations. Either participants did not experience a shift in mental models or participants are not as consciously aware of a shift in mind as was initially assumed to be the case.

- Nine participants stated that the program had a profound impact on them and that they would be able to translate what they learnt during the seminars back at the workplace. It seems evident that these participants did experience a shift in mind, but from their comments it does not become evident whether their learning related to systems thinking or perhaps other learning points. The following extract of comments indicates that we are not able to draw any conclusions from the responses, even though participants may have experienced a shift in mind:
    - I'll be able to implement this at work
    - It enlightened me throughout and
    - I can now turn around my store

6.3.3 Comments with Evidence of Systems Thinking

Comments that indicate a possible mind shift towards systems thinking were cited by 33 individuals. These participants chose to express their moment of epiphany citing a number of different elements that indicate that there has been a significant

impact on how they in. Closer examination of individual comments reveals that participants have experienced some form of change in understanding around the following items:

- Nonlinearity
- Identification of root causes
- Interconnectedness
- Primacy of the whole
- Worse-before-better behaviour
- Shared vision
- Perspective and
- System alignment

All of these items are core to systems thinking. How each one of these elements relates too systems thinking specifically and in how far this realisation may have determined a shift in mind for participants, will be discussed in greater detail in the sub-sections below.

6.3.3.1 Nonlinearity

One of the defining characteristics of complex systems is nonlinearity. As shown in table 2-1, Sterman (2000) describes this characteristic as follows:

Effect is rarely p ens locally in a system (near the operating point) often does not apply in distant regions (other states of the system). Nonlinearity also arises as multiple factors interact in decision making.

When participants were asked about the aha-moment they experienced, six individuals cited examples of non-linearity as part of their eureka moment (see table 5-1, comments: 5, 6, 10, 12, 13 and 19). One of the participants stated that "the simulation makes it possible to assess the ripple effect that different decisions have in the daily business operations." As a result of participating in the business simulation, participants realised in how far small changes in some of the decision parameters can have major impacts on the company's output. This output in turn has an impact on the organisations ability to deliver as promised which in turn has an impact customer satisfaction (Goldratt, 2004).

6.3.3.2 Identifying Root Causes

In chapter 2 it was discussed that double-loop learning (generative learning) was important for an organisation to become a learning organisation. It is common that in our attempt to solve problems we often tend to look for immediate short-term solutions, rather than trying to identify what the underlying causes of the problems are. When this is the case we engage in adaptive learning (single-loop) which is about coping and dealing with problems as they arise. Furthermore, as shown in table 2-1, Sterman (2000) maintains that solutions to problems are often counterintuitive:

> In complex syst me and space while we tend to look for causes near the events we seek to explain. Our attention is drawn to the symptoms of difficulty rather than the underlying causes.

Two participants seem to have realised that they did not manage to solve problems for the system effectively, due to their failure to identify the underlying causes of the problem (see table 5-1, comments: 8 and 20). One participant mentioned that they used the feedback they received to correct their action and to improve the performance of their virtual organisation. However, as they failed to generate the desired results the participant realised that fighting immediate symptoms does not necessarily provide solutions for underlying causes. Another participant mentioned that she was not able to see the direct link between cause and effect on all parts of the system. Some of the decisions her team made would affect a number of other parts of the system. However, it was often not obvious what kind of impact these actions would have down the line and as a result of trying to solve the problem for a particular part of the system, her team caused more harm for the system as a whole.

Because feedback is easily distorted in the real world it is often difficult to get to understand those underlying causes. The virtual world however eliminates a lot of this distortion due to simplified system dynamics, making it easier to identify underlying causes. One participant (see table 5-1, comment 32) claimed that after the first period of play, she was able to use the feedback data to perfect her planning. When she realised that she missed her sales projections never the less, she could go back and identify the root cause of her planning errors.

6.3.3.3 Interconnectedness

Proposition 3 already suggested that participants may have an improved understanding of the importance of the interrelationships operating in a system as a driver of value creation. According Cilliers (1998) a large number of elements is necessary, but not sufficient for a system to be complex. The elements of the system have to interact and this interaction must be dynamic. As was shown in table 2-1, Sterman (2000) maintains that:

> The actors within a system interact strongly with one another and with the natural world. Everything is connected to everything else. Because of the tight couplings among actors, our actions feed back on themselves. Our decisions alter the state of the world, causing changes in nature and triggering others to act, thus giving rise to a new situation which then influences our next decision.

A number of participants gave examples of the importance of the interrelationships between system elements as examples of their aha-moment (see table 5-1, comments: 2, 4, 5, 7, 12, 16, 17, 18, 20, 21, 24, 25, 28, 29, 30, 31 and 33). The examples that participants gave showed that they realised that the relationship between different elements of the system created value for the system rather than the elements themselves. Nonlinearity coupled with the concept of the importance of interrelationships was often an eye-opener for participants as they engaged in systems thinking and were able to drive additional value for the organisation. As participants experimented with different strategies they realised that several

strategies may work icular strategy was often dependent on how the elements within that system interacted. The interrelationships were not only important for internal operations but also critical for the interactions of the system with external parties. Improved understanding of the needs of suppliers and customers and their interaction with the system was frequently mentioned in response to the aha-moment question.

6.3.3.4 The Primacy of the Whole

According to Kofman and Senge (1993), the defining characteristic of a system is that it cannot be understood as a function of its isolated components. Participants needed understand how the entire system, from receiving inputs to delivering an end product to the customer, creates value for the organisation. Several participants spoke of the importance of the whole when expressing their aha-moment (see table 5-1, comments: 1, 5, 13, 20, 21, 23, 30 and 33). They reported an improved understanding of the importance of aligning individual elements to work together to generate value for the entire system. A problem in one part of the system can have a huge impact on other parts of the organisation. This was especially evident in the process flow simulations. Errors in upstream planning could have detrimental effects on downstream performance. Furthermore, employing short-term measures in an attempt to correct mistakes could result in new mistakes as additional inventory put pressure on bottleneck operations.

Participants reported ›d how errors such as poor system alignment impacted the financial statements. High inventory levels, including beginning inventory, work-in-progress inventory and finished goods inventory tie up capital in the organisation that could be put to better use. In the second retail simulation participants needed to markdown finished goods items of which they had too much stock. Participants reported an aha-moment relating to their new understanding of the impact these miscalculations had on their financial results.

6.3.3.5 Worse-Before-Better Behaviour

Organisations cannot be everything to everybody and many of the most important decisions require us to make trade-offs. How we make trade-offs in our decisions is often encouraged through incentives and rewards. Furthermore how we react to problems depends on our ability to see and understand the root causes of problems. As has been discussed in chapter 2, many managers engage in adaptive or single-loop learning which allows them to solve the problems for the short-term. Ideally however, managers should engage in generative or double-loop learning and identify the root cause of a problem and focus on finding a long-term solution to that problem. We can link this back to complexity theory and remind ourselves of the following characteristic as outlined by Sterman (2000) in table 2-1:

> Time delays in feedback channels mean the long-run response of a system to an intervention is often different from its short-run response. High leverage policies

often cause wo low leverage policies often generate transitory improvement before the problem grows worse.

The worse-before-better behaviour that Sterman refers to here can have serious implications on the way organisations are managed. If worse-before-better behaviour results in benefits for the organisation in the long-term, but managers are rewarded based on short-term results, then it is likely that managers are going to focus on generating these transitory improvements, even though they may result in the problem getting worse over the long-term. The problem that this causes is that rewarding managers based on short-term results is also an incentive for managers to engage in adaptive (single-loop) learning, while generative (double-loop) learning is thereby discouraged. Some participants seem to have realised that single-loop learning is not beneficial for the organisation and in order to be able to generate value over the long-term we need to focus on generating value for all stakeholders and not focus only on the bottom line (see table 5-1, comments: 2, 4, 7, 18, 24 and 28). As participants make decisions over multiple periods of play, they realise that it is relatively easy to boost profits over the short-term. However, boosting short-term profits often results in decrease in value for other stakeholders (e.g. customers and employees). The other stakeholders are however fundamental to the organisations long-term success and only if decisions are made to ensure that the organisation is able to generate value for all of its stakeholders is any improvement sustainable.

6.3.3.6 Working T

As argued by Bellinger (2004), a shared vision is about creating a desired future and not about solving problems. In order to get the organisation to where it truly wants to be, the members of an organisation need to share a common vision. According to Larsen *et al* (1996) members of the organisation must enrol in that vision in order to generate what Senge (2006) calls “creative tension”. Creative tension is the difference between the shared vision and the current reality. As members enrol in that shared vision their efforts drive towards bringing the current reality of the entire organisation towards that desired state. Some participants experienced an aha-moment which indicates an improved understanding of the necessity of a shared vision (see comments 20, 21, 25, 27 and 29). This realisation is very powerful as it encourages individuals not to think of their personal interests in the organisation, but rather to see themselves as part of a collective whole. As individuals understand and buy-in to a shared vision they are more likely to pursue interests that benefit the system. As discussed in section 2.3.1, the action strategies that people make use of, are rarely in line with their espoused values. Individuals react defensively if the governing variables of their theories-in-use are under threat. As individuals begin to enrol in a shared vision the governing variables that determine their behaviour move away from an egocentric view towards an interest in achieving goals as a group and they are able to overcome barriers to learning and are better able to cope with change.

6.3.3.7 Perspectiv

Changing our perspective may have a significant impact on the way we relate to and perceive the world. This observation is supported by McNamara (1999) who argues that our perspective forms our mental models, our deeply ingrained assumptions, our generalisations and our pictures and images of how we understand and interact with the world. The responses that tested the first proposition already indicated that a large number of participants agreed to the fact that the simulation allowed them to see their organisation from a different perspective (see chapter 6.2.1). Some of the participants highlighted this again when qualifying their aha-moment (see table 5-1, comments: 3, 9, 14, 17 and 26). Their comments indicate that they were able to see their own roles within the organisation free from some of the boundaries that exist in the real world. Participants had the opportunity to see the impact that their functions had on the organisation as a whole. In a real world setting the view is often limited and we are unable to see the impacts of our actions further down the system or process.

6.3.3.8 System Alignment

As discussed in section 6.2.2 achieving the best possible results for the system as a whole requires that the individual processes of the system are aligned. With other words, it is not helpful to invest heavily in the improvement of one process if there

are dependent proces rtain level of performance. The output of a system is determined by the critical constraint in the system and all other processes should be aligned to the constraint (Goldratt, 2004). Although this concept is most evident in the process flow simulations, participants in all three, the process flow, business acumen and financial performance simulations, reported aha-moments related to system alignment (see table 5-1, comments: 1, 5, 10, 12, 13, 19, 20, 21, 23, 29, 30 and 33). The comments that participants gave indicate that they soon realised that they often spent resources on operations that did not add value to the business nor did the measures they implemented have any significant impact on any of the other stakeholder groups. Participants soon became conscious of the fact that in order to create value, they needed to allocate resources to the functions or processes that needed them the most. By allocating resources to these functions or processes they were able to elevate a system constraint and generate additional value for the organisations stakeholders.

6.4 Conclusion

The analysis of the first three propositions shows that the overall level of agreement towards the new perspective, the system needs and the importance of interrelationships was high. Some participants singled out some of these issues again as they reported on their aha-moment. Based on the responses it seems that

participants feel that t ows them to step outside of their everyday roles and allows them to interact with the system using a systems thinking perspective. However, it seems that other variables, besides the simulation may also impact the way in which participants relate to these elements of systems thinking. It is possible that variables such as the nature of the simulation, the seminar venue, the program duration, the culture of the organisation, the program content and/or the program facilitators may have had some influence on how participants responded to the questions asked.

When asked whether participants had experienced an aha-moment during the simulation, 31% of all participants cited an aha-moment that could be associated with systems thinking. From responses that participants gave, it was possible to identify the following key themes of systems thinking: Non-linear as opposed to linear causation; understanding the root causes of problems; interconnectedness; improved understanding of the primacy of the whole; adaptive versus generative learning; importance of working towards a shared vision; seeing one's purpose from a holistic perspective; and the importance of system alignment. 23% of all participants reported an aha-moment that that had to do with an improved understanding of the organisations performance drivers. However, it was not possible to determine whether these participants experienced a shift in mental models related to systems thinking. 8% of participants reported that they had experienced some sort of shift in mind, but it was not possible to deduce from their comments that this shift in mind was in any way related to systems thinking. 7%

failed to link their exp : to the real world and the insights they reported on relate to the gaming element of the simulation. The remaining 31% either stated that they did not experience an aha-moment, or the reported moment did not relate to the research proposition.

7 CONCLUSION

7.1 Introduction

The research carried out was experimental in nature and attempted to determine whether it may be possible that individuals that participated in business simulation programs may have transformed their mental models from compartmentalised silo thinking to holistic systems thinking. In section 1.3 the following quote by Sterman (2000) summarised the argument for systems thinking: “effective decision making and learning in a world of dynamic complexity requires us to become systems thinkers – to expand the boundaries of our mental models and develop tools to understand how the structure of complex systems creates their behaviour.” The motivation for the research therefore came from wanting to examine whether business simulations may bring about such a mental model shift and possibly allow individuals and organisations to become more effective at learning and decision making.

7.2 Summary of Results

It was proposed that the business simulation tools used would be able to expose the following three elements of systems thinking: seeing the organisation from a

different perspective ing system needs and understanding how the interrelationships that operate within the system create value for that system. To test these propositions participants were given a questionnaire and were asked to express their opinion on a 5-point Likert scale. Based on the high average ratings in all three instances the participants seem to support the claims of all three propositions. This means that the simulation tools provided a space which allowed participants to engage with their organisational system from a holistic perspective and encouraged systems thinking.

Over and above giving participants an opportunity to engage with their organisation from a systems perspective, it was proposed that as a result of seeing the system from this birds-eye-view, participants experience a shift in mental models away from compartmentalised silo thinking towards holistic systems thinking. In an open-ended question in which participants were asked to share whether they experienced any significant moment of insight during the program, approximately a third of all participants stated that their most significant moment of clarity was in some way related to systems thinking. The remaining participants did not express new insights that could be specifically linked to systems thinking. However, it is also not possible to reason that they did not experience such a shift in mental models related to systems thinking. All that can be said is that they failed to express it, regardless of whether it may have occurred or not.

7.3 Recommer

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Based on the results it is possible to draw some interesting conclusions. Some new insights were gained for both the world of business and the world of academics. The following sub-sections give recommendations for both these areas.

7.3.1 Business Related Recommendations

This section focuses primarily on organisations that use business simulations for capability building. These recommendations outline some of the benefits that organisations may be able to look forward to as a result of improved systems thinking. Furthermore, a few recommendations are included in this section for business simulation providers.

7.3.1.1 Business Simulation Users

As argued by Senge (2006), work must become more 'learningful' as the world around us becomes more interconnected and business becomes more complex and dynamic. It is no longer sufficient for organisations to have a 'grand strategist' lead the organisation from the top, but people's commitment and capacity to learn at all levels in the organisation will determine which organisations will truly excel in

future. Business simu provide answers, but rather to promote questioning. Simulations encourage us to seek answers in a world that is so inconceivably complex that it far exceeds our cognitive capabilities to understand it. By keeping our thinking within our immediate area of influence and setting mental boundaries by department or functional area we are unable to understand how our actions influence the behaviour of the system of which we are part. In terms of our thinking we therefore need to free ourselves from these boundaries and have the courage to expand our thinking and explore our own existence not as separate from, but as part of a greater whole. The following quote by Peck (1978) summarises this pursuit of improved understanding appropriately:

> Seek greater understanding, but do not expect greater detail. There are many who by the virtue of their passivity, dependency, fear, and laziness, seek to be shown every inch of the way and have it demonstrated to them that each step will be safe and worth their while. This cannot be done. For the journey of spiritual growth requires courage and initiative and independence of thought and action. While the words of the prophets and the assistance of grace are available, the journey must still be travelled alone. No teacher can carry you there. There are no preset formulas. Rituals are only learning aids, they are not the learning.
>
> *Peck (1978)*

From an organisational perspective, coping with change means that organisations and its members need to be able to adapt to rapidly changing environments and need to engage in continuous learning. However, many organisations face immense barriers that obstruct them in implementing change initiatives and we need to look for ways to overcome these barriers to ensure continued survival. McNamara (2000) maintains that individuals that practice systems thinking are

more effective in solv dership skills, are better at communicating, can plan more effectively and are better able to deal with organisational development and change. A brief outline is given below explaining why an improvement of skills in each one of these areas may be vitally important for organisations.

- More effective problem solving: For effective problem solving in organisations it is critical that individuals are able to identify the underlying causes of those problems. Instead of only focussing on problems and events (adaptive learning) leaders need to focus on fixing the systems and structures that cause the problem in the first place (generative learning).
- More effective leadership: One of the most important responsibilities of a leader is to set the direction of the organisation and to ensure that others follow in that direction. The leader must create a vision for the organisation and ensure that the organisational members share that vision.
- More effective communications: Because individuals often struggle to see beyond their own roles in organisations they are unable to communicate in a way that creates buy-in towards a common vision. Even though they may communicate the appropriate message verbally, they may not be expressing that message through their actions. In chapter 2 we differentiated between peoples' espouses values and their theories-in-use. Only once individuals begin to see their roles in a system as a part of a greater whole will they be able to distance themselves from their model 1 theories-in-use and the governing variables that influence their behaviour (i.e. control the purpose of

the encounter; m uppress negative feelings; be rational). As individuals begin to engage in systems thinking they are able to move away from this egocentric view as described by Argyris's model 1 to a more altruistic and thoughtful view. Their actions will be more closely aligned to their espoused values and what they believe in will be closely mirrored by their behaviour. Only once our actions support the values we advocate is what we communicate believable and only then can we expect others to buy into our vision.

- More effective planning: Only if an individual is able to understand the system and what the systems needs to deliver, can that individual plan effectively. It is important to understand the importance of system alignment and plan according to what the system is able to deliver. If a leader or manager does not understand the constraints of a system, poor planning may affect system health.
- More effective organisational change: Effective organisational development requires a good understanding of what is important to each stakeholder in the system including an excellent overall understanding of the major functions, departments, processes, teams and individual employees. A systems view is critical to be able to see beyond the immediate area of influence and understand how ones decisions impact other parts of the organisation.

7.3.1.2 Business S

Providers of business simulations need to keep in mind that the purpose of a simulation is to create a simplification of reality that is intended to promote understanding (Bellinger, 2004). Whether a model is a good model or not depends on the extent to which it promotes understanding. As shown in chapter 5, for participants to experience an aha-moment they need to be engaged with the simulation in such a way that encourages them to engage in systems thinking. For this to occur they need to be convinced that the model they work with allows for all three of the following: participants need to see the system that they work in from a new perspective, the model must allow them to better understand the overarching needs of the system and it needs to make it evident that value is created through the interrelationships operating in the system. If participants have a feeling that just one of these elements is not well represented in the model it is more likely that they will not experience a moment of significant insight in the simulation program that may be a result of a mental model shift towards systems thinking.

7.3.2 Academic Related Recommendations

According to Scharge (1999), change in information does not result in a change in behaviour. Simply capturing the organisations strategy in a well-articulated summary is not going to move the management ranks forward. Scharge (1999)

argues that adults t selves through their own experience. The combination of a change in information together with simulation and learning through experience is therefore necessary to encourage a change in behaviour. Only once individuals change their behaviour, is the necessary momentum created to move the organisation into the right direction.

As educators we need to encourage learners to use their own reason to solve problems and make sense of the world. Senge (2006) maintains that in its everyday use, the word "learning" has become synonymous with taking in information. Taking in information is however only distantly related to real learning. Real learning requires us to be engaged and experience the impact of our decisions and actions. Simulation is a method that allows for this engagement and the feedback created through the simulation tool combined with change in information changes the way we see and relate to the world. As humans we cannot learn by being passive spectators, we need to engage, experiment and use our own reason to make sense of the world around us. Instead of simply transmitting content, learners need to be encouraged to find their own way, their own enlightenment. Enlightenment does not come as a result of following the direction from another, but rather, as argued by Kant (1784):

> Enlightenment is man's release from his self-incurred tutelage. *Sapere aude!* Have courage to use your own reason! – That is the motto of enlightenment.
>
> *Kant, I (1784)*

7.4 Recommendations for Further Research

The research conducted was experimental in nature and gave evidence that individuals engage in systems thinking as they participate in business simulations. However, from the data collected it is not possible to conclude the extent to which a transformation in mental models takes place and what the impact of such a shift in mental models may have on organisational performance. A closer examination of the following unanswered questions would make for interesting further research:

- To what extent do participants change their mental models as a result of participating in business simulations?
- How can we go about measuring systems thinking?
- Does a shift in mental models towards systems thinking result in changes in behaviour?
- What are the interventions needed to ensure continued growth in terms of systems thinking?
- What is the expected return on investment for improved systems thinking?

7.5 Conclusion

The data collected as part of this research project has shown that business simulations have the ability to encourage systems thinking in individuals and that

as a result of engagi ıer of participants seem to have experienced a shift in mind that in some way was related to systems thinking. However, participants were only involved in simulation seminars over a relatively short period of time and it is therefore difficult to determine in how far their new view of the world will impact their behaviour back at the workplace. However, continued encouragement towards and engagement in systems thinking seems to be beneficial for the organisation. As has been shown here on the basis of only one simulation seminar, it seems that a large portion of participants have already developed a better understanding of their system. The simulation itself is of course only a very simplified model of reality and to develop the understanding of systems thinking, additional opportunities to engage within a simulated world may be helpful to further encourage this type of thinking. Further research needs to be done to determine in how far business simulations may be able to improve the actual skills necessary to adopt a systems thinking approach and to determine the frequency with which participants need to be confronted with the elements of systems thinking in a virtual world.

REFERENCE LIST

Anderson, L. (1997) Espoused theories and theories-in-use: Bridging the gap. *Unpublished Master of Organisational Psychology thesis*, University of Qld.

Anderson, P. H and Lawton, L. (2004) Simulation Exercises and Problem-Based Learning: Is There a Fit? *Developments in Business Simulations and Experiential Exercises.* Vol. 31, p 68-73.

Anderson, P. H and Lawton, L. (2005) The effectiveness of a simulation exercise for integrating problem-based learning in management education. *Developments in Business Simulations and Experiential Learning.* Vol. 32, p 10-18.

Argyris C. and Schön, D. (1978) *Organizational Learning: A Theory of Action Approach.* Reading, MA: Addison-Wesley.

Argyris, C. (1977) Double Loop Learning in Organisations. *Harvard Business Review*, September-October. p 115-124.

Argyris, C. (2002a) Double-Loop Learning, Teaching, and Research. *Academy of Management Learning and Education.* Vol. 1, No. 2, p 206-218.

Argyris, C. (2002b) Teaching Smart People How to Learn. *Reflections*. Vol. 4 Issue 2, p 4-15.

Atkins, P. W. and Johnston, K. (2005) Dialectical thinking and systems thinking: Contributions from adult development. *Australia New Zealand Systems Society*. Vol. 1, p 2-13.

Axelrod, R. (1976) *Structure of Decision: The Cognitive Maps of Political Elites*. Princeton, NJ: Priceton University Press.

Basseches, M. (1984) *Dialectical Thinking and Adult Development*. Norwood, New Jersey: Ablex Publishing Corporation.

Beer, M. and Nohira, N. (2000) Cracking the Code of Change. *Harvard Business Review*, May-June 2000, p 133-141.

Beer, M. and Spector, B. (1993) Organisational Diagnosis: Its Role in Organisational Learning. *Journal of Counseling & Development*. Vol. 71, p 642-650.

Bellinger, G. (2004) Organisational Change - Yet another Thought [online]. Manchester: The First Discipline. Available at http://www.systems-thinking.org/simulation/simnotta.htm (accessed 05/07/2006).

Boeree, C. G. (1998) *Qualitative Methods Workbook.* Shippensburg, PA: Shippensburg University.

Bolt, J. F. (ed.) (2005) *The Future of Executive Development*. USA: Executive Development Associates.

Cheng, P. and Nisbett, R. (1985) Pragmatic reasoning schema, *Cognitive Psychology 17*, p 391-416.

Cilliers, P. (1998) *Complexity and Post-modernism. Understanding Complex Systems.* New York: Routledge.

Clark, L. (1994) *The Essence of Change*. England: Prentice Hall.

Copeland, T., E. (1994) Why Value Value. *The McKinsey Quarterly*. Nr 4, p 97-109.

Côté, M. (2002) A Matter of Trust and Respect. *CA Magazine,* March 2002.

Dick, B. and Dalmau, T. (2000) Argyris and Schön: some elements of their models [online]. Available at http://www.scu.edu.au/schools/gcm/ar/as/argyris2.html (accessed 07/05/06)

Dooley, J. (1999) Problem-Solving as a Double-Loop Learning System [online]. San Francisco: Adaptive Learning Design http://www.well.com/user/dooley/Problem-solving.pdf (accessed 07/05/06).

Doyle, J. and Ford, D. (1998) Mental model concepts for system dynamics research, *System Dynamics Review 14*, p. 3-29.

Gentner, D. and Stevens, A. (1983) *Mental Models*. Hillsdale, NJ: Lawrence Erlbaum Associates.

George, J. M. and Jones, G. R. (1999) *Understanding and Managing Organisational Behaviour.* 2nd ed. USA: Addison-Wesley Publishing Company.

Goldratt, E. M. and Cox, J. (2004) *The Goal: A process of ongoing improvement.* 3rd revised ed. Republic of S.A.: Goldratt Group (S.A.)

Goldratt, E. M., Schragenheim, E. and Ptak, C. A. (2000) *Necessary but Not Sufficient.* Great Barrington, MA: The North River Press.

Goosen, K. R., Jensen, R. and Wells, R. (1999) Purpose and Learning Benefits of Business Simulations: A Design and Development Perspective. *Association for Business Simulations and Experiential Learning.* Vol. 26, p 133-143.

Halford, G. (1993) *Cl* *lopment of Mental Models*. Hillsdale, NJ: Lawrence Erlbaum Associates.

Johnson-Laird, P. (1983) *Mental Models: Toward a Cognitive Science of Language, Inference, and Consciousness*. Cambridge, England: Cambridge University Press.

Kant, I. (1784) An Answer to the Question: What is Enlightenment? *Berlinische Monatschrift 1784.*

Knowles, M. (1996) *Adult Learning. A Guide to Resource Development*. New York: McGraw-Hill.

Knowles, M., Holton III, E. F. and Swanson, R. A. (2005) *The Adult Learner.* 6th ed. San Diego, CA: Elsevier Butterworth-Heinemann

Kofman, F. and Senge, P. (1993) Communities of Commitment: The Heart of the Learning Organisation. *Organisational Dynamics* Vol. 22

Kotter, J. P. (1990) What Leaders Really Do. *Harvard Business Review*. May/June p 103-111.

Kotter, J.P. (1995) Leading Change: Why Transformation Efforts Fail. *Harvard Business Review,* March-April 1995, p 59-67.

Larson, K., McInerney, C., Nyquist, C., Santos, A. and Silsbee, D. (1996) Learning Organisations. *PAD633*, University of Albany

Malholtra, Y. (1996) Organisational Learning and Learning Organisations: An Overview [online]. New York: Brint institute. Available at http://www.kmbook.com/orglrng.htm (accessed 05/07/06).

March, J. G. and Simon, H. A. (1993) *Organizations*. 2nd ed. USA: Blackwell Publishers.

McNamara (2000) Systems Thinking [online]. Minneapolis, Minnesota: Authenticity Consulting. Available at http://www.managementhelp.org/systems/systems.htm #anchor123477 (accesses 07/05/06).

McNamara, C. (1999) Thinking about Organisational Systems [online]. Minneapolis, Minnesota: Authenticity Consulting. Available at http://www.managementhelp.org/org_thry/org_sytm.htm (accessed (07/05/06).

Mintzberg, H. (1987) Crafting Strategy. *Harvard Business Review*, Vol. 65, No. 4, p 70.

Mumford, A. (1988) *Developing Top Managers*. Aldershot, England: Gower Publishing Company.

Peck, M. S. (1978) *The Road Less Travelled*. 1st ed. New York: Simon and Shuster.

Porter, M.E. (1996) What Is Strategy? *Harvard Business Review*, November-December 1996, p 59-79.

Prahalad, C. K. and Hamel, G. (1995) *Competing for the Future.* US/UK: Harvard Business School Press.

Quinn, R.E. (1996) *Deep Change. Discovering the Leader Within*. 1st ed. San Francisco, CA: Jossey-Bass.

Schank, R. and Abe *Goals, and Understanding*. Hillside, NJ: Lawrence Erlbaum Associates.

Scharge, M. (1999) *Serious Play. How the World's Best Companies Simulate to Innovate*. Boston: Harvard Business School Press.

Schein, E.H. (1984) Coming to a New Awareness of Organisational Culture. *Sloan Management Review*, Winter 1984, p 3-16.

Senge, P. M. (2006) *The Fifth Discipline*. London: Random House Business Books.

Simon, H. A. (1997a) *Administrative Behaviour.* 4th ed. New York: The Free Press.

Simon, H. A. (1997b) *Models of Bounded Rationality. Vol 3. Empirically Grounded Economic Reason.* Cambridge, MA: The MIT Press.

Sterman, J. D. (2000) *Business Dynamics. Systems Thinking and Modeling for a Complex World*. USA: McGraw-Hill Higher Education.

Thatchenkery, T., Behara, R. and Kenny, C. (1999) Building Capabilities for Change through Laboratory Simulations. *Association for Business Simulations and Experiential Learning*. Vol. 26, p 144-150.

Vennix, J. (1990) *Mental Models and Computer Models*. PhD thesis. Nijmegen, The Netherlands: Nijmegen Institute for Cognition Research and Information Technology.

Vincent, A. and Shepherd, J. (1998) Experiences in Teaching Middle East Politics via Internet-based Role-Play Simulations. *Journal of Interactive Media in Education,* p 98-109.

Welman, J. C. and K *thodology*, 2nd ed. Oxford: Southern Africa.

Wenzler, I., and Chartier, D. (1999) Why do we bother with Games and Simulations: An Organisational Learning Perspective. *Simulation and Gaming* Vol. 30.

Zalatan and Mayer (1999) Developing a learning Culture. *Association for Business Simulations and Experiential Learning.* Vol. 26, p 45-51.

APPENDIX A: Questionnaire

QUESTIONNAIRE FOR THE
< PROGRAM >

dd/mm/yyyy

PART A: PRELIMINARY INFORMATION

A1. Participant name: _____

A2. Email: _____

A3. Program: _____

PART B: QUESTIONNAIRE

The questionnaire requires you to reflect on the learning experience of the program. Please note that the questions relate only to the insights that you have gained as part of this program. Should the program not have delivered additional insight in regard to the questions, please indicate this in your response.

B1. As a result of the simulation, did you get to view your organisation from a perspective from which you had never viewed your organisation before?

Strongly disagree — To some extent — Strongly agree

1 2 3 4 5

B2. Do you have a better understanding of the things that are important for the entire organisation to survive and grow?

Strongly disagree — To some extent — Strongly agree

1 2 3 4 5

B3. Do you have a better understanding of how the different functions in the organisation work together and create value for the organisation as a whole?

Strongly disagree — To some extent — Strongly agree

1 2 3 4 5

Did you at any UNIVERSITEIT VAN PRETORIA UNIVERSITY OF PRETORIA YUNIBESITHI YA PRETORIA Aha-effect?

Yes ☐

No ☐

If yes, can you briefly explain what this Aha-moment was?

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

* The “Aha-effect” refers to a point in time during the program were you suddenly grasped a particular concept and things that were unclear before started to make sense to you.

This survey is being conducted as part of a research project to assess the impact of business simulations on adult education. All information you provide will be kept strictly confidential. Your name and the name of your company will never be revealed to anyone outside the study team or reported in any publications or reports. If you wish to receive a copy of the report once the analysis is completed, please send an email with your request to michael.schlosser@bts.com. Thank you for your assistance!

APPENDIX B: Program Evaluation

Seminar

Seminar No

< COMPANY NAME >

< PROGRAM NAME >

Surname: _____ Date: _____ / _____ /_____
day / month / year

First Name: _____

WORKSHOP EVALUATION

	Excellent	Very Good	Good	Fair	Poor
Know How Sessions					
Financial Analysis for Decision Making	☐	☐	☐	☐	☐
Achieving Breakthrough Results	☐	☐	☐	☐	☐
The Simulation	☐	☐	☐	☐	☐
Feedback Sessions	☐	☐	☐	☐	☐
The Facilitators					
Performance	☐	☐	☐	☐	☐
Knowledge	☐	☐	☐	☐	☐
Overall, how would you rate the <name> Program	☐	☐	☐	☐	☐

LEARNING POINTS

Having completed the < Program name > presented by BTS, how would you rate the LEVEL OF CHANGE in YOUR understanding of the following concepts:

	To a great extent	To a very good extent	To a good extent	To a fair extent	No Change
Drivers of Profitability	☐	☐	☐	☐	☐
Return on Assets (ROA)	☐	☐	☐	☐	☐
Customer Satisfaction	☐	☐	☐	☐	☐
Employee Satisfaction	☐	☐	☐	☐	☐

Additional Comments :