Exploratory Research into IT's Support of Organisational Agility: Concept Development and Pilot Testing of an Assessment Instrument

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ABSTRACT

This exploratory research is aimed at the development of a conceptual model and assessment instrument to assess the extent to which IT supports organisational agility. The concepts of uncertainty, flexibility and agility are reviewed and a synthesis of concepts is undertaken to form the agility construct to be used in this research, together with proposed dimensions and measurement indicators.

In deciding how to assess IT's support of organizational agility the idea of measuring "fit" or "alignment" is used. We conceptualise an organization as having a "business agility orientation", similar to Venkatraman's (1989) "business strategic orientation", and we measure this "business agility orientation" along the constituent agility dimensions developed in this research. As with Chan (1993), a set of matched "IT agility orientation" dimensions and related indicators is proposed and an "agility alignment" score is calculated by matching, on a one-to-one basis, the indicators of the "business agility orientation" and the "IT agility orientation". The degree of alignment between the organization's business and IT agility orientations is thus indicative of IT's support for organizational agility.

The measurement instruments developed are subjected to pilot testing for reliability and validity. No causal model is posited in this research. High measurement scale reliability was reported although concerns of multicollinearity caution against over reliance of these results. Given the limited focus of this pilot testing and the limited study of only four organisations, encouraging internal validity is found. Crucial to any extension of this research are the use of a shorter set of questions and the extension of validity testing.

Key Words: Agility, Flexibility, Uncertainty, Organisational Agility, Alignment,

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1 Introduction

The business strategy literature is increasingly focused on how organisations can cope with and adapt to the turbulence and discontinuity that characterises today's business environments (e.g. Eisenhardt & Brown, 1998; Courtney, Kirkland & Viguerie, 1997; de Geus, 1997; Chakravarthy, 1997; Muralidharan, 1997; Volberda, 1997; Stacy, 1996; Gould, 1996; Ahmed, Hardaker & Carpenter, 1996; Turner, 1998, 1997). Turner (1997) notes how the traditional theory of strategy and strategic planning (with its emphasis on a linear, rational process) gave way, in the late 1980's, to the idea of strategy as emergent rather than planned. Both these paradigms assume, however, stability (or, at least, incremental change) and the possibility of control; both of which are decreasingly a characteristic of the business environment. Chakravarthy (1997) defines turbulence as the unpredictability of change combined with the speed of change caused by, inter alia, falling barriers to entry, shorter product life cycles and increasing returns to scale. Key, according to Chakravarthy (1997), to operating in such an environment, is speed and flexibility of movement.

The influence of IT ("IT" is used, from hereon forward, in an inclusive sense, incorporating information and communications technologies and systems as well as the management thereof) in creating these turbulent and discontinuous environments is generally acknowledged (see above references; ~~Boar, 1997;~~ Tapscott, 1996). The concern over coping with turbulence and discontinuity and the ability of IT to provide the speed and flexibility of movement needed to adapt to and survive these environments is reflected in the IT strategy literature (e.g. Evans & Wurster, 1997; Ross, Beath & Goodhue, 1996; Rockart, Earl & Ross, 1996; Broadbent & Weill, 1997; Strassmann, 1997; Luftman (Ed.), 1997; Clark, Cavanaugh & Brown, 1997).

Despite the focus on coping with turbulence and the numerous articles and books on how to craft IT strategies for such environments executive management continue to report, in survey after survey, the inability of their organisations to achieve and maintain alignment between the business and IT (Brancheau, Janz & Wetherbe 1996, Niederman, Brancheau & Wetherbe, 1991, Pervan, 1993, Pollard & Hayne, 1996, Galliers, Merali & Spearing, 1994). It is hypothesized that this continuing misalignment and unresponsiveness stems from a lack of rigorous conceptual definition and proposed measurement of how IT supports organisational agility. IT practioners need to be able to go beyond merely theoretical ideas and need to be able to measure the level of alignment of their IT infrastructure, resources and organizations with their organisation's requirements for agility. Only then can they make informed decisions as to where to invest to improve such capability. (The varying concepts of agility, flexibility, responsiveness etc. are discussed in Section 2 below as well as the rationale for settling on the concept of agility as opposed to any of the other concepts).

Given the acknowledged importance of agility to coping with turbulence it is surprising to find so little on the topic of measuring an organisation's level of agility and, in particular, in relation to IT. Wiseman (1988) comments that the advancement of the IT field depends on giving priority to measurement as theory construction and a cumulative tradition, the ultimate objectives of a research field, are inseparable from measurement. To move from anecdotes and case studies to testable models and hypotheses it is critical to link theoretical concepts to empirical indicants. Further DeLone & McLean (1992) have called upon the IT research community to develop validated measures that are closely tied to the effectiveness of IT in organizations. It is toward the end of filling this gap that this exploratory research is aimed; the development of a conceptual model and assessment instrument to assess the extent to which IT supports organisational agility.

2 Literature Review

This section begins with a review of the concepts of uncertainty, flexibility and agility. A synthesis of concepts is then undertaken to form the agility concept to be used in this research, together with proposed dimensions and measurement indicators.

2.1 Uncertainty

As mentioned in the introduction, the business strategy literature is increasingly focused on how organisations can cope with and adapt to the turbulence and discontinuity that characterises today's business environments. To contextualise the concepts of flexibility and agility, a brief introduction to the concepts of uncertainty and risk is in order.

What will become immediately clear is that the literature, both academic and popular, are extremely inconsistent in their definition and use of the terms "uncertainty" and "risk" and this confusion, as will be seen, is reflected in the conceptualisation of flexibility and agility.

Knight (1921) was the first to distinguish between risk and uncertainty: "*Uncertainty must be taken in a sense radically distinct from the familiar notion of Risk, from which it has never been properly separated. ... It will appear that a measurable uncertainty, or "risk" proper ... is so far different from an unmeasurable one that it is not in effect an uncertainty at all*". Knight believed that *a priori* reasoning cannot eliminate indeterminateness from the future. **Risk is "measurable uncertainty"; true uncertainty is not measurable, even with probabilities.**

Strangert (1977, p. 35) re-enforces this notion: "*Uncertainty refers to an unstructured perception of uncertainty and risk to the situation in which alternative outcomes have been specified and probabilities been assigned to them*", as does Barbier & Pearce (1990) who note that risk denotes broadly quantifiable probabilities while uncertainty refers to contexts in which probabilities are not known. Schweppe, Merrial & Burke

(1989) define uncertainties as quantities or events that are beyond the decision maker's foreknowledge or control. It is clear from the above that uncertainty is associated with an inability to predict or structure the possible future (whether using probabilities or not).

Conflicting usage of the two terms abounds however and a few examples will suffice. Often the distinction between uncertainty and risk is not between the ability or otherwise to assign probabilities but between the ability to control (if only partially) the outcome. Bernstein (1998) in his excellent review of the development of the concept of uncertainty and risk states "*When we take a risk we are betting on an outcome that will result from a decision we have made, though we do not know for certain what the outcome will be. The essence of risk management lies in maximizing the areas where we have some control over the outcome while minimizing the areas where we have absolutely no control over the outcome and the linkage between effect and cause is hidden from us*". Ku (1995) notes that uncertainty" *is a generic term used to describe something that is not known (either because it occurs in the future or has an impact that is unknown). It is unknown "at a point in time" and is not necessarily the "unknowable""*. Thus the term "uncertainty" has been used to mean an "unknown" that cannot be solved deterministically or an "unknown" that can only be resolved through time. Choobineh & Behrens (1992) consider uncertainty as the manifestation of unknown consequences of change and risk as the consequence of taking an action in the presence of uncertainty. Paraskevopolous, Karakitsos & Berk (1991) attribute the origins of uncertainties to errors in specification, statistical estimation of relationships, and assumptions of exogenous variables. Uncertainty arises because of incomplete information such as disagreement between information sources, linguistic imprecision, ambiguity, impreciseness, or simply missing information. Such incomplete information may also come from simplifications and approximations that are necessary to make models tractable. Hertz & Thomas (1984) associate risk with the lack of predictability about the problem structure, outcomes, or consequences in decision or planning situation whereas uncertainty implies a lack of predictability about all elements of the problem. Amram & Kulatilaka (2000) define uncertainty as the randomness of the external environment (whereas Peters (1999) correctly states that true randomness implies probability and predictability). A firm's exposure to uncertainty can be changed through investments (that in turn change the sensitivity of the organisation's cashflows and value to uncertainty. For example, real options are strategic investments that transform a firm's exposure to external uncertainty to exposure from the value of the strategic investment). Risk, in turn, defines the adverse economic consequences of a firm's exposure to uncertainty (the traditional definition of loss).

It is suggested that the original definition by Knight (1921) be retained as a reference point when reviewing the concepts in the following sections and is perhaps best summarized by Peters (1999): "*... the relationship between risk and true uncertainty is widely misunderstood. In statistics, risk and uncertainty have become synonymous. In our normal modes of thought, they have become synonymous for us, too. ... The definition of uncertainty says nothing about the chance of loss. It says nothing about risk. It says only that things are doubtful. ... Risk, for instance, can usually be quantified. True uncertainty cannot. ... Often we need uncertainty in order to reduce our risk of loss.*"

Miller & Shamsie (1999) note that "*although there has been a great deal of research into strategic responses to uncertainty, much of the literature and many of the findings are contradictory. On the one hand some scholars claim that strategy becomes more complex and multifaceted to cope with the many contingencies posed by uncertainty; for example, more product variations are offered or a broader range of competitive tactics are used. ... On the other hand, other studies show that uncertainty induces firms to simplify their product lines or to focus on fewer competitive tactics*". Miller & Shamsie (1999) believe that such disagreements over the impact of uncertainty have arisen largely because researchers have failed to distinguish among several different types of uncertainty, each occurring at a different level of analysis, and each having an impact on the perceptions of managers making product variety decisions.

Milliken (1987) has argued that most studies had concentrated on environmental uncertainty, and even those that identified different sources of uncertainty failed to distinguish among three very different types of uncertainty; general external events, cause-effect relationships between an organization and its environment and decision outcomes. Following Milliken (1987), Miller & Shamsie (1999) address three kinds of uncertainty:

- ***Environmental State Uncertainty*** - which confronts all members of an industry and occurs when administrators perceive their environment or one of its components to be unpredictable: for example, it might be difficult to forecast overall demand, competitive behavior, socio-cultural trends, or other general industry characteristics. This may be in part a function of the inherent degree of volatility or change in the industry;
- ***Organisational Effect Uncertainty*** - occurs when it is difficult for managers to understand or predict "*what the impact of environmental events or changes will be on their organization*" (Milliken, 1987: 137). This is often a function of the knowledge, skills, and resources available to a specific firm; and
- ***Decision Response Uncertainty*** – which derives from the ignorance of or risks managers perceive in predicting the consequences of individual decisions. This uncertainty depends on the qualities of the decision maker and decision in question.

Geske (1993) believes there are various methods of coping with uncertainty but that these can be categorised as either:

- ***uncertainty reduction*** - an attempt to minimise surprises; or
- ***uncertainty adaptation*** - an ability to adapt to surprises.

Eppink (1978) offers two ways to respond to uncertainty:

- ***Reducing the relative impact of external changes*** - makes oneself less vulnerable. For example, multi-product firms with highly diversified portfolios; and
- ***Increasing response capacity*** – For example by enhancing logistic flexibility.

Courtney, Kirkland and Viguerie (1997) view uncertainty as a continuum with increasing businesses facing their Level 4-end of the continuum:

- *Level 1* - the future is clear enough to develop a forecast and any residual uncertainty is relatively low;
- *Level 2* - although the future is less clear alternative scenarios can be formulated;
- *Level 3* - well-defined scenarios are not possible but a range of possible futures is; and
- *Level 4* - true ambiguity exists as causal relationships are non-linear and have multiple causes and end-states are sensitive initial conditions.

To cope with these levels of uncertainty, Courtney et. al. (1997) identify three strategic postures for a business:

- *Shaping the future* - the ability to re-write the rules of the game;
- *Adapting to the future* - speed and flexibility as key to responding to any of a number of possible market circumstances; and
- *Reserving the right to play* - taking an option on a particular strategy so that, should it arise, the organisation can continue playing.

In summary, we consider uncertainty as future events that are truly unpredictable and unmeasurable. Risk, on the other hand, is measurable, most often using probability and represents loss. Organizations face uncertainty from varying sources, including uncertainty about their environment and its components, uncertainty about how environmental events will impact their organization and uncertainty about the consequences of specific decisions in the face of uncertainty. Lastly, three generic strategies for coping with uncertainty are suggested for organizations:

- ***Uncertainty avoidance*** - reduce or mitigate the organisation's exposure to sources and types of uncertainties;
- ***Uncertainty absorption*** – acquire the capability to respond/adapt to unforeseen circumstances (this includes the notion of taking options out on possible futures); and

- ***Uncertainty shaping*** – influencing the dominant logic and dynamics of the environment so as to eliminate or reduce uncertainties (although note that this is, by Knight (1921)'s definition of uncertainty, a contradiction in terms).

2.2 Flexibility

2.2.1 Defining Flexibility

Golden & Powell (2000) note that the concept of **flexibility is not amenable to a simple definition as it is both multidimensional and polymorphous**. Likewise Narain, Yadav, Sarkis & Cordeiro (2000) state that there is confusion among the numerous definitions of flexibility and it is arguable that, even now, the concept is not well understood. Shewchuk (1999) notes that a large amount of research has been performed towards this end, for example, Sethi & Sethi (1990) report that at least fifty terms for the various types of flexibilities can be found in the literature.

Swamidass (1988), notes that among the persistent problems hindering the understanding of flexibility (albeit manufacturing flexibility) are:

- the scope of flexibility-related terms used by various authors overlaps considerably;
- some flexibility terms are aggregates of other flexibility terms used; and
- identical terms used by more than one writer do not necessarily mean the same thing.

In summarising her literature review of the use of the term "flexibility", Ku (1995) notes that:

- Flexibility, along with other closely related words, is widely used across different areas;
- Research on flexibility is fragmented across many disciplines, which together point to the versatility of its use and also a lack of consensus; and
- Identical terms used in different studies do not necessarily have the same meaning and the interpretations of flexibility are often confusing. For example, Mandelbaum (1978) considers diversity a source of flexibility, i.e. a way to achieve or increase flexibility. On the other hand, DeGroote (1994) says that flexibility is a hedge against diversity. Stirling (1994) says flexibility is a form of diversity.

The overwhelming majority of articles dealing with flexibility are from the flexible manufacturing literature. Only one article was found that attempted to understand flexibility in a non-manufacturing context (Harvey, Lefebvre & Lefebvre, 1997). Despite the apparent definitional confusion and the focus on manufacturing, an attempt is made in this section to distill the key elements within the concept of flexibility.

According to the Oxford English Dictionary (Simpson & Weiner, 1989: p 1049), flexibility is defined as: "*1) the capability of being bent; pliancy; 2) the quality of yielding to pressure; 3) susceptibility of modification or alteration; 4) capacity for ready adaptation to various purposes or conditions; 5) freedom from stiffness or rigidity; 6) capacity for free, rapid, and varied execution or delivery*".

Evans (1982) undertakes an analysis of the concept of flexibility by assessing the semantics of related words:

- ***adaptability*** - the ability to respond to foreseen changes. This contrasts with flexibility which is the ability to respond to <u>unforeseen</u> changes. Adaptability is thus a necessary but not sufficient condition for flexibility;
- ***elasticity*** - the ability to return to a normal state;
- ***liquidity*** - the ease of conversion or transition from one time period to some desired position in the next period;
- ***plasticity*** - the ability to maintain a state;
- ***robustness*** - the ability to endure <u>anticipated</u> contingencies successfully;
- ***resilience*** - the ability to absorb or accommodate <u>unforeseen</u> discontinuities or shocks; and
- ***versatility*** - a hedge against changes of state.

Evans (1982) thus defines flexibility as:

- the ability to bend or change (as in physical malleability);
- yielding to pressure or change triggered by a shift in environmental conditions;

- the susceptibility of modification or the ability to effect alterations, such as the liquidity of an investment, a business, or a technological portfolio; and
- the capacity for ready adaptation to new situations

and defines **strategic flexibility** as the **capability that aids repositioning when conditions change.** Later, Evans (1991) uses the polymorphous nature of flexibility to develop a framework for strategic flexibility. Carlsson (1989) surveys the economic literature and concludes that flexibility gives a firm the **ability to deal with all forms of turbulence or uncertainty in the environment**.

Slack (1983), commenting on work by Wild (1980) and the notion that production (operations) objectives ``*fall into two groups; those related to customer service and those related to resource productivity*", concludes further that ``*flexibility is the same class of objective as reliability, it is both a condition to be applied to other objectives and an inherent characteristic of the system itself*". Easton & Rothschild (1988) adopt a complementary position: ``*flexibility, unlike most other organisational variables, is a second order dimension. It concerns changes in state rather than the states themselves*". Correa (1994), reflecting a more modern view, considers flexibility to have now become an important first order competitive criterion. Flexibility is no longer regarded as just a facilitator of traditional order winning criteria, e.g. delivery time, reliability, cost, quality, but an important order winner in its own right.

Verter & Dincer (1992) define flexibility as the **ability of a system to cope with changes effectively**. Holling (1973) equates the resilience of ecological systems with a kind of flexibility maintained for survival in a range of conditions.

Upton[1994] proposes a flexibility as "*...the ability to change or react with little penalties in time, effort, cost or performance*". He proposes a three-level generic framework to capture the various types of flexibility that companies may require:

- the dimensions of flexibility (what has to change: products, capacity, delivery?);
- the time horizons involved (are changes required minute by minute? From day to day? Every season?); and

- the specific element of flexibility that is most important to the company.

Three such generic elements are proposed:

- increasing the current possible range of values;
- increasing mobility over the range; and
- increasing uniformity over the range.

Upton (1994) defines **external flexibility** as capabilities possessed by the company and used to accommodate ``*sources of variability to which the firm must respond*" and which are ``*seen as flexible by the market*", and **internal flexibility** as ``*the operations strategy and set of capabilities a firm nurtures to respond to its environment*".

Slack (1983) defines flexibility as how far (**range**) and how easily (**ease**) one can change what one wants to achieve. According to Upton (1994) and Slack (1989), flexibility can be defined as having **three basic dimensions**:

- the range of states a system can adopt;
- the cost and time (ease) of moving from one state to another; and
- the uniformity of some performance measure over a range.

The time and cost elements of flexibility can be considered ``trade-off" measures, because the time to change from one state to another may be shortened at extra cost, and conversely, the cost of change may be reduced by extending the time given for the change.

Mandelbaum (1978) defines flexibility as ``*the ability to respond effectively to changing circumstances*", and characterizes flexibility into **action flexibility**, which is defined as ``*the capacity for taking new action to meet new circumstances*" and **state flexibility** which is defined as ``*the capacity to continue functioning effectively despite changes in the environment*". Thus action flexibility is the ability to respond to change by taking appropriate action and state flexibility is the innate capacity to function well in more than one state.

Eppink (1978) defines ***active flexibility*** as the response capacity of an organisation and ***passive flexibility*** as the possibility to limit the relative impact of environmental changes.

Gupta and Buzacott (1988) refer to ***sensitivity*** as the degree of change that can be tolerated before performance deteriorates. The higher the sensitivity the less tolerable changes are to a system. This is equated with active flexibility. They also refer to ***stability*** as the maximum size of disturbance that a system can tolerate and still achieve performance targets, albeit through corrective action. This is equated with passive flexibility. Thus sensitivity and stability together include the degree of change, the variety of change, and the magnitude of change that the system can respond to. In general, reduced sensitivity and greater stability imply increased flexibility.

Summarising these three authors, there are essentially two types of flexibility:

- ***Active (or action) flexibility*** - the ability to respond by reacting and/or changing. This is reactive as new information becomes available; and
- ***Passive (or state) flexibility*** - an immunity or insensitivity to or tolerance of change and therefore no need to react to change. The term 'state' reflects the ability of a system to operate successfully under a number of scenarios. It is proactive and an organisation's or system's ability to cope is independent of future choices as the ability has been built in already.

Frazelle (1986) prefers to categorise flexibility in terms of its long and short term strategic effects. He defines **long term flexibility** as the ``*reduced effort required to reconfigure for new production tasks and business strategies because of changes in the production program and business plan and changes in the quantitative and qualitative capacity requirements of the business*" and **short term flexibility** as the ``*reduced effort necessary to reset between known production tasks within the scope of an existing production program or business plan*".

An alternative categorisation of flexibility is given by Carlsson (1989):

- ***type I flexibility*** - deals with "foreseeable events" and can therefore be built into processes (internal flexibility); and
- ***type II flexibility*** - the ability to respond to *``uninsurable changes in the market"* and *``unprogrammable advances in technology"* (external flexibility). This is built into organisations and covers the risk-taking attitudes of its people, their expectations of change and their interactions in the long term.

Golden & Powell (2000) define flexibility as the **capacity to adapt**. They use the term capacity as opposed to capability as they believe the former better captures the multidimensional nature of flexibility. They assert that the ability to change can exist in four areas (that is, there are four dimensions in which flexibility can be sought. They view these dimensions as "flexibility thrusts" but which, unlike Wiseman's (1985) "strategic thrusts" are not mutually exclusive):

- **Time/Temporal –** *"the length of time that it takes an organisation to respond to environmental changes (short term, medium term, long term)".*
  Epplink (1978) suggests a typology of environmental change – strategic, competitive, operational - which can be mapped to three types of flexibility namely, strategic, competitive and operational. Gustavsson (1984) divides flexibility, on a time basis, into three categories, strategic (long-term), tactical (medium-term) and operational (short-term). Upton (1994) proposes three degrees of temporal flexibility, operational (ability to change day-to-day or within in a day as a matter of course), tactical (ability to occasionally change or adapt, say every quarter and to make changes that will demand some effort and commitment) and strategic (ability to make one-way, long-term changes which involve significant change, commitment or capital and which occur infrequently, say every few years or so);

- **Foreseen and unforeseen changes –** *the range and the number of options that an organisation has available to react, that is, "the degree to which an organisation can adapt to foreseeable and unforeseeable changes"* and *"the range of options available in responding to environmental change"*.

Epplink (1978) says flexibility is a strategic response to the unforeseen. Krijnen's (1979) definition incorporates foreseen and unforeseen environmental changes. There is thus an element of planning for the foreseeable events and adapting to unforeseen events. Carlsson (1989) argues for Type I flexibility (related to the concept of risk and involves planning for foreseeable events) and Type II (relates to uncertainty and involves rapidly responding to uninsurable (unforeseen) changes in the market). Golden & Powell (2000) use foreseen and unforeseen to represent the two ends of the continuum from events which have been planned for to the events that were not planned for;

- **Intention/ Extent to which obtained offensively or defensively** – *whether the organisation is being proactive (offensive) or reactive (defensive) in its stance toward flexibility.*
  Those who take an offensive stance attempt to control change in the environment to gain competitive advantage. Defensive organisations react and try to minimise the impacts. This is also described as being active or passive; and

- **Focus/ Degree to which internal or external to the organisation** – *whether the flexibility is gained internally to the organisation or by managing external relationships with trading partners, that is, the area in which the flexibility is created*".
  Ansoff (1968) suggests internal and external strategic flexibility. Das & Elango (1995) provide list of areas where both these dimensions can be obtained – e.g. for internal: manufacturing, employee flexibility, organisational structure; for external: suppliers, alliances, multinational operations.

2.2.2 Flexibility as a Response to Uncertainty

Narain, Yadav, Sarkis & Cordeiro (2000) note that flexibility is closely linked to environmental uncertainty. Beach, Muhlemann, Price, Paterson & Sharp (2000) note that the use of flexibility for the purpose of accommodating uncertainty is a notion which has received broad recognition, but the types of uncertainty a system can be expected to address appears to be dependent on the operational level from which it is viewed.

At the overall organization level, Evans (1991) has flexibility composed of a number of ``senses" including adaptability, agility, corrigibility, elasticity, hedging, liquidity, malleability, plasticity, resilience, robustness, and versatility. He argues that each of these organisational flexibilities would be in response to some form of external environmental uncertainties or pressures. Frazelle (1986) claims that flexibility is required in order to maintain competitiveness in a changing business environment (and cites issues such as a rapidly decreasing product half-life, the influx of competitors, an increasing demand for product changes and the introduction of new products, materials and processes). Slack (1983) suggests that the incentives to seek flexibility are founded in the instability and unpredictability of the manufacturers' operational environment, developments in production technology and the widening aims of production to progress beyond cost and productivity issues to manufacturing system flexibility.

Eppink (1978), in discussing planning, notes that the more uncertain the situation the more an organisation will need flexibility as a complement to planning. Flexibility is therefore a characteristic of an organisation that will make it less vulnerable to unforeseen strategic change. Gertler (1988) discusses strategies for inter-firm competition and mentions flexible specialisation and integration as two such strategies. This refers to a firm's ability to respond to fluctuations in market demand and to adopt new products quickly. DeGroote (1994) investigates the relationship between flexibility and diversity, which encapsulates notions of variety, complexity and variability. Amongst the relationships he shows is that an increase in environmental diversity makes the selection of a more flexible technology desirable. Conversely, the more flexible a technology the more desirable it is to operate in a more diverse environment.

Marschak & Nelson (1962: p. 52) state that "*the value of flexibility is a function of variation in price and how well that variation can be predicted before the decision is* *made*". Based on this relationship they show that the greater the uncertainty the greater the value of flexibility. Merkhofer (1975) confirms the complementarity of uncertainty, flexibility, and learning. Learning is the acquisition of additional information or reduction of uncertainty; flexibility provides the ability to take advantage of learning.

Within the manufacturing context, Gerwin (1987) attempts to associate types of uncertainty with types of flexibility:

Table 2.1 Flexibility types

Association of flexibility types and uncertainty, Gerwin (1987)

Flexibility type	Uncertainty
Mix	*Uncertainty as to which products will be accepted by customers created a need for mix flexibility*
Changeover	*Uncertainty as to the length of product life cycles leads to changeover flexibility*
Modification	*Uncertainty as to which particular attributes customers want . . . leads to modification flexibility*
Rerouting	*Uncertainty with respect to machine downtime makes for rerouting flexibility*
Volume	*Uncertainty with regard to the amount of customer demand for the products offered leads to volume flexibility*
Material	*Uncertainty as to whether the material inputs to a manufacturing process meet standards gives rise to the need for material flexibility*
Sequence	*Sequence flexibility . . . arises from the need to deal with uncertain delivery times of raw materials*

Correa (1994) suggests that environmental uncertainty and variability in outputs are the two main reasons that manufacturing flexibility is sought. These two factors, in whatever form they may materialise, can be translated into types of operational change which can be further categorised according to whether the need for change is planned or unplanned. **Unplanned changes**, either originating internally or externally, are referred to as stimuli, i.e. the cause of the requirement for flexibility. The sources of stimuli, Correa (1994) suggests, can be categorised as either process, labour, suppliers, customers, society, corporate and other functions and competitors. Unplanned change has five main dimensions: size, novelty, frequency, certainty and rate. In response, management attempt to impose forms of control and as a consequence flexibility is required to handle those elements that remain.

Mandelbaum (1978) argues that flexibility is a preferred approach to modeling uncertainty than the optimality models when the decision maker does not have full confidence in the models being used. This is of particular relevance to the use of option-pricing models in real options. These models are often complex and their parameters difficult to understand and estimate. Decision-maker confidence must, as a consequence, suffer. However, in line with option thinking, flexibility captures the idea of leaving as many options open as possible and is in contrast to robustness where commitments are made now. Thus flexibility enables the delaying of commitment to a particular course of action (with related costs) and is like a call option. Viewed as such, the higher the degree of uncertainty the more valuable the flexibility.

Eppink (1978) offers two ways to respond to uncertainty, equivalent to two ways to increase flexibility:

- ***Reducing the relative impact of external changes*** - making oneself less vulnerable. For example, multi-product firms with highly diversified portfolios exhibit high external flexibility or robustness; and
- ***Increasing response capacity*** - by enhancing logistic flexibility or action flexibility. This is exemplified by early warning systems, e.g. the provision of information, multi-purpose equipment, and smaller units.

Mascarenhas (1981) describes two ways an organisation can achieve the high flexibility required for unstable environments:

- ***increase its options***; and
- ***control its environment*** (that is make it more stable).

To operationalise flexibility, Ku (1995) proposes that there are two approaches;

- ***options*** - which provide flexibility, exhibit characteristics of flexibility or lead to more options in the future. This covers, for example, short lead times, modular and small unit technologies that promote flexibility by faster responsiveness, incremental additions, and limited commitment; and
- ***strategies*** - which preserve, introduce or increase flexibility as courses of action. Strategies for increasing flexibility include selecting a portfolio that contains flexible elements. Hart (1937), for example, suggests several ways to preserve flexibility: holding inventory to avoid uncertainty, deferring decisions until more

information arrives, offsetting uncertainties through a diversified portfolio and eliminating uncertainty by purchasing futures contracts and insurance.

Gerwin (1993) suggests that the use of flexibility can be represented by **four generic strategies**:

- ***adaptation*** - e.g. the defensive or reactive use of flexibility to accommodate unknown types of uncertainty;
- ***redefinition*** - e.g. the proactive use of flexibility to raise customer expectations, increase uncertainty for its rivals and gain competitive edge;
- ***banking*** - e.g. the defensive use of flexibility to accommodate known types of uncertainty such as surges in demand or alternatively the proactive use of surplus flexibility to redefine competitive conditions; and
- ***reduction*** - e.g. the use of long term contracts with customers and suppliers, preventive maintenance and total quality control programmes and designing for manufacture to limit the need for flexibility.

Mandelbaum (1978) suggests six different ways to provide or increase flexibility (also suggested and confirmed by others such as Eppink (1978) and Gustavsson (1984)):

- ***Staging*** – by limiting the irreversibility of changes through dividing a decision into a sequence of decisions thus limiting the responsibility or commitment of each act. Limited commitment keeps options open and retains flexibility;
- ***Partitioning*** - the action space, resources, or opportunities as time proceeds not only enlarges the choice set but also allows more elements (members of the choice set) to move freely. By dividing what seems like one capacity size decision into several decision variables, we have more control over each unit. Partitioning also gives the ability to decide sequentially. Traditionally, standardisation improves economy while modularity increases flexibility by the allowance of different combinations of sizes and types of technology as well as incremental additions;
- ***Postponement*** - of action gives time and opportunity to obtain more information, for uncertainties to be resolved and new options to open up and be developed simultaneously. This delay is not usually free, neither is the additional information

free, hence the value of this information must be worth the delay. Suing temporary arrangements, paying a premium for the option to delay and , building reserves are all examples of postponement;

- ***Searching*** - for additional actions is a way to enlarge the choice set. One definition of flexibility is the number and variety of choices available. Option-generating techniques assist in the search for more solutions to a problem. This is based on the rationale that the more choices available, the more and different types of futures (uncertainties) can be met;
- ***Reducing the resistance to change*** - makes it easier and cheaper to change. This is accomplished by removing or relaxing constraints (thereby enlarging the choice set) as well as lowering the cost of change. Together with the fourth source, this strategy enables decisions to be made more frequently while increasing the number and quality of options available at each point. Examples include reducing lead times, cost of changing, and other barriers to change; and
- ***Diversification*** - encompasses the notions of variety and tolerance which increase the bearing capacity of a system.

Because flexibility is not a free good (Stigler, 1939) there is no point being flexible if it is not needed or desired. Uncertainty must therefore be important or costly enough before flexibility is worth considering. This implies that measuring flexibility is necessary if one wants to come to a decision as to whether or not the costs of flexibility are worth the benefits. Flexibility may even have a downside. For example, is there an optimal level of flexibility, beyond which more flexibility is not useful? Further, there are diminishing returns i.e. the marginal benefit of an additional option decreases as the number of choices increases.

Mandelbaum (1978) suggests the circumstances where flexibility is not useful:

- A well modeled and solved problem;
- The decision maker has enough faith in the model to implement results with little or no allowance for unexpected changes;
- Learning is not expected (the value of flexibility depends on finding out more about what we do not already know);

- Delays are not possible or have a detrimental or negative impact;
- Complex situations with multiple interested parties;
- changes are not desirable because lengthy debates are necessary; and
- There is no uncertainty.

2.2.3 Measuring Flexibility

Narain, Yadav, Sarkis & Cordeiro (2000) note that while several attempts have been made to measure flexibility, no universally acceptable measurement system exists for measuring the various flexibility types. This is because some of the methods lack rigorous justification, while others have a firmer theoretical basis but are more difficult to apply and are limited in scope. Beach, Muhlemann, Price, Paterson & Sharp (2000) note the absence of agreement on the purpose of measuring flexibility (e.g. to compare the effectiveness of alternative types of technology, to measure the operational performance of a facility, or to assess the feasibility of developing particular business strategies) is, perhaps, the absence of any agreement on the constituent types of flexibility.

Shewchuk (1999) contends that several problems are encountered when attempting to utilize predefined flexibility types and measures in practice:

- the difficulty of defining flexibility has resulted in definitions which are incomplete and/or ambiguous, measures which do not entirely match the corresponding definitions, and identical terms which are defined and/or measured differently (Shewchuk & Moodie 1997). Consequently, it may be difficult in many instances to identify a suitable flexibility type or measure for a given application;
- because every manufacturing enterprise, environment, and business strategy is unique in some manner, there is no guarantee that the assumptions upon which a given flexibility type or measure is based will be valid for a particular application; and
- as prior research has demonstrated, different individuals often have different views on how to define and measure flexibility. Even if the underlying

assumptions are valid, the way in which a flexibility type or measure is defined may be unsuitable.

The above problems result largely from developing flexibility types and measures *a priori* to having knowledge of the particular application of interest. Shewchuk (1999) suggests that one approach to tackling these problems is to have practitioners develop flexibility types and measures *in situ*, i.e. once this knowledge has been obtained. In this way, they can be sure that the flexibility types and measures are both valid and reflect their view of flexibility. This approach can be implemented by supplying practitioners with a set of generic flexibility types and measures, and sufficient instruction, such that they can derive particular types and measures for their applications as required.

Narain, Yadav, Sarkis & Cordeiro (2000) and Slack (1983) believe the following factors contribute to difficulties in measuring flexibilities:

- flexibility is a measure of the potential rather than performance;
- flexibility has multiple dimensions;
- we lack a coherent, detailed classification of flexibility;
- the domain of flexibility is difficult to determine a priori;
- flexibility has to be user- or situation-specific, making it hard to develop any universal measures; and
- flexibility has three dimensions - range, cost, and time.

Gupta and Goyal (1989) attribute the apparent diversity to the ``*wide array of dimensions, which constitute modern, advanced manufacturing systems*". Later Gupta (1993) and Gupta and Buzacott (1996) speculates that the cause of ``*so many different measurement schemes*" and ``*lack of universal acceptance of any one scheme*" is the fact that any measurement of flexibility must, because of its nature, be user or situation specific. Gupta and Goyal (1989) classified the literature on flexibility measurement into six groups:

- measures based on economic consequence;
- measures based on performance criteria;

- multidimensional approach;
- Petri-nets approach;
- the information-theoretic approach; and
- the decision-theoretic approach

Narain, Yadav, Sarkis & Cordeiro (2000) provide representative examples of measures in each of these categories.

Ku (1995) categorised measures as:

- ***indicators*** – these were found to be mostly partial measures. While not all indicators are necessary, an indicator alone is insufficient to capture the multi-faceted meaning of flexibility;
- ***expected value*** – the decision analysis concept. Three types of measure were found; and
- ***entropy*** – the scientific concept. Two types of measures were found.

Golden & Powell (2000) propose four measures (metrics) of flexibility for the temporal and range dimensions:

Temporal:

- **Efficiency** – "*the degree to which an organisation meets the challenge within the time constraints imposed*"; "*the capacity to react in an efficient manner*".

- **Responsiveness** – "*the time it takes to adapt to new circumstances*"; "*the ability to respond to change within an appropriate time frame*"; "*Evaluated in relation to the time it takes to adapt to new circumstances*"; "*Responsiveness measures speed*";

Range:

- **Versatility** – "capability of the organisation to respond to situations which it has foreseen"; "*measures the extent to which an organisation has planned for, and can respond to, environmental change. Moreover, it is a measure of the range of* *activities that the organisation has contingently planned for*"; Plans are formulated on foreseen changes. "*measures the ability of an organisation to have flexibility within a specific range of possible future options which the organisation has allowed for, or planned for, to accommodate foreseen future changes*"; "*Versatility measures the flexibility the organisation possesses to react to changes in the environment which it could envisage happening*". "*The range is determined by the planning capabilities of the organisation*";

- **Robustness** – "*the ability to respond successfully to unforeseen environmental change*".

Ku (1995), rather than establishing a single definition of flexibility, uses the multi-faceted meaning of flexibility to distil the essential elements of any definition of flexibility. She notes the following:

- Eppink (1978) identifies three dimensions of flexibility (***types, aspects, and components***) that are not independent of each other;
- Slack (1988) gives range and response dimensions for each type of flexibility he defines. ***Range*** refers to the ability to adopt different states, while ***Response*** refers to the ability to move between states. In an earlier paper, Slack (1983) gives the dimensions of range and ease, where ***Ease*** is the cost and time to make the change. Cost and time are frictional elements to do with the difficulty of changing;
- Gerwin (1993) stipulates three necessary elements in defining flexibility: range, time, and discretion. Ku (1995) interprets these as follows:
  - ***Discretion*** refers to the ability and potential (and willingness) to change or fill a gap;
  - ***Range*** refers to the number and diversity of choices available; and
  - ***Time*** refers to responsiveness, lead time, and time to change.
- In addition to range and time, Schneeweiss & Kühn (1990) add five more elements to flexibility:
  - goal,
  - objective (relates to condition),

- stochastic and not deterministic (uncertainty),
- evaluation of elasticity and
- the possibility to plan for it. They assert that elasticity is a partial aspect of flexibility.

Ku (1995) notes further that the above elements of flexibility are closely related to Kogut & Kulatilaka's (1994) three conditions under which options are valuable: uncertainty, time dependence, and discretion (the ability to exercise and change.) Decisions depend on time and the value of flexibility comes from investing in the capability to respond favorably to uncertain future events.

Mandelbaum's (1978) survey of about twenty definitions of flexibility found them to be consistent with the discussion above, namely, that flexibility reflects the potential or capability to respond to change. This reflects:

- a general capacity to deal effectively with the widest range of possibilities;
- an ability to perform well both in the old state before a change and in the new state after the change;
- an ability to switch from the first period position to a second period position at low cost; and
- a system's ability to perform different jobs that may occur or to perform one job under different environmental conditions.

Consequently, Ku (1995) thus believes the necessary elements of flexibility to be:

- ***Potential or Capability to Change*** – Flexibility conveys a change. It includes the transition between two states, choosing between alternatives, barriers to change, and switching cost;
- ***Range*** - There is more than one way to change. It includes the size of choice set, number of alternatives, the extent to which demand can be met and levels of change;
- ***Time*** - Flexibility is about rapid and not gradual change. It includes responsiveness, lead time, and time to change;

- ***Uncertainty conditions*** – Uncertainty must exist and there must be alternatives or strategies available for flexibility; and
- ***Favourability*** – A means of distinguishing between choices. According to Ku (1995), favourability is that aspect of flexibility which relates to value optimisation. The ability to change, number of choices and responsiveness may conflict with favourability.

Whereas types of flexibility are context-dependent, elements of flexibility are context-free. Types or kinds of flexibility relate to the conditions under which it is useful and Ku (1995) proposes an uncertainty-flexibility mapping to identify types of flexibility. For example, volume flexibility addresses demand uncertainty.

Ku's (1995) considers the definitional elements of flexibility and proposes the following indicators of flexibility:

- ***Number of Choices*** - central to the concept of flexibility is the capability to change, reflecting a potential or a provision for change that is available in the future. Therefore any measure of flexibility should reflect the potential, but not necessarily the realisation.

  Jones & Ostroy (1984) observe that flexibility is a property of an initial period position and refers to the cost or possibility of moving to various second period positions. This can be viewed as a sequence of decisions in a minimum of two stages where the first stage is the initial position providing the flexibility which can be realised in the second stage. Thus flexibility is associated with the initial state but measured by the number of states it can move to or the number of choices available in the second stage. The amount of flexibility is relative.

  Mandelbaum & Buzacott (1990) define flexibility as the number of options open at the second period. Mandelbaum (1978), Merkhofer (1975), and Rosenhead (1980) support this definition of flexibility of the size of a choice set associated with alternative courses of action. Size of choice set is one of the measures proposed by Marschak & Nelson (1962) who admit however that it is insufficient by itself and subject to the partitioning fallacy. Evans (1982) accuses Marschak & Nelson (1962) of confusing the property of flexibility with its measure and that the size of choice set is only one aspect of flexibility. Some differentiation of desirability, quality, and diversity among the choices is therefore necessary to avoid triviality (e.g. choices that are feasible but unlikely to be chosen).

- ***Disablers versus enablers*** - According to Upton (1994, p. 77) flexibility is "*the ability to change or adapt with little penalty in time, cost, and effort of performance.*" Reflecting the difficulties in changing and the barriers to change, these penalties are what Slack (1983) calls "frictional elements." Reducing the lead time or response time makes it faster to change. Reducing the switching cost makes it cheaper to change. Mandelbaum defines switching cost as the average sum of gains and losses in the transition, which is only incurred if the change occurs. Removing barriers makes it easier to change. Ku (1995) calls these indicators ***disablers***. The disablers indicate the availability of an option by minimal cost, minimal time and other reduction of barriers. The disabler includes the switching cost when flexibility is realised.

  There is a difference between the cost of providing the flexibility and the cost of changing. The ***enabler*** reflects the cost of providing flexibility, i.e. it guarantees future flexibility and reflects the premium on flexibility. It is the cost associated with the first decision. The flexibility associated with any investment or initial position is largely valued by the initial sunk cost.

- ***Motivators*** - Ku (1995) posits that the favourability inherent in flexibility can be represented by positive values or elements that are desirable and calls these elements motivators. These are the benefits or payoffs associated with the choices available.

  Mandelbaum (1978) suggests that flexibility can be measured by the effectiveness and likelihood of change. He does not decompose these elements further nor apply them. From Ku (1995)'s perspective, effectiveness refers to the number of favourable choices, i.e. choices that do actually lead to favourable outcomes. Likelihood refers to the probability of the occurrence of the trigger state as well as the combined effects of disablers and motivators, indicating the probability of the subsequent choice being selected. As probabilities of change, these likelihoods also reflect that element of potential.

Eppink (1978) associates the likelihood of state transition with the degree of commitment or the decision maker's willingness to abandon his current position. Ku (1995) interprets the likelihood as a function of the disablers (the more difficult the change, the less likely) and the motivators (the better the outcome, the more likely the change.)

Table 2.2 Flexibility elements and indicators(Ku, 1995)

Elements	Indicators	Representation
Potential, Capability to change	two-stage decision, state transition	investment in first stage, characteristics or capabilities in second
Purposeful change, response to stimuli	trigger event, trigger state	uncertainty or chance node, states of uncertainty
Availability (existence) of transitional states or possibility of change	number of states, size of choice set	number of options in second stage
Likelihood of change	probability of trigger state or proportional representation of disablers	probabilities, costs, lead time
Provision, property of initial position, guarantor	enabler	premium, cost of providing the capability

Barriers to change	disablers	switching cost, response time, speed of change, constraints
Favourability	motivators	profit, income, value, benefits

The above classification portrays a multi-dimensional picture of flexibility. Thus, according to Ku (1995), flexibility is: a ***potential*** **or capability to** ***change***, associated with an ***initial position***, but measured by the ***number of favourable choices*** that are available later. Favourability is embedded in positive returns or benefits called ***motivators***. The value of future flexibility is captured by ***enablers*** which guarantee that provision of flexibility. The availability of these choices depends on switching costs and other frictional elements called ***disablers***.

These indicators (number of choices, enabler, disabler, motivator, trigger event, trigger state, likelihood, and two stage decision sequence) describe the essence of flexibility and provide a framework for structuring options and strategies for flexibility.

The assessment of flexibility refers to measuring flexibility, trading off aspects of flexibility, and comparing options or strategies that differ in the degree of flexibility they provide. This assessment depends on the level of complexity, which spans the spectrum from "simple" to "complex." Ku (1995) proposes that for simple problems, structuring is not necessary, and ***indicators*** are sufficient for measuring flexibility. More complicated problems however require model structuring and assessment using indicators and expected values. Although simple problems do not require structuring, structuring helps to identify the relevant indicators for measuring flexibility.

2.2.4 The Impact of IT on Flexibility and IT Infrastructure Flexibility

Golden & Powell (2000) note that the study of the effect of IT on organisational flexibility is relatively recent and briefly review past research, categorizing such into where IT has a positive and a negative impact of flexibility:

- **Positive Impact:**
  - Lucas & Olson (1994) state that IT contributes to organisational flexibility in three ways:
    - by changing the nature of organisational boundaries;
    - by altering the nature and pace of work; and
    - by helping firms respond to changing market conditions;
  - Avison (1988) proposes 4GLs and prototyping as allowing more flexibility in development;
  - Prager (1996) propose object orientation as allowing more flexibility in IS development and believes OO technology an effective way to handle demands of flex and an uncertain future;
  - Behrsin (1994) believes IS architectures provides the foundation for rapid response to changing market conditions;
  - Duncan (1995) notes that that potential value of IT infrastructure has been discussed in the literature in terms of flexibility and responsiveness;
  - Monteiro & Macdonald (1996) concludes that IS provides an element of flexibility in strategy and that IT architecture can be a tool for flexibility to an organization as well as allowing more flexible links with trading partners;
  - Venkatramann (1994) argues that IT is a fundamental enabler in creating and maintaining flexible business networks and enables such networks by facilitating rapid information exchange amongst firms; and
  - Boynton (1993) postulates that IT is needed to compete effectively and develop cross-organisational information processing capabilities that are flexible, reusable, modular, general purpose and open to other platforms both inside and outside the organization.

- **Negative Impact**:
  - Boynton (1993), Avison, Powell, Keen & Ward (1995) and Lambert & Peppard (1993) all argue that IT is often a cause of rigidity and inflexibility;
  - Lucas & Olson (1994) believe that IT can contribute to organisational flexibility but argue that technological flexibility from IT can begin to create organisational inflexibility if technology becomes too old and hard to maintain;
  - Upton (1994) argues that manufacturing-integration software is anything but changeable and malleable and that firms are still struggling to make their IS more flexible;
  - Sayer (1989) argues that manufacturing flexibility derives more from social innovation than from technology developments in IT;
  - Suarez (1995) discovers that manufacturing plants with more programmable automation are less flexible;
  - Upton (1995) finds no correlation between extent of computer integration and increase in operational flexibility;
  - Boynton (1993) argues that the reason for inflexibility is that existing information architectures are geared toward particular competitive conditions and that old are not designed to meet the dual challenge of rapid product customization and production/distribution efficiency;
  - Eardley, Avison & Powell (1997) argues that certain rigid IS inhibit the ability of organisations to change business strategy; and
  - Research on flexibility in IS is largely confined to the system development process (Allen, 1991; Avison, 1995; Fitzgerald, 1990);

Golden & Powell (2000) conclude that IT is an enabler to organisational flexibility by:

- providing more flexible ways of doing things and
- using the IS infrastructure, providing flexibility that allows organisations to adapt their information systems to new competitive environments.

Davenport & Linder (1994) state that IT infrastructure flexibility should be viewed as an organisational core competency, suggesting that a *"good" infrastructure is* *quantified by its flexibility and robustness to enable change*". Weill (1993) suggests that IT infrastructure flexibility must be able to handle increased customer demands without increased costs. Venkatraman (1994) believes that IT infrastructure should mainly focus on speed of implementation and flexibility.

Allen & Boynton (1991) noted that efficiency and flexibility are the two most critical factors in selecting any IT application or system, with flexibility the more important of the two. According to these authors, IT infrastructure flexibility allows organizations to respond to new market conditions while providing for future integration. These perspectives indicate that the issue of flexibility may be viewed as a critical component of IT infrastructure.

Henderson & Venkatraman (1993, 1994) suggested that business functional knowledge and skills contribute to infrastructure flexibility by affecting the IT organization's ability to plan effectively. Flexibility in interpersonal and management skills is needed because IT applications have become more horizontal, as opposed to the traditional hierarchical. This necessitates a new type of adaptable employee who can easily handle IT coordination and boundary issues.

Byrd & Turner (2001) note that although the importance of the IT infrastructure flexibility construct has been strongly suggested through the writings of practitioners and researchers (Allen & Boynton, 1991; Brancheau, Janz & Wetherbe, 1996; Broadbent & Weill (1997); Broadbent, Weill, O'Brien & Neo, 1996; Broadbent, Weill & St. Clair, 1999; Davenport & Linder, 1994; Gibson, 1993; Information Week, 1999; Rockart, Earl & Ross, 1996; Weill, 1993) the development of a valid, reliable instrument to measure this construct has not been reported in the literature.

In developing their construct, Byrd & Turner (2001) note that IT infrastructure is a multifaceted concept that seems to include two related but distinct components (Broadbent & Weill (1997) and Henderson & Venkatraman (1994):

- **A technical IT infrastructure** - *the choices pertaining to applications, data, and technology configurations; and*

- **A human IT infrastructure** - *the choices pertaining to the knowledge and capabilities required to manage effectively the IT resources within the organization.*

Byrd & Turner (2001) thus define the IT infrastructure as: "*the shared IT resources consisting of a technical physical base of hardware, software, communications technologies, data, and core applications and a human component of skills, expertise, competencies, commitments, values, norms, and knowledge that combine to create IT services that are typically unique to an organization. These IT services provide a foundation for communications interchange across the entire organization and for the development and implementation of present and future business applications*".

The authors adopt a definition of flexibility as they perceive it in the management literature: "*the degree to which an organization possesses a variety of actual and potential procedures, and the rapidity with which it can implement these procedures to increase the control capability of the management and improve the controllability of the organization over its environment*".

Combining these two definitions Byrd & Turner (2000) define the concept of IT infrastructure flexibility as: "*IT infrastructure flexibility is the ability to easily and readily diffuse or support a wide variety of hardware, software, communications technologies, data, core applications, skills and competencies, commitments, and values within the technical physical base and the human component of the existing IT infrastructure*".

The initial hypothesis for their research was that IT infrastructure flexibility consists of eight dimensions-four in the technical base and four in the human component:

- ***Compatibility and connectivity*** - Duncan (1995) demonstrated that one way to describe technical IT infrastructure flexibility more precisely was through the qualities of:

- **_Connectivity_** - the ability of any technology component to attach to any of the other components inside and outside the organisational environment; and
- **_Compatibility_** - the ability to share any type of information across any technology component.

According to Duncan(1995) , an organization with high connectivity, compatibility (and modularity) is viewed as a having high technical IT infrastructure flexibility.

- **_Application functionality_** - relates to the ability to add, modify, and remove the modules of software applications with little or no widespread effect on the applications collectively;
- **_Data transparency_** - is defined as the free retrieval and flow of data between authorized personnel in an organization or between organizations regardless of location;
- **_Technology management_** - pertains to the organization's ability to deploy IT in the most effective possible manner in support of the business strategies;
- **_Business skills_** - relate to the ability of IT personnel to understand the business processes they are to support and to apply the appropriate technical solution to a given business problem;
- **_Management knowledge and skills_** - refer to the importance of IT personnel having skills and knowledge to assume roles outside their area of training or original competencies. These may include areas like project management and business process support; and
- **_technical skills_** - are a set of measures of technical capabilities, such as programming, understanding software development processes, and knowledge of operating systems.

The findings of second-order analyses in the study performed by Byrd & Turner (2001) revealed that the proposed eight dimensions can be expressed in three factors - two for technical infrastructure and one for human infrastructure:

- **_The integration factor_** - This factor is a merger of the dimensions of IT connectivity and IT compatibility. This suggests that respondents considered transparent access into all organisational platforms as contributory to the flexibility of the IT infrastructure;

- ***The modularity factor*** - is a combination of application functionality and database transparency. The items of the modularity factor suggest that the survey respondents acknowledge the trend toward faster application development (e.g., reusable software modules, component/object-oriented technologies). This second-order factor also implies that access control (e.g., transparency) is important, as modem organizations must be capable of disseminating data faster and to a wider range of users; and
- ***The human factor*** - The four dimensions of the human infrastructure all loaded on one factor. The evidence of this second-order analysis suggests that IT personnel within a firm should be well-rounded, with technology management, business knowledge, management knowledge and technical skills.

Byrd & Turner (2001) believe that in addition to the solid results of convergent validity and discriminant validity of the factors in their study, the nomological validity of all the IT infrastructure flexibility factors was promising and the resulting instrument looked encouraging. The relationships between the factors of IT infrastructure flexibility and the IT investment measures were solid, although not spectacular. The study insinuated that a flexible IT infrastructure is positively related to an increase in costs and competitive advantage for adopting organizations. Byrd & Turner (2001) suggest their results point to the need for further study of the relationships between IT infrastructure flexibility and the costs and benefits of this flexibility. They suggest that IT researchers employ the results of this study to develop new, more rigorous studies to further clarify these issues.

2.3 Agility

2.3.1 Defining Agility

As is the case with the concept of flexibility, the concept of agility has its roots within the manufacturing sector. Meredith & Francis (2000) note that the concept of agility has roots in approaches such as time-based competition, fast-cycle innovation and intrapreneuring and that lean and flexible manufacturing have been especially influential. Meredith & Francis (2000) believe that these ``philosophies" can be seen as necessary but not sufficient for an agile enterprise and that organisational strength in turbulent situations requires proactivity, adaptability, flexibility, speed, learning and skills to provide strategically driven and effectively implemented waves of change. Such a dynamic capability can be defined as ``*the organisation's capacity to gain competitive advantage by intelligently, rapidly and proactively seizing opportunities and reacting to threats"* (Bessant, Brown, Francis & Kaplinksy, 1999).

According to Meredith & Francis (2000) an agile manufacturing facility, characteristically, has six attributes:

- produces to order, whereas traditional mass production produces to stock;
- meets the customer's specific needs, whereas traditional mass production produces a ``good, average" product;
- achieves a speed and flexibility in its functioning that is matched to the speed and flexibility of the technologies it manages;
- mobilises and manages all forms of knowledge intelligently to support an agile strategy;
- adopts new ways of working when these facilitate agility (e.g. moving from functional to team working and from arms-length to interdependent relationships with other companies); and
- creates ``virtual" project and ad hoc organisations to add capabilities as and when they are needed.

According to Dove (1996) and Kidd (1995), the concept of agility comprises two notions:

- Responding to changes (anticipated or unexpected) in proper ways and due time; and
- Exploiting changes and taking advantage of changes as opportunities.

Preiss, Goldman & Nagel (1996) suggests co-operation as an important means for achieving agility and has proposed four steps for implementing agility, which include understanding market forces, recognizing enterprise level attributes, obtaining enabling infrastructures and implementing business practices.

Katayama & Bennett (1999) contrast the terms agility, adaptability and leanness:

- **Agility** – Agile manufacturing seeks to cope with demand volatility by allowing changes to be made in an economically viable and timely manner. Although the word 'manufacturing' is used with this concept, the principles of agility can equally apply to other functions of a business and to service industries. Agility relates to the interface between the company and the market. Essentially, it is a set of abilities for meeting widely varied customer requirements in terms of price, specification, quality, quantity and delivery. Agility has been expressed as having four underlying principles:
  - delivering value to the customer;
  - being ready for change;
  - valuing human knowledge and skills; and
  - forming virtual partnerships;
- **Adaptability** - is a feature of the company's production system. It is the inherent ability to adjust or modify its cost performance according to demand. 'Adaptable production' is based on increasing cost sensitivity by shifting some of the company's fixed cost base towards variable costs. This is in contrast to the more typical approach under lean production, whereby the variable cost element is lowered by reducing unit resource consumption;

- **Lean production** - is different from mass production in that it uses less of everything "*.... half the human effort in the factory, half the manufacturing space, half the investment in tools, half the engineering effort to develop a new product in half the time*". It requires keeping far less inventory on site, results in fewer defects, and produces a greater and ever growing variety of products. Implementing lean production means eliminating waste in the production system.

According to Katayama & Bennett (1999), agility, adaptability and leanness are not alternatives, but are mutually supporting concepts to improve competitiveness and the prospects of survival in an increasingly volatile and global business environment. Together they ensure:

- responsiveness to customer requirements;
- cost sensitivity at different levels of demand; and
- resource efficiency and high performance.

Goldman, Nagel & Preiss (1995) defined agility as: "*capable of operating profitably in a competitive environment of continually, and unpredictably, changing customer opportunities*" and "*dynamic, context-specific, aggressively change-embracing, and growth oriented*". Goldman et al. (1995) identified four key dimensions of agile competition:

- ***enriching the customer*** - This entails a quick understanding of the unique requirements of each individual customer and rapidly providing it;
- ***co-operation*** – intraorganisational and interorganisational co-operation such as supplier partnerships and perhaps emerging virtual relationships with competing organizations in order to enhance competitiveness;
- ***utilising new organisational structures*** - to master change and uncertainty through techniques such as concurrent engineering and cross-functional teams; and
- ***leveraging the impact of people, information and technology*** – particularly recognising the importance of employees as a company asset, placing greater emphasis on education, training and empowerment.

Vokurka & Fliedner (1998) believe that a more robust, theoretical foundation is still a necessary requirement in aiding the transformation of agility and its principles to a science and that agility is an emerging theory on strategic change for organizations. Referring to Goldman et. al. (1995) they regard agility as the ability to market successfully, low-cost, high quality products with short lead times and in varying volumes that provide enhanced value to customers through customization (Fliedner & Vokurka, 1997). Agility entails a continual readiness to change, sometimes radically. It merges the four distinctive competencies, identified by Hayes & Wheelwright (1979), of cost, quality, dependability and flexibility but challenges past competitive paradigms by adding the ability to respond rapidly to any change in market demand (whether a change in product characteristics, customer orders or internal company conditions). According to Vokurka & Fliedner (1998) an agile firm handles change as a matter of routine; Agility is a capability of responding to change in a dimension beyond flexibility. Agile firms embrace change as they understand not only their current markets, product lines, competencies and customers, but also understand the potential for future customers and markets and the necessity of changing to meet those opportunities. Agility allows a company to react more quickly than in the past. An agile firm proactively anticipates customer requirements and leads the emergence of new markets. Vokurka & Fliedner (1998) also believe agility is context-specific in that differences among markets limit the generalisability of detailed rules for becoming agile.

In contrasting flexibility and agility Vokurka & Fliedner (1998) point out that flexibility refers to the capability of an organization to move from one task to another quickly and as a routine procedure, with each situation defined ahead of time so that the procedures needed to manage it are in place. Traditional dimensions of flexibility include, for example, those that are product or service related (e.g. volume, product mix, and specification flexibility), or process related (e.g. machine changeover, scheduling and innovation flexibility). To be agile, a firm needs to be able to deal with unpredictable changes in market or customer demands. Whilst agility can refer to any of the dimensions of flexibility, the key difference is the ability to respond quickly to unanticipated marketplace changes. Flexible changes are responses to known situations where the procedures are already in place to manage the change. Agility extends the capability of flexibility by requiring the ability to respond to unpredictable changes in the market or customer demands.

Sarkis (2001) notes that, though a number of definitions for agility have been posited within the last few years, a common thread focuses on being able to function and compete within a state of dynamic and continuous change and gives the definition for agility, as provided by the Advanced Research Programs Agency (ARPA) and the Agility Forum, as an example: ``*agility is the ability to thrive in an environment of continuous and often unanticipated change*."

Sarkis (2001) then contrasts ``agile", ``lean" and ``flexible" using the U.S. Department of Defense's summary of these philosophies:

- ***Lean manufacturing*** - a set of practices intended to remove all waste from the system, striving to minimize usage of resources;
- ***Flexible manufacturing*** - a structure as opposed to a strategy which addresses a production line that can be easily reconfigured or customized for producing different products; and
- ***Agile manufacturing*** - a strategy that contains lean manufacturing and flexible manufacturing and addresses the business enterprise world.

According to these definitions, lean and flexible fall within the scope of agile, although Sarkis (2001) notes that other authors have stated that these are distinct and separable philosophies mostly as a result of these concepts being at different levels of practical and academic maturity. Industry-led requirements for agility first appeared in the 21st Century Manufacturing Enterprise Strategy, Volumes 1 and 2 (Iacocca Institute, 1991). Goldman et. Al. (1995) provides one framework for agility that includes four major dimensions:

- ***Outputs*** - customer enriching ``solution" products;
- **Inputs** - cooperating to enhance competitiveness;
- ***External influences*** - unpredictable change and social values; and

- ***Internal operations*** - leveraging the impact of people and information.

Dove (1996) argues that drivers of agility can be determined by relationships that exist among entities within an organization. One such driver is the relationship between opportunistic customers and adaptable producers that may be defined as **opportunity management**. Another important linkage and driver for an agile environment is the link between adaptable producers and ceaseless technology that may be defined as **innovation management**. Vokurka & Fliedner (1998) believe these driver examples show that the relationships that exist within an agile environment include both inter- and intra-enterprise situations. The goal of agility and these management principles is to reduce the toll of change on product cost, quality and availability and on organisational viability, and innovation leadership. The principle of change management is significant within the set of agile definitions.

Meredith & Francis (2000) posit that there are two interdependent aspects of agility and propose a "Wheel of Agility":

- ***Strategic*** - an outward-looking approach is required. Necessary activities include scanning the environment and assessing the likely impact of industry trends, technology drivers, competitive forces, market changes and market segment dynamics. However, strategy is more than assessment as positions have to be taken and commitments made and this may be required urgently as situations change with increasing frequency;
- ***Operational*** – that is, within the organisation, specifically processes of production, maintenance and process innovation. Closely aligning operations with strategy is essential in an agile organization.

The contents of the wheel are summarized:

- **Quadrant I: agile strategy -** The first quadrant focuses on strategic aspects of agility. Four policies/practices are specified:
  - **Wide-deep scanning** - the firm's procedures for intelligence gathering from the external environment (e.g. competitors' strategies, technological developments, customers' needs, changes in the economic and market

situation). As significant factors could occur anywhere, wide scanning is required. As pivotal change drivers need to be fully understood rather than reacted to instantly, deep scanning is required;

- **Strategic commitment** - the top team's willingness to adopt agile policies. Top teams in agile firms need to be wedded to the agile ideal and the pursuit of instant fulfillment of customers' unique needs by developing fast-response, reconfigurable capabilities;
- **Full deployment** - the extent to which agile policies and practices are adopted by every department, group, project-team and cell. Agility is more effective where the linkages between departments, functions, teams and individuals are highly integrated; and
- **Agile scoreboard** - the degree to which the performance management system of the firm supports agile policies and practices. Key measures may include: fixed asset utilisation, time-to-market and order-to-delivery time (Proops, 1997).

- **Quadrant II: agile processes -** The second quadrant focuses on organisational processes that support agility. Four policies/practices are specified:
  - **Flexible assets and systems** - Assets and systems need to be lean (having a minimum of waste with an organisation designed to improve the effectiveness of all aspects of the operations (Kidd, 1994);
  - **Fast new product acquisition** - the ways in which companies improve their products offered, including the service aspect. It is termed product ``acquisition" because smaller firms may not develop totally new products but acquire ideas, licenses and formats from or in collaboration with others;
  - **Rapid problem-solving** - if a firm is slow in identifying and solving problems its creative energies are absorbed in rectification and minor improvement and not seizing opportunities. Symptoms of problems need to be identified quickly and sufficient resources allocated to find an effective solution, that can be quickly implemented; and
  - **Rich information systems** - help to ensure that decision-making is shared and effective as an agile company requires rapid and frequent decision-

making. Reliable decisions can only be made when the wider context is understood by the decision maker.

- **Quadrant III: agile linkages -** The third quadrant focuses on outside linkages. Four policies/practices are specified:
  - **Agility benchmarking** -provides the comparative background to set agile objectives. Whilst benchmarking is important for identifying best practice, the mission of the agile company is to be proactive and progress beyond accepted best practice of the moment. The agile organisation aims to be a first mover, not a follower. Agility must be more than an aspiration; it needs to be an implemented organisational philosophy emphasising short-cycle process innovation;
  - **Deep customer insight** - provides a very close relationship with customers, and potential customers. Sony described it as ``*taking the skin temperature of customers each day"* (Morita, 1989) or providing customers with solutions even before the customers know what their needs are (Shulman, 1997). The essence of agility is the precipitation of opportunity, reading the signals and creating opportunities for sales;
  - **Aligned suppliers** - as a slow or non-responsive supply chain markedly degrades the agile capability of the firm. Eliminating barriers between the firm and supplier, sharing goals, building long-term partnerships and even an interchange of people can make for a high level of integration and a sharing of accrued benefits; and
  - **Performing partnerships** - with other organisations offer new or enlarged capabilities through co-operation (including “virtual enterprises");

- **Quadrant IV: agile people -** The fourth quadrant focuses on people and the management of the human resource of the firm. Four policies/practices are specified:
  - **Adaptable structure** - the traditional bureaucratic organisational structure is inherently non-agile as it depends upon predetermined rules to guide behaviour. Adaptable organisational structures enables the firm to become

configured to grasp opportunities. Ideally the agile organisation will have the *``organisational flexibility to adopt for each project the managerial vehicle that will yield the greatest competitive advantage"* (Goldman and Nagel, 1993);

- **Multi-skilled, flexible people** - for most of the twentieth century management has improved by developing new and better systems (MBO, TQM, JIT etc.). Agile firms are less dependent on systems and more dependent on the intelligence and opportunism of people (as well as their capability, involvement, commitment and empowerment);
- **Rapid, able decision-making** - speed of response is one of the main characteristics of the agile organisation. Both rich information systems, which allow information to flow throughout the company, and skilled decision-makers and robust decision-making processes are required; and
- **Continuous learning** - According to Senge (1990) *``the rate at which organisations learn may become the only sustainable source of competitive advantage"* and this requires an organization *``where people continually expand their capacity to create the results they truly desire, where new and expansive patterns of thinking are nurtured, where collective aspiration is set free, and where people are continually learning how to learn together"*. The intensive learning of individuals, collectively, captured, continually built upon, and mobilised is a characteristic of an agile enterprise.

Fliedner and Vokurka (1998), building on the ideas of Nakane (1986) and Ferdows & De Meyer (1990), posit a model showing the inter-relationship between the competitive capabilities of cost, quality, dependability and flexibility but add agility. Fliedner and Vokurka (1998), argue that although the number of competitive priorities enumerated has increased, they can arguably still be grouped according to the original four capabilities; efficiency, dependability, quality and flexibility (efficiency refers to both cost and capital efficiencies; quality includes the dimensions of product quality and reliability, service quality, speed of delivery and maintenance quality; dependability concerns delivery and price promises; flexibility included product and volume changes).

As in the model developed by Ferdows & De Meyer (1990), quality improvement is a necessary precondition for improving and developing other competitive capabilities. After a sufficient level of quality is achieved, firms should continue to expand their quality efforts while developing programs to improve their dependability. When a competitive level of dependability is achieved, firms should further continue developing quality and dependability improvements, while tackling flexibility. On successful improvement in flexibility capabilities, firms can then move on to agility. The efforts to improve agility should be supported by continued efforts to improve quality, dependability and flexibility further. A company must be sufficiently competent at being able to manage changes to well-defined conditions before it can extend its capabilities to responding to unforeseen changes.

Fliedner & Vokurka (1997) identify numerous internal and external strategic initiatives that promote agility and cite examples including:

- reductions in manufacturing cycle times and order response times;
- partnerships;
- outsourcing;
- schedule sharing;
- supply channel performance improvements;
- postponement;
- teamwork and cross-functional management teams;
- employee education, training and empowerment; and
- business process reengineering.

Zhang & Sharifi's (2000) study found four categories of agility capabilities:

- ***Responsiveness*** **-** This is the ability to identify changes, respond rapidly to changes either reactively or proactively, and recover from changes. This is itemised as:
  - Sensing, perceiving and anticipating changes;
  - Immediate reaction to changes; and

  - Recovering from changes;
- ***Competency*** **-** This is an extensive list of abilities that provide a company with productivity, efficiency, and effectiveness in achieving its aims and goals. The following items form the major part of the list:
  - Strategic vision;
  - Appropriate technology, or sufficient technological capability;
  - Products/service quality;
  - Cost- effectiveness;
  - High rate of new products introduction;
  - Change management;
  - Knowledgeable, competent, and empowered people;
  - Operations efficiency and effectiveness (leanness);
  - Co-operation (internal and external); and
  - Integration;
- ***Flexibility*** **-** This is the ability to carry out different work and achieve different objectives with the same facilities. It consists of items such as:
  - Product volume flexibility;
  - Product model/configuration flexibility;
  - Organisation and organisational issues flexibility; and
  - People flexibility.
- ***Speed*** **-** This is the ability to carry out tasks and operations in the shortest possible time. Items include:
  - Quickness in new products time-to-market;
  - Quickness and timeliness in products and services delivery; and
  - Quickness in operations (short operational lead-times).

Zhang and Sharifi (2000) note that among the four types of capabilities, responsiveness is the essential capability for any organisation which needs to be agile. The other three are the necessary elements in order to achieve responsiveness.

Goranson (1999) notes a number of interlocking definitions of agility which he organizes into three orthogonal concepts:

- Mass customization (and supporting ideas such as being close to the customer) as the core concept;
- Thriving in environments with high change rates – this deals with the expected and constant (if constantly and predictably accelerating) type of change; and
- Adaptability (or the ability to change when the unexpected happens) as a central concept.

Goranson (1999) notes that a dominant definition of the agile enterprise is one that responds to (and ideally benefits from) unexpected change (i.e. adaptability). Goranson (1999) adds the concept of "*agility as creativity*" and believes that agility is the ability to change to be cheaper, better and faster (i.e. more profitable) in a dynamic sea of change. There are four contexts for agility:

- The sum of internal agility of each organisational component;
- The agility of the organization as a whole (which may be greater or lesser than the sum of its parts);
- The ability of each component to quickly/cheaply aggregate; and
- The ability of each component to quickly/cheaply change the aggregation boundary.

Goranson (1999) also notes a layering of agility types. Internal agility does not necessarily result in external agility (i.e. agility with your partners, whether virtual or not). To measure agility both the boundaries between components and the internal processes that support components must be looked at.

2.3.2 Measuring Agility

Vokurka & Fliedner (1998) note that significant advances have been made in the measurement of quality but research is still needed in the measurement of other capabilities, particularly flexibility and agility and that a measurement device for agility (at the time of their study) had not been reported in the literature. As a result it is difficult to quantify a specific level of agility attainment. Similar to flexibility, agility is a complex and multidimensional concept and is context-specific. Empirical studies need to be undertaken to measure agility with attention given to properties such as multidimensionality, reliability, and validity. They comment, however, that even though an agreed-upon definition has not fully evolved, the lack of a definition/theory should not be a hindrance in making advances in this area. Organizations can be agile and strive for agility and improvement without having a concrete definition or theory.

Goldman et al. (1995), recommends metrics that fall within four areas that can be used to define agility:

- total customer solutions;
- cooperate to compete;
- leverage people and knowledge; and
- master change and uncertainty.

Sarkis (2001) notes that metrics for agility may be based on the definition that agility can be described as the potential to respond to change. Unexpected change may be categorized into the following five groups:

- resources;
- technology;
- processes (internal conditions and mechanisms);
- environment (external conditions and mechanisms);
- demand (customer conditions and mechanisms);

and example metrics are given:

Table 2.3 Agility metrics (Sarkis, 2001)

Change metric	Metric examples	Possible measures
Technology	Opportunity cost	Market share due to specific technology
	Modular processes	Impact of addition of removal of a product or process
	Level of technical tools	Internal integration level (percent of systems integrated)
	Integration of additional technology	Cost of updating legacy system for new technology
Demand	Organizational flexibility	Number of distinct virtual enterprises
	Product variety	Number of product families
	Demand change cost	Cost per engineering change
	Product expandability	Levels in product family tress
	New product introduction	Rate of new products introduced per time period
	Range of capability	Number of dissimilar part families in one system
	Flexibility of manufacturing system	Alternative number of routes per part family
Process change	Partnering	Time to partner after awareness of opportunity
	Organizational	Levels of management
	Organizational	Degree of cross-functional teams
	Organizational	Degree of cross-training per individual
	Organizational	Resistance to change level
	Adaptability	Cost to relocate processes
	Adaptability	Length of learning time
	Process techniques	Set-up time
	Process techniques	Variability of processes
Resource change	Capability of workers	Number of equipment qualified on
	Availability of changes	Automation level
	Availability of changes	Efficiency
	Acquisition time	Time to acquire labor, supplies, etc.
	Quality costs impact from change	Change in defect history
	Supply chain formation	Time to form supply chain
Environmental change	Legislative	Process change per regulation
	Past performance	Number of new contracts won
	Equality in internal/external treatment	Process change per external stimulus

Long (2000) posits a way for measuring strategic agility using the following dimensions:

- ***Clarity of Vision*** - a clear, compelling vision of the ends the organization is working toward, the kinds of relationships and results it hopes to create. It is the embodiment of strategic intent. Strategies themselves describe ways of realizing that intent, that is, the means by which you hope to bring the vision to life. And because conditions and circumstances are always changing, the strategies must be flexible and ready to change, even as the vision remains stable;

- ***Knowledge of Clients*** -without information from and about targeted clients, an organisation may wind up pushing products and services into the marketplace that clients may not want or need. Strategic thinking requires one know as much as possible about clients, especially what they value and why they value it;

- ***Understanding Core Capabilities*** - how you create value using core capabilities (the knowledge, skills, processes, and know-how the firm has acquired that would be difficult for others to copy or develop quickly);

- ***Selecting Strategic Targets*** - knowing how you create value in order to select clients who will value what you are best able to provide. The key to selecting effective strategic targets is being able to identify opportunities in which you can match your core capabilities with the opportunity in the marketplace. You want to be agile enough to jump on the many opportunities that present themselves. But there is a limit to the number of opportunities one can exploit in a given period, so it is important to select only those for which you have an edge over your competitors. "Selecting Strategic Targets" is a measure of our ability to match up the opportunities we identify with our core capabilities in ways that create optimum value for our clients and for ourselves and that show us where we may need to be modifying, enhancing, or developing new capabilities;

- ***Shared Responsibility*** - with clients and with those you work with. The best chance of maintaining the continuing input and feedback needed to remain strategically agile in the face of constantly changing conditions;

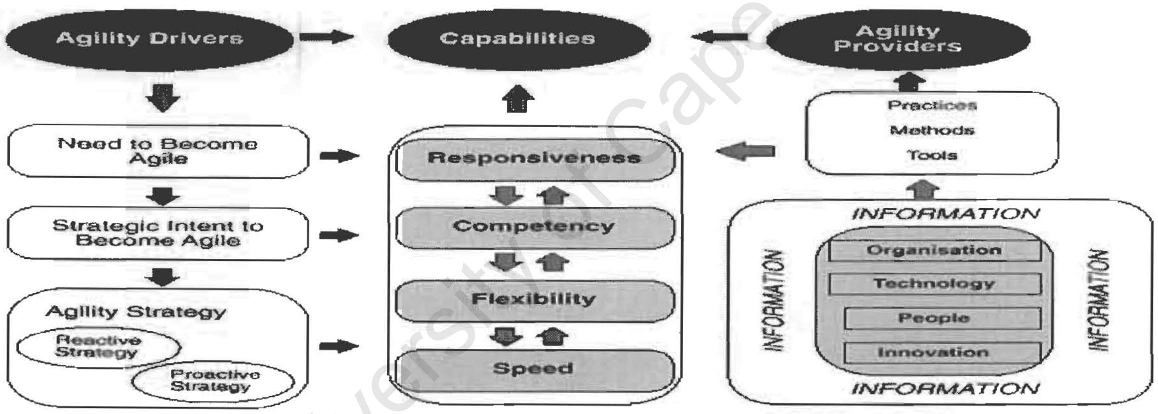
- ***Knowledge of Competitors*** - knowing what competitors are up to. You need to know how your competitors create value for their clients and determine which clients might be attracted to their services as opposed to yours. This can give you valuable insights into what different clients value and why. It also provides crucial information for deciding which opportunities to invest in; and

- ***Taking Action*** - getting results. Being agile without results is a waste of time and effort.

Long (2000) believes that strategic agility requires a balance between factors that provide stability and those that provide flexibility. The main anchors of stability are "Clarity of Vision" and "Understanding of Core Capabilities." Without these, the risk is run of being agile without having any overall strategy, and dissipating resources as "opportunities" are chased that the organization is ill prepared to exploit. Flexibility, on the other hand, requires an excellent "Knowledge of Clients" and their needs and goals and an equally sound "Understanding of Competition." Knowledge of these two factors are critical to being able to see opportunities as they begin to develop and to identify the best way of pursuing them.

Zhang & Sharifi (2000) develop a conceptual model for implementing agility. Their analysis confirmed that there is a strong correlation between drivers, capabilities, and providers thus providing a preliminary validation of the proposed conceptual model:

Figure 2.1 Agility drivers, capabilities and providers (Zhang & Sharifi, 2000).



The main elements of the model are:

- *"agility drivers"* - the changes/pressures from the business environment that necessitate a company to search for new ways of running its business in order to maintain its competitive advantages;
- *"agility capabilities"* - the essential capabilities that the company needs in order to positively respond to and take advantage of the changes; and
- *"agility providers"* - the means by which the so-called capabilities could be obtained. These providers are to be sought from four major areas: organisation, people, technology, and innovation. It is also suggested that the providers need to be fully integrated with the support of information systems/technology.

The factors scored in the model were general factors such as:

- how responsive the company is to changes in its business environment;
- how able is the company in proactively capturing the market and customer needs; and
- how able is the company in taking advantage of unexpected opportunities in market.

Each of these general factors was divided into many sub-factors, such as the rate of new product introduction, which can be scored more accurately. Therefore, the assessment tool took a layered structure.
The top layer corresponds to the **three general areas** to be assessed:

- the ability of a company in detecting, analysing and understanding the changes in its business environment;
- the ability of a company in dealing with these changes (by effecting the changes in its internal and external affairs) and providing the right solutions in the shortest possible time; and
- the ability of a company in tackling the changes as opportunities and taking advantages of the opportunities.

In the second layer, the three general areas were broken down into sub-areas corresponding to individual agility drivers to be dealt with. Only sub-areas corresponding to the drivers that are reasonably turbulent for a specific company, as indicated in the results from agility need level assessment, were assessed for a company. The results from need level assessment were used to control the scoring process.

In the third layer, a number of questions were designed to assess the availability and strength
of various capabilities in dealing with problems corresponding to the individual sub-areas in layer two.

Goranson (1999) believes that agility metrics have two parts:

- The context of the change; and
- The effectiveness of the response.

The context of the change can be categorized into:

- Resources – intellectual property, technology, raw materials, commodities;
- Processes – internal conditions and mechanisms;
- Environment – external conditions and mechanisms including processes with partners; and
- Demand – customer conditions, markets, mechanisms.

Goranson (1999) mentions that change may be categorisable in terms of constraints rather that the above infrastructure mechanics. Technology is viewed as a resource; agility is not a response to technological innovation but a business response which might be empowered by technology. Agility may also be pursued for some strategic reason without prompting by external or uncontrollable change.

Goranson (1999) proposes metrics that measure the time and cost associated with the potential that a system has to accommodate future change (i.e. agility is the potential to respond well to unexpected change). Further, agility can be viewed as insurance and there is a point beyond which more agility is a wasting of resources. A measure of this is also required and ideally one wants to shown a chain of logic from a metric to organisational performance measures such as profitability.

Two metric dimensions are proposed:

- ***Scope*** – how large a domain is covered by the agile system i.e. how far from the expected set of events the system can go whilst still responding well (or how many types of change are covered); and
- ***Robustness*** – how well the system responds given a specific scope (or how radical a change the system can gracefully respond to).

Goranson (1999) proposes quantitatively scalable metrics:

- Metrics should not be process-dependent nor linked to any specific granularity of processes;
- They should scale horizontally across functions i.e. not function-specific; and
- They should be internally linear i.e. there should be no discontinuous thresholds in an interval at which improvement is suddenly radical.

Of these the first is considered most important and the other two highly desirable. There may be a different metrics used however where the agility component crosses the boundary of an organization.

Thus one can measure:

- Agility within a component;
- The agility a component contributes to the entity of which it is a part;
- The agility of a component within an entity; and
- The agility of a system as a whole (consisting of multiple entities).

Goranson (1999) proposes a scenario-based conversation to capture the intrinsic agility of a process and the agility contribution of the process to the system as a whole. As a metric measurement tool a reference model is proposed which is simply a matrix of infrastructural elements (representing the areas of application within the system under consideration) along one boundary and decisional elements (representing the life-cycle processes of the system being considered) along the other axis. The life-cycle is broken down into its major processes which each involving decisions (i.e. cost and commitment) as to which use tools and methods to use (which will be informed by the metrics).

Goranson (1999) uses the following infrastructural elements:

- Physical – facilities, equipment, logistics;
- Social/Cultural – social and psychological "laws", community and business cultures; and

- Legal/Explicit – business processes, workflow/business plans, contracts/regulation.

And the following decisional elements:

- Opportunity Identification (opportunity strategy, exposure, targeted marketing, search);
- Partner Selection (partner qualification, performance history, search);
- System Formation (strategy development, partner criteria and selection, enterprise metrics, capitalization, product liabilities, risk/reward strategies, operating strategy, dissolution plan);
- System Operations (performance metrics, customer relations, operating practice); and
- System Reconfiguration/Dissolution (need identification, residual liabilities, dissolution plan).

Thus the organization is viewed as a set of value-added processes and capabilities that provide value-addition.

Goranson (1999) notes certain dependencies between elements which help identify a handful of cells within the matrix that are key to an agility strategy; less than 2% of the cells need to be understood in any detail. Which cells are key as well as what is entered in any cell is related to strategic and environmental conditions and what type and extent of agility is beneficial to the system.

2.4 A Synthesised Concept of Agility for Assessing IT's Support of Organisational Agility

It should be clear that there is significant confusion and variety in authors' views of how the concepts of flexibility and agility are defined and how they interrelate. This researcher believes that much of the confusion derives from the failure to keep the terms "uncertainty" and "risk" clear and consistent.

Although there are dissenting voices (e.g. Dove, 1995 and Kid, 1996), the agility literature is far more adamant that what distinguishes agility from flexibility is that agility is a potential to respond to unforeseeable events (that is, true uncertainty), whereas flexibility is a potential to respond to foreseeable, predictable and quantifiable events (that is, true risk).

The agility literature is also quite clear that, in addition to the ability to cope with true uncertainty, agility adds certain dimensions beyond those traditionally incorporated in flexibility; specifically a significant focus on:

- delivering value to the customer (which in turns introduces the need for understanding what the customer values and needs in depth);
- valuing and leveraging human knowledge and skills; and
- adopting, where applicable, new organisational forms and practices (including the idea of virtual organizations and extensive use of intra-organisational co-operation).

The other key notion within the concept of agility, apart from the notion of dealing with true uncertainty, is the ability to timeously identify environmental changes and respond, with speed, to changes. Terms such as responsiveness (Zhang & Sharifi, 2000) and adaptability (Goranson, 1999) are used to represent this need for speed of change. Other authors view adaptability as a distinct concept to agility (e.g. Katayama, 1999) or include it as one of the dimensions of agility (Bessant et. al., 1999). Nevertheless, speedy response to unanticipated change is central to most authors' distinction of agility from flexibility.

The measurement of agility focuses on the distinguishing factors of agility, namely:

- Responsiveness to changes in the business environment;
- Ability to benefit (or, at least, survive) unpredictable change; and
- Ability to anticipate and take advantage of changing customer needs.

Summarising the discussion of flexibility is more difficult. The concept of flexibility has attracted more attention for a far longer time than agility has and there are many conflicting definitions. Flexibility:

- Refers to a capacity/capability/ability held by an organization/system to change/adapt/respond/yield;
- can be expressed by way of attributes held by an organization/system (e.g. robustness) as well as attributes not held by an organization/system (e.g. rigidity);
- can deal with either true uncertainty (i.e. unforeseeable) as well as risk (i.e. foreseeable);
- is a multidimensional concept including ideas about adaptability, elasticity, liquidity, plasticity, robustness, resilience and versatility;
- is a polymorphous concept, that is, is context-dependent;
- can be acquired from a number of sources both internally to the organization (e.g. its structure, systems and processes) and externally to the organization (e.g. its relationships with suppliers and partners) and may be found within the strategic, tactical and operational capability of an organisation;
- incorporates a sense of the degree, variety and magnitude of change that an organization can tolerate and may be reflected in an ability to actively respond to events by changing as well as passively tolerate some range of events by being immune/insensitive to the events, limit the impact of events or absorb the consequences of events without changing; and
- incorporates a sense of both the range/number of options open to an organization/system as well as the cost and time or ease with which an organization/system can change.

The majority of the literature on flexibility is firmly embedded within the manufacturing context and discussions around flexibility measures, for example, take place within the context of manufacturing flexibility types. It is however evident that far more thought has been given to the generic and essential characteristics of flexibility and related measures. These are transferable out of a manufacturing context and can inform, for example, the measurement of agility. For example, the discussion of flexibility or agility as a potential for change and the measurement of the "favorability" of a change is more developed within the flexibility literature.

Although a thorough reading of the flexibility literature does show that the flexibility concept has developed beyond a purely manufacturing context, it still is largely associated therewith and does not focus on the customer and organisational dimensions to the same extent as the agility literature does. It is therefore proposed that the use of agility as an umbrella concept lifts the discussion out of an overwhelming manufacturing bias and allows the introduction of these new or increased-focus agility dimensions which better reflect current business management thinking.

A definition is needed that is as inclusive of the underlying notions of both flexibility and agility whilst remaining as context-free as possible. Accordingly, drawing from the previous sections, agility is defined as "***the potential of an organization to be responsive and resilient***":

- ***Potential*** - agility does not have to be realised for it to exist;
- ***Responsive*** – encapsulates the notions of:
  - ***Aware*** – stakeholder knowledge of and awareness of the environment (including customers and partners) and changes within that environment or the possibility of change (including unforeseen change);
  - ***Willing*** – stakeholder willingness to change, keep options open and/or commit resources to new or changed directions (in both a proactive or reactive manner and opportunity-exploiting and innovative or impact- and risk-reducing manner); and

  - ***Fast*** – organisation's ability to change with speed (time to become aware and respond proactively and favorably);
- ***Resilient*** – encapsulates the notions of:
  - ***Range*** – the range of uncertainties that can be accommodated (or range of states the organisation can adopt - covering the spectrum of predictable risks to unpredictable, true uncertainty) as well as the number and diversity of options that are available for exercise whilst achieving the overall purposes of the organisation; and
  - ***Ease*** – the costs associated with creating and maintaining agility capability as well as the costs associated with making a change (exercising an option, switching).

In search of a catchphrase to express the above: "***an agile organization is an <u>aware</u> organization that <u>can</u> (range and ease) and does (willingness) respond <u>fast</u> to change, both foreseen and unforeseen":***

- *Aware of change*
- *Willing to change*
- ***Fast** awareness and fast, proactive and favorable response to change is central*
- *Range of response possible*
- *Ease of response possible*

[Taking a different view (and bordering, perhaps, on the frivolous), we could restate agility as: "***Agility = Ability + Attitude***", with ability consisting of the <u>capabilities</u> to be fast (F), change with ease (E), be aware (A) of change and accommodate a range (R) of uncertainty and response (giving the acronym "FEAR"). Such an acronym, in turn, implies the notion of "competitive angst" as necessary to survival. "FEAR" should spur management to embed, within their organisation, the necessary capabilities for agility. Add to the "FEAR" factor (representing the ability of the organization to be agile) a "Willingness" factor (representing the attitude of the organization toward change and being agile) and one has, based on the above posited elements of agility, the essential elements of an agile organization].

The source and nature of a change as well as the source and nature of the agility are not central to this definition and will vary according to environmental and organisational circumstances. Purists might object that the term "resilience" refers to regaining an original shape or position and is therefore inappropriately chosen as agility may require a system to adopt a position or shape far removed from the one it originally occupied. There is however another sense to the term "resilience", which I believe is the intuitively held notion of "returning to health", for example, resilient to an infection. In the case of organizations, each organisation has some purpose (or mix of purposes representing its varying stakeholders) and resilience in this context is clearly a reference to recovering relatively easily and quickly to a position (not necessarily the starting-out position) where these purposes are being met favorably.

When assessing organizational agility previous research has distinguished between where, in an organization, agility may occur or has distinguished between the types of agility that may be found. The previous sections alluded to a number of possibilities including:

- External and internal (Upton, 1994) or long-term and short-term agility (Frazele, 1986);
- Strategic and operational (Meredith & Francis, 2000) or strategic, tactical and operational agility (Upton, 1994; Gustavsson, 1984);
- Agility to deal with physical, social/cultural and legal/explicit uncertainties or by categorizing agility by decisions across the value-chain (Goranson, 1999); and
- Agility within strategy, processes, linkages and people.

To aid one's assessment of agility within an organization one would like to define an organization in terms of a number of areas where agility may be found or required. Such "granularity" further aids one when diagnosing where an organization may fall short in terms of its agility capability. In deciding on such a "view" of an organization one needs to accommodate the notions of the "extended organization", that is, linked to key partners in the value chain (or value system or network), as well as the "embedded organization", that is, immersed in and influenced by a socio-politicoeconomic milieu. Reviewing the literature of flexibility and agility and the "views" used by previous researchers, this researcher has used a combination of that used by the Meredith & Francis(2000) - agile strategy, processes, linkages and people - and Zhang & Sharifi(2000) -agility drivers - as well as the Porter value chain (suppliers, distributors etc.) and the McKinsey Seven-S Framework (De Wit & Meyer, 1994 - strategy, structure, systems, staff, style, superordinate goals/shared values. Combining these "views" of an organization and its environment, this researcher has defined the following "areas" of an organization where one would assess the need for and existence of agility:

- ***Marketplace*** – Structure and favorability of markets, demand, products, opportunities and competition basis, intensity and constraints;
- ***Environment*** – Socio-eco-political (including regulatory) considerations; the general economic, government/regulatory, environmental, moral/ethical milieu;
- ***Linkages*** - Customers and their needs, wants and desires, power and requirement for deep insight; external linkages, the relationships with suppliers and with distributors/intermediaries and forms of partnership possible;
- ***Strategy & Structure*** – route chosen to maintain competitive success. Wide-deep scanning; Commitment by management; full deployment; performance measurement; agile structure, for example, flexible and adaptable work practices, HR policies, organisational structure etc.;
- ***Processes*** – the internal systems and procedures that make the organization work. Product design, marketing & selling, administrative, manufacturing, financing etc. robust decision-making, learning, innovation, opportunity recognition; knowledge management; measurement; lean and flexible assets and systems; rapid problem solving; fast product development/acquisition; and
- ***People*** - capability, involvement, commitment and empowerment; skilled decision-makers; continuous learning; knowledge management.

The above areas logically group into two:

- the marketplace and environment encapsulate what Zhang & Sharifi (2000) referred to as "agility drivers". They indicate where in the organisation's environment risk and uncertainty are expected and, consequently, where agility is needed; and

- the linkages, strategy and structure, process and people dimensions are the areas where we would expect to find the elements of agility embedded (or where we would find the "agility capabilities and providers" in Zhang & Sharifi's (2000) terminology).

Following on Ku's (1995) discussion, this researcher has chosen to use indicators for measuring agility. The concept discussions in the preceding sections were used in developing, a priori, the indicators, although the research instruments of Zhang & Sharifi (2000) and their indicators were resorted to wherever possible to increase face and content validity.

In deciding how to assess IT's support of organizational agility the idea of measuring "fit" or "alignment" is proposed. This idea has been used extensively in assessing IT's support of an organization's business strategy, perhaps the best example being Chan (1993). Chan (1993) adopted Venkatraman's (1989) notion that an organization has a "strategic personality" which he believed could be expressed by measuring an organisation's "strategic orientation" along seven dimensions. Chan (1993) then posited an "alignment" construct that compared the "business strategic orientation" of the organization to its "IT strategic orientation". Where there was a close match it was inferred that IT supported the organisation's business strategy. For each dimension of business and IT "strategic orientation" a number of similarly-worded indicators were devised and an alignment score, that represented IT's support of the organisation's strategy, was calculated by matching each of the indicators and finding the difference in their scores (which, for each dimension of "strategic orientation" were summed and averaged").

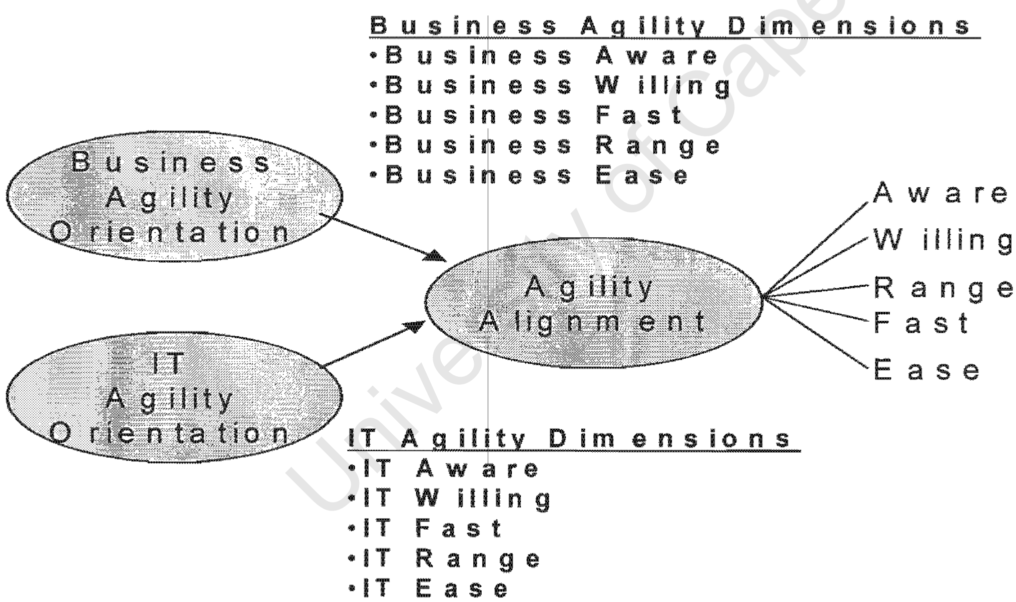
This research will follow a similar approach. We will express an organisation's need for agility in each of the above six organizational areas (which collectively represent an organization and its environment) along each of the five agility elements. We thus conceptualise an organization as having a "business agility orientation" similar to

Venkatraman's (1989) "business strategic orientation" and we measure this "business agility orientation" along its constituent dimensions of aware, willing, fast, need and range. Each of these dimensions will have a number of indicators and we will choose indicators so that they cover the six organizational areas.

As with Chan (1993) we will form a set of matched "IT agility orientation" dimensions and related indicators and an "agility alignment" score will be calculated by matching, on a one-to-one basis, the indicators of the "business agility orientation" and the "IT agility orientation".

Graphically:

Figure 2.2 Business and IT Agility Construct



Using the organisational areas and the agility elements above we can establish a set of indicators at the intersection of each. The indicators chosen are indicated in the following tables. Each set of questions includes a set of IT-related questions that will be matched against the corresponding businee-related questions to form a measure of the degree of alignment between the organization's agility requirements and IT's support thereof. The resultant questionnaire that will be used in this research is shown in Appendix A.

Table 2.4 Agility elements

	Agility Elements				
Organisational Area	*Aware*	*Willing*	*Fast*	*Range*	*Ease*
Marketplace (MRKT)	1, 2 (43, 44-49)	3, 4 (50, 105)	5, 6 (51, 42)	7, 8 (19-21, 97-102)	9, 10 (52, 53-61)
Environment (ENV)	11, 2 (41, 44-49)	12,13 (93, 88)	14,15 (62, 63)	16, 10 (86, 53-61)	17, 18 (64, 65)
Strategy& Structure (STRUT)	19, 20 (85, 103)	21, 22 (66, 103)	23, 24 (67, 33-35)	25, 26 (68, 84)	27, 28 (69, 70)
Linkages (LINK)	29, 30 (24, 7, 16)	31, 32 (8, 17)	33, 34 (1, 10, 22)	35, 36 (29, 89)	37, 38 (2-4, 11-13, 6, 15)
Processes (PROC)	39, 40 (89, 91-96, 71)	39, 41 (89, 91-96, 36)	39, 42 (89, 91-96, 72)	39, 43 (89, 91-96, 72-82)	39, 44, 45 (89, 91-96, 81, 82)
People (PEOP)	46, 47, 48 (38-40, 83, 37)	49, 50 (32, 28)	51, 52 (30, 31)	53, 54 (26, 28)	55, 56 (26, 27)

<u>Note</u>: The top row of question numbers refer to Table 2.5 below. The question numbers in parentheses refer to Table 2.6 below)

In the above table each agility element measure is thus a multi-item measure (by reading down each associated column in the table) and a score is calculated for each agility element by summing and averaging the scores in each column. The associated indicators for each multi-item measure fall within the various organizational areas. This ensures we get a set of indicators that cover the possible areas of an organization where agility will either be required or will be found.

Table 2.5 Agility questions – business agility orientation

1	We deliberately and regularly try identify or anticipate the marketplace changes that may impact our business severely, even if they are "unthinkable" in the ordinary course of events.
2	Intelligence gathering and scanning of the following is extremely important to our organization: • Economic and market changes • Competitor strategies and activity • Customer needs, wants and desires • Government policies and regulation (including labour-related, deregulation, privatisation) • Global changes (including social/political "causes", regional stability, trade policies) • Socio-political developments locally
3	We will compete on whatever basis we need to.
4	We believe in focusing on our core competencies and core product/service offerings and not in being easily distracted and side-tracked by seemingly attractive opportunities outside of our traditional lines-of-business.
5	Over the past 3 years, our organization has been able to quickly respond to and accommodate changing market and product/service requirements, even where these have been radical.
6	Over the past 3 years we have missed significant opportunities because of our inability to change fast enough.

7	We systematically and purposefully involve our customers in: • Product design • Product/service quality reviews • Trying to understand what the future may hold in terms of our products and services
8	Over the past 3 years our organization has been "caught by surprise" (i.e. have been significantly impacted) by changes in/by: • Markets and/or Customers • Competitors • Suppliers and/or Distributors • Government and/or Labour activity • Economic conditions (e.g. recessions, forex rates, commodity prices) • Technology developments (e.g. potentially leading to product/service obsolescence, substitutability)
9	Our markets and demand for our products and services are so turbulent that we battle to keep up with the changes we are constantly having to make to our business

10	Over the past 3 years, we have been able to easily:
	• Introduce new product/service offerings
	• Make substantial changes to existing product/service offerings
	• Enter new target markets (same industries as organization operative in)
	  ○ locally
	  ○ abroad
	• Enter new target markets (same different industries as organization operative in)
	  ○ locally
	  ○ abroad
	• Implement new or significantly changed processes
	  ○ Production/manufacturing
	  ○ sales/distribution
	  ○ administration

11	We have often been caught unawares by socio-political changes that have had a significant impact on our business.
12	Management seem reluctant to "change with the times".
13	We tend to ignore what's going on around our business and prefer to get the work done.
14	We routinely identify socio-economic impacts on our business in time and before they harm our business.
15	Relative to our competitors we are more adept at implementing quickly the changes that need to be made because of changing government, regulatory or labour policies.
16	We have invested in a number of capabilities and initiatives that provide a hedge against adverse socio-political or economic changes.
17	Over the past 3 years our organization has weathered, with relatively little cost or effort, the changes caused by, for example, changing global and regulatory requirements.
18	We ensure that we build into our organization a capacity to absorb the impact of developments within our local and global business environment.
19	Management believe that predicting the future with any real assurance is difficult and prefer to "keep their options open".
20	Top management don't particularly worry about anything beyond the next 2-3 years.
21	We will reorganise ourselves, drastically if necessary, to accommodate changes in our markets, products, etc
22	As an organization we will commit to our decisions and will not allow ourselves to be distracted from our course without good cause
23	Management are quick to identify new opportunities or discard failures or divest from declining businesses/markets
24	Our decision-making and problem-solving processes, at the following 'levels' are quick • Executive & General level • Senior management • Middle management
25	We adopt a range of organisational forms/contractual arrangements with potential business partners (e.g. joint ventures, "virtual organizations", subsidiary arrangements, out/co-sourcing arrangements etc)?

26	We invest in a wide range of capabilities and/or businesses and alliances so that we have a hedge against unpredictable changes
27	We are constrained by the way we are organized and structured and cannot easily take advantage of new opportunities or evade threats to our survival and/or growth
28	We are able to change strategic direction with ease (cost and effort)
29	We monitor the quality of and the cost/profit associated with our various customer channels
30	Compared to our competitors we are far better at supplier chain and customer relationship management
31	Our management is very willing and prepared to change suppliers or distributors if this is required for business growth
32	In order to keep things manageable and overheads down, it is important to limit the number of ways of linking to the market and interacting with customers even if this sometimes goes against how the customer would like to interact with us
33	Our supply chain needs to be responsive and fast Our distribution chain needs to be responsive and fast
34	We are able to quickly adopt new customer channels or change existing customer channels to accommodate changes in the way customers want to interact with us.
35	We are very constrained in terms of the types of products/services our distribution channels/intermediaries can accommodate/handle
36	The products/services our customers require are very diverse and non-standardised
37	Our supply and distribution chains can easily accommodate: • Large or sudden changes in volumes • Large or sudden changes in product types or specifications • New product introductions
38	Easy and effective linking (i.e. interfacing to or integrating with) our Suppliers is extremely important to the success of our business Easy and Effective linking (i.e. interfacing to or integrating with) our

	Distributors/Intermediaries is extremely important to the success of our business
39	The biggest obstacles to changing our business processes are: • People knowledge/skills • IT/IS constraints/limitations/inflexibility • Lack of integration between our internal processes • Lack of integration with our business partners • Management unwillingness to change • Management awareness of the need for change • Too costly or difficult to change • We cannot change fast enough
40	We measure (and benchmark) the performance of our processes
41	As far as our business processes are concerned, we believe that "if it ain't broke, don't touch it" even when we could improve the processes
42	Our business processes, on the whole, allow us to speedily accommodate and exploit new business opportunities
43	How flexible (i.e. able to accommodate large changes e.g. in volume or product/service types or new products/services) are the following processes: • Production/manufacturing • Sales/distribution • Marketing • Customer-facing processes • Human resources • Back-office administration • Financial administration • Product design
44	Our processes and systems have been designed to be easily changeable
45	Our business processes seldom prevent us from embarking on a new business initiative
46	We purposefully assess and build on our peoples' • Involvement and commitment • Capability

	• Empowerment
47	Our organization has specific processes, systems and procedures for ensuring we manage knowledge and learning
48	We actively and purposefully assess knowledge and skills within our organization to ensure we have the right people
49	Our people display a high level of innovativeness compared to our competitors
50	Our people display a willingness to change when necessary
51	Our people display a high level of proactiveness compared to our competitors
52	Our people are capable of coping with sudden change
53	Our people and work practices are inflexible and a problem when we need to change
54	We have forgone significant opportunities as our people do not have the right knowledge, skills or attitude to embrace these opportunities
55	We believe in using flexible work practices so that we can accommodate changes and new business directions with ease
56	We are easily able to re-configure the way we deploy our human resources

The matching IS/IT questions are:

Table 2.6 Agility questions – IT agility orientation

<u>Our</u> IT/IS enables our supply chain to: • Be as responsive and fast as it needs to be (1) • Easily accommodate - large or sudden changes in volume (2) - large or sudden changes in product types or specifications (3) - new product introductions (4) • change and re-configure as easily as it needs to be (5) • easily and effectively interface or integrate with our suppliers' systems and processes (6)

Our IT/IS allows us to manage our supply chain better than our competitors (7)
Our IT/IS allows us to change suppliers relatively easily if required (8)
The IT/IS of our main supply partners is an inhibitor to a fast and responsive supply chain (9)
Our IT/IS enables our distribution chain to: • Be as responsive and fast as it needs to be (10) • Easily accommodate - large or sudden changes in volume (11) - large or sudden changes in product types or specifications (12) - new product introductions (13) • change and re-configure as easily as it needs to be (14) easily and effectively interface or integrate with our distributors' systems and processes (15)
Our IT/IS allows us to manage our distribution chain better than our competitors (16)
Our IT/IS allows us to change distributors/intermediaries relatively easily if required (17)
The IT/IS of our main distribution/intermediation partners is an inhibitor to a fast and responsive distribution chain (18)
Our IT/IS allows us to: • Systematically and purposefully involve our customers in: - product design (19) - product/service quality reviews (20) - trying to understand what the future may hold in terms of our products and services (21) • Quickly adopt new customer channels or change customer channels to accommodate changes in the way customers want to interact with us (22) • Link to the market and to customers in whatever way is necessary (23) • Monitor the quality and cost/profit of our customer channels (24)

Our IT/IS allows us to manage our customer relationships better than our competitors (25)	

Indicate the extent to which IT/IS provides effective support for:

- Flexible work practices to accommodate changes and new business directions with ease (26)
- Easy re-configuration of the way we deploy our human resources (27)
- Knowledgeable, skilled, willing people ready to embrace new business opportunities (28)
- Diversity of products/services our distribution channels/intermediaries can accommodate/handle (29)
- A high level of proactiveness of our people compared to our competitors (30)
- The ability of our people to cope with sudden change (31)
- A high level of innovativeness of our people compared to our competitors (32)
- Quick decision-making and problem-solving processes, at the following 'levels':
  - Executive & General level (33)
  - Senior management (34)
  - Middle management (35)
- Improving our business processes (36)
- Assessing knowledge and skills within our organization to ensure we have the right people (37)
- Assess and building on our peoples':
  - Involvement and commitment (38)
  - Capability (39)
  - Empowerment (40
- Remaining abreast of socio-political changes that may significantly impact our business (41)
- Our ability to change fast (42)

Our IT/IS allows us to:

- identify or anticipate marketplace changes that may impact our business severely (43)

- gather intelligence and scan for:
  - Economic and market changes (44)
  - Competitor strategies and activity (45)
  - Customer needs, wants and desires (46)
  - Government policies and regulation (including labour-related, deregulation, privatisation) (47)
  - Global changes (including social/political "causes", regional stability, trade policies) (48)
  - Socio-political developments locally (49)
- compete on whatever basis we need to (50)
- quickly respond to and accommodate changing market and product/service requirements, even where these are radical (51)
- cope with the turbulence of our markets and demand for our products and services and the resultant changes we are constantly having to make to our business (52)
- With ease:
  - Introduce new product/service offerings (53)
  - Make substantial changes to existing product/service offerings (54)
  - Enter new target markets (same industries as organization operative in)
    - Locally (55)
    - Abroad (56)
- Enter new target markets (same different industries as organization operative in)
  - Locally (57)
  - Abroad (58)
- Implement new or significantly changed processes
  - Production/manufacturing (59)
  - sales/distribution (60)
  - administration (61)

- identify socio-economic impacts on our business in time and before they harm our business. (62)
- implement quickly and, relative to our competitors more adeptly the changes that need

to be made because of changing government, regulatory or labour policies. (63)

- weathered, with relatively little cost or effort, the changes caused by, for example, changing global and regulatory requirements. (64)
- build into our organization a capacity to absorb the impact of developments within our local and global business environment (65)
- reorganise ourselves, drastically if necessary, to accommodate changes in our markets, products, etc (66)
- Quickly identify new opportunities or discard failures or divest from declining businesses/markets (67)
- adopt a range of organisational forms/contractual arrangements with potential business partners (e.g. joint ventures, "virtual organizations", subsidiary arrangements, out/co-sourcing arrangements etc) (68)
- re-organize and re-structure to easily take advantage of new opportunities or evade threats to our survival and/or growth (69)
- change strategic direction with ease (cost and effort) (70)
- measure (and benchmark) the performance of our processes (71)
- enable our business processes so that we can speedily accommodate and exploit new business opportunities (72)
- Be flexible (i.e. able to accommodate large changes e.g. in volume or product/service types or new products/services) in the following processes:
    - Production/manufacturing (73)
    - Sales/distribution (74)
    - Marketing (75)
    - Customer-facing processes (76)
    - Human resources (77)
    - Back-office administration (78)
    - Financial administration (79)
    - Product design (80)

- Allow our processes and systems to be easily changeable (81)
- Enable our business processes so that we can always embark on new business

initiatives (82) • manage knowledge and learning (83) • invest in a wide range of capabilities and/or businesses and alliances so that we have a hedge against unpredictable changes (84) • "keep our options open" (85) • invest in capabilities and initiatives that provide a hedge against adverse socio-political or economic changes. (86)

IT/IS is the main cause for:
• Inability to maintain a diverse, non-standardised range of products/services as required by our customers (87)
• Poor ability to understand what is going on around our business (88)
• Poor people knowledge/skills (89)
• An unwillingness to change when necessary (90)
• Lack of integration between our internal processes (91)
• Lack of integration with our business partners (92)
• Management unwillingness to change (93)
• Management awareness of the need for change (94)
• It being too costly or difficult to change (95)
• Not being able to change fast enough (96)
• being "caught by surprise" (i.e. have been significantly impacted) by changes in/by:
    ○ Markets and/or Customers (97)
    ○ Competitors (98)
    ○ Suppliers and/or Distributors (99)
    ○ Government and/or Labour activity (100)
    ○ Economic conditions (e.g. recessions, forex rates, commodity prices) (101)
    ○ Technology developments (e.g. potentially leading to product/service obsolescence, substitutability) (102)
• An inability to commit to decisions (103)
• Unacceptably short-term (2-3 years) focus of management (104)
Inability to focus on our core competencies and core product/service offerings (105)

Lastly, the following questions are used in an initial assessment of the agility construct's validity:

- *"Our IT/IS effectively supports our ability to be agile"*
- *"Our organisational agility is effectively enabled by our IT/IS"*.

as is an assessment of business performance using the following question (from Chan, 1993):

- *"How would you rate your organisation's performance over the past 2 years, relative to your competitors*:

	Not as Good	About the Same	Far Better
Financial Performance (e.g. profitability & return on equity)			
Market Growth (e.g. market share gains, sales growth, revenue growth)			
Product/Service Innovation			
Company Reputation amongst customers			

3 Research Instrument Pilot Approach

3.1 Introduction

The focus of this research was on exploring the concepts of flexibility and agility and on the conceptual development of a construct, and related research instruments, for assessing IT's support of organizational development. The pilot of the developed research instruments is limited and does not form the main thrust of this research. Section 4.2.4 below mentions the limitations of this part of the research.

3.2 Data description and Sample Selection

Business Agility Orientation (BAO) and IT Agility Orientation (IAO) (see figure 2.2 above) is gathered by means of a questionnaire. Part 2 of the questionnaire elicits BAO data and Part 3 elicits IAO data from respondents. Part 1 of the questionnaire gathers general information on the respondent as well as data on Business Performance (BUSPERF) over the past 2 years.

The questionnaires were delivered by e-mail and respondents were given the options of completing and returning the questionnaires via e-mail, fax or online (and over the Internet).

The structured questionnaire developed (Appendix B) was administered to management of certain departments within four organizations:

Table 3.1 Respondents

Organisation	Organisation-Type	No. Responses
Eskom	Utility	14
Rhomberg	Manufacturer	4

Futuregrowth	Financial services	2
Spaceage Technologies	IT service provider	3

Given that the intention was to pilot the assessment instrument, the study of only four organizations and the return of only 23 complete questionnaires is considered acceptable (Fink, 1995 considers 10 to be the minimum necessary). All but three questionnaires (returned by fax) were completed online. As all questions were completed a non-response analysis is unnecessary.

3.3 Data manipulation and analysis

Microsoft Excel (Microsoft Excel, 2002) was used to record and manipulate questionnaire responses. Statistical routines were performed using the Statistica data analysis software (Statsoft, Inc., 2001).

3.3.1 Alignment Scores

Agility is represented by the five dimensions of Awareness, Willingness, Fast, Range of Response and Ease of Response. The questionnaire employs a 5-point Likert scale to represent the indicators for each of these dimensions. A value for each dimension is obtained by summing and averaging the values of the indicators representing each dimension Thus an average score is calculated for each dimension of agility (aware, willing, fast, range and ease).

In addition to the averages calculated, the median, minimum, maximum and standard deviations of the responses for each dimension are calculated.

An agility score for BAO and IAO are calculated by summing and averaging the agility dimension scores of each (called BAOS and IAOS respectively). An overall Agility Alignment Score (AAS) is then calculated, following the moderation approach (Chan, 1993), by multiplying BAOS and IAOS.

3.3.2 Statistical Tests

As the primary focus of this research was on concept development and on the initial development of a research instrument, statistical testing is restricted to testing for measurement scale reliability and validity considerations are limited to an initial test for correlation between the agility alignment measures and BUSPERF and two questions mentioned at the end of Section 2 above (i.e. a limited test of predictive validity). No causal model is posited and therefore further validity investigations beyond these are inappropriate.

Reliability of the measurement scale was assessed using Cronbach's Alpha. Nunnaly's (1978, 1970) suggestion of an alpha of 0.7 as an acceptable reliability is used as a guide.

Predictive validity was assessed through correlation between AAS and BUSPERF and the two questions from Section 2 mentioned above. Pearson's correlation was used. The correlation coefficients and the significance levels are reported below.

4 Pilot Results and Discussion

The tables and radar plot below show the summarized results for all 4 organisations and the summarized reliability and validity statistics.

4.1 Summarised Results

Table 4.1 Average Scores and Statistics for agility dimensions and organisational areas

Section 2 - Business agility orientation

	AWARE	WILLING	FAST	RANGE	EASE	MARKET	ENVIRON	STRAT	LINKAGE	PROCESS	PEOPLE
min	2.52	2.25	2.33	2.02	1.67	2.71	2.15	2.20	1.40	0.00	0.00
max	4.45	4.07	4.92	4.55	4.60	5.01	4.89	4.10	4.58	4.30	5.00
mean	3.70	3.33	3.60	3.50	3.32	3.74	3.71	3.41	3.43	3.29	3.41
std dev	0.60	0.48	0.64	0.70	0.75	0.63	0.76	0.48	0.79	0.97	0.94
median	3.83	3.41	3.58	3.42	3.36	3.82	3.79	3.40	3.40	3.55	3.43

Section 3 - IT agility orientation

	AWARE	WILLING	FAST	RANGE	EASE	MARKET	ENVIRON	STRAT	LINKAGE	PROCESS	PEOPLE
min	2.38	1.88	2.44	2.43	2.52	2.50	1.86	1.78	1.95	1.60	2.40
max	4.47	4.10	4.57	4.10	4.64	4.21	4.07	4.20	4.35	4.60	5.70
mean	3.34	2.72	3.60	3.33	3.66	3.33	3.10	3.20	3.23	3.28	3.42
std dev	0.64	0.50	0.65	0.51	0.67	0.52	0.69	0.69	0.78	0.68	0.92
median	3.14	2.72	3.49	3.29	3.51	3.25	3.08	3.14	3.20	3.22	2.98

The summarized results for the four individual organizations are not required for this research but are shown in Appendix C for completeness.

Figure 4.1 Radar plot of mean scores for agility dimensions and organisational areas

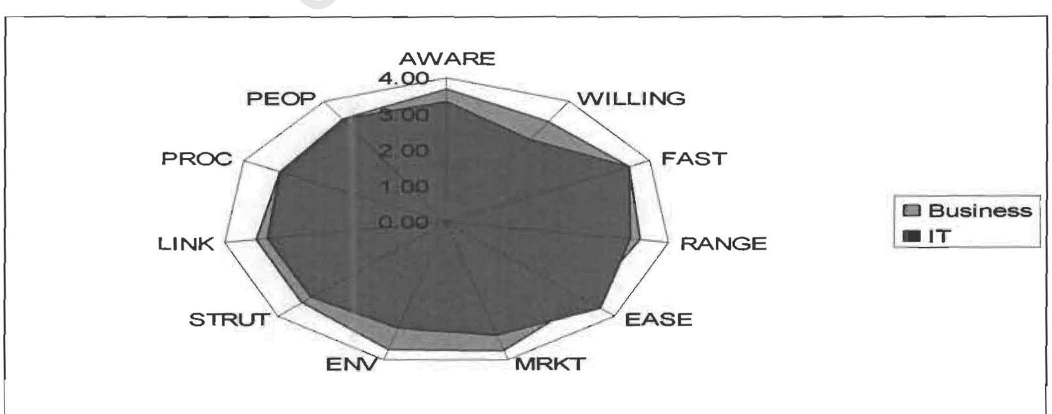


Table 4.2 Business Performance and "Predictive Question" Scores

	BusIT	ITBus	FP	MG	PS	CR	BUSPERM
min	2.00	2.00	1.00	1.00	1.00	2.00	1.25
max	5.00	5.00	3.00	3.00	3.00	3.00	3.00
mean	3.73	4.00	2.50	2.32	2.64	2.82	2.57
std dev	0.98	1.07	0.74	0.78	0.73	0.39	0.51
median	4.00	4.00	3.00	2.50	3.00	3.00	2.75

Key:

- ***BusIT*** = "Our IT/IS effectively supports our ability to be agile"
- ***ITBus*** = "Our organisational agility is effectively enabled by our IT/IS"
- ***FP*** = Financial performance (e.g. profitability & return on equity)
- ***MG*** = Market growth (e.g. market share gains, sales growth, revenue growth)
- ***PS*** = Product/Service innovation
- ***CR*** = Company reputation amongst customers
- ***BUSPERM*** = overall business performance measure (by summing and averaging FP, MG, PS and CR)

Table 4.3 Agility Alignment Scores (AAS):

AWARE	WILLING	FAST	RANGE	EASE	MARKET	ENVIRON	STRAT	LINKAGE	PROCESS	PEOPLE	AGILITY
12.31	9.16	13.03	11.64	12.49	11.53	12.01	11.19	11.52	11.19	13.05	11.74

Key: ***Agility*** = Sum and average of individual scores for aware, willing, fast range and ease.

4.2 Summarised Statistics

4.2.1 Reliability

4.2.1.1 Part 2 of Questionnaire (Business Agility Orientation)

Summary for scale: Mean=17.4105, Std.Dev.=2.80488 Valid N:23

Cronbach alpha: .935215 (Standardized alpha: .93953)

Average inter-item correlation: .763537

Table 4.4 Reliability analysis results – BAO

	Mean if deleted	Var. if deleted	StdDev. if deleted	Item – Total Corr.	Alpha if deleted
Aware	13.73965	5.006595	2.237542	0.834448	0.919273
Willing	14.07907	5.581932	2.362611	0.789259	0.931977
Fast	13.82629	4.778177	2.185904	0.885846	0.909197
Range	13.91829	4.749551	2.179347	0.798876	0.926871
Ease	14.07864	4.354706	2.086793	0.883518	0.911581

Table 4.5 Reliability analysis results – BAO intercorrelations

Correlations	Aware	Willing	Fast	Range	Ease
Aware	1.000	0.645	0.823	0.768	0.765
Willing	0.645	1.000	0.803	0.648	0.783
Fast	0.823	0.803	1.000	0.712	0.845
Range	0.768	0.648	0.712	1.000	0.773
Ease	0.765	0.783	0.845	0.773	1.000

A high alpha of .935 is reported suggesting a high degree of measurement scale reliability.

4.2.1.2 Part 3 of Questionnaire (IT Agility Orientation)

Summary for scale: Mean=16.5873 Std.Dev.=2.55329 Valid N:23

Cronbach alpha: .914694 Standardized alpha: .912187

Average inter-item correlation: .749519

Table 4.6 Reliability analysis results – IAO

	Mean if deleted	Var if deleted	StDv if deleted	Item – Total Corr.	Alpha if deleted
Aware	13.26770	3.697145	1.922796	0.892169	0.871318
Willing	13.85976	5.107694	2.260021	0.420022	0.955638
Fast	13.01978	3.578189	1.891610	0.933210	0.861518
Range	13.27675	4.115798	2.028743	0.938101	0.870213
Ease	12.92519	3.881412	1.970130	0.776674	0.898034

Table 4.7 Reliability analysis results – IAO intercorrelations

Correlations	Aware	Willing	Fast	Range	Ease
Aware	1.000	0.543	0.881	0.892	0.716
Willing	0.543	1.000	0.452	0.409	0.188
Fast	0.881	0.452	1.000	0.909	0.865
Range	0.892	0.409	0.909	1.000	0.896
Ease	0.716	0.188	0.865	0.896	1.000

A high alpha of .914 is reported suggesting a high degree of measurement scale reliability.

4.2.2 Validity

Predictive validity was limited to testing for correlation (using Pearson correlation) between the following (the resultant correlation coefficients are given as well as respective significance levels, p):

Table 4.8 Correlation analysis results – full questionnaire

Variable 1	Variable 2	Correlation	p

		coefficient	
"Our organisational agility is effectively enabled by our IT/IS"	Business Agility Orientation Score (BAOS)	-.0048	.983
	IT Agility Orientation Score (IAOS)	.2340	.282
	Business Performance Score (BUSPERFS)	.2877	.183
	Agility Alignment Score (AAS)	.1168	.595
"Our IT/IS effectively supports our ability to be agile"	Business Agility Orientation Score (BAOS)	**.4452**	**.033**
	IT Agility Orientation Score (IAOS)	**.5537**	**.006**
	Business Performance Score (BUSPERFS)	**.4303**	**.006**
	Agility Alignment Score (AAS)	**.5584**	**.04**

The statement ***"Our IT/IS effectively supports our ability to be agile"*** is significantly correlated (all $p<0.05$) with the Business Agility Orientation Score, IT Agility Orientation Score, Business Performance Score and the Agility Alignment Score (If the Eskom respondents (14 of the 23 observations) are used then a highly significant correlation of 0.73 (p=.003) between this question and the Agility Alignment Score is reported).

There are no significant correlations reported between ***"Our organisational agility is effectively enabled by our IT/IS"*** and any of the four above scores despite the similarity of the wording. Add to this the lack of correlation between the two variable 1 questions above (.2985; p=.167) and it would appear that the two questions are interpreted by respondents in very different ways.

The small number of observations (less than 50) however advise some caution when interpreting these results.

4.2.3 Questionnaire Length

It is common cause that where survey questionnaires are too lengthy the chances of respondent fatigue, disinterest or annoyance are increased with consequent threat to scale reliability and construct validity. The questionnaire utilized in this research was too long, although respondents were warned that the purpose of the questionnaire was to elicit which indicators were the better and were asked for their indulgence (3 respondents commented nevertheless on the length).

A shortened version of the questionnaire is desirable in any extension of this research beyond this initial pilot and toward this end this researcher has selected one of each of the questions in each of the cells of the table in Section 2.4 above. The questions were chosen based on this researcher's opinion of which questions are "richer" in terms of their insight into the potential agility capabilities or deficiencies within an organization as well as to ensure as wide as possible a coverage on the various operations of an organization. This "reduced" questionnaire was then tested for scale reliability and basic internal validity.

Table 4.9 Reduced question set

Organisational Area	Aware	Willing	Fast	Range	Ease
Marketplace (MRKT)	1	4	6	8	10
Environment (ENV)	2	13	15	16	17
Strategy& Structure (STRUT)	20	21	23	25	28
Linkages (LINK)	29	31	33	35	38
Processes (PROC)	39	41	42	43	44
People (PEOP)	48	49	51	54	55

Table 4.10 Average Scores and Statistics for agility dimensions and organisational areas – reduced questionnaire.

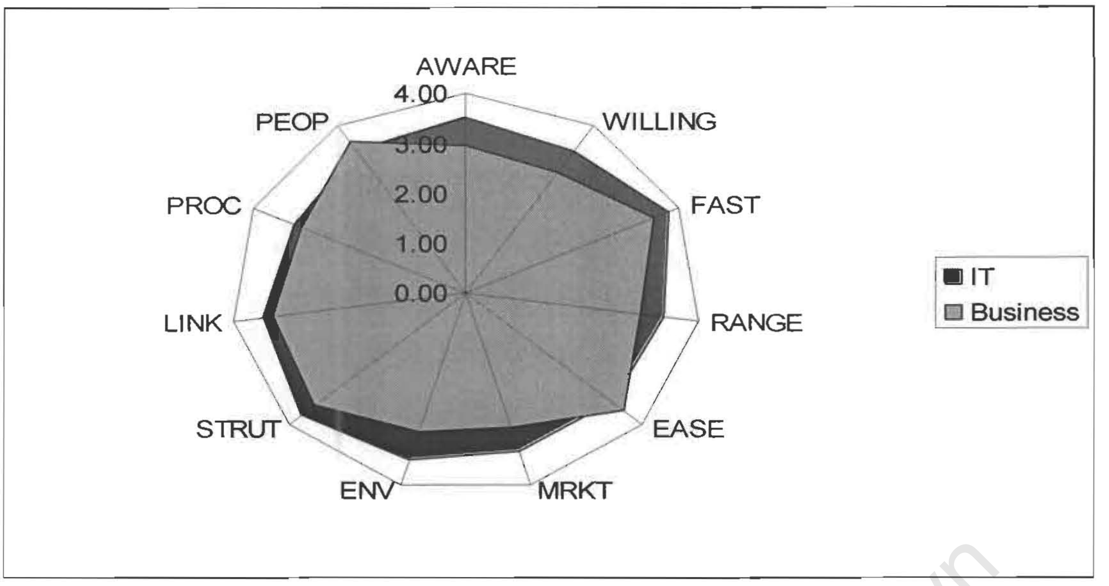
Section 2 - Business Agility Orientation

	AWARE	WILLING	FAST	RANGE	EASE	MRKT	ENV	STRUT	LINK	PROC	PEOP
min	1.33	1.67	2.17	1.73	2.33	1.74	1.87	1.80	0.80	1.20	2.00
max	4.00	4.00	5.00	4.17	5.00	3.80	3.93	4.60	5.00	4.20	5.00
mean	2.94	2.86	3.55	3.01	3.59	2.82	2.91	3.41	3.32	3.08	3.59
std dev	0.73	0.61	0.90	0.67	0.88	0.71	0.50	0.85	1.00	0.83	1.00
median	2.91	2.83	3.46	3.04	3.59	2.93	2.83	3.40	3.30	3.10	3.60

Section 3 - IT Agility Orientation

	AWARE	WILLING	FAST	RANGE	EASE	MRKT	ENV	STRUT	LINK	PROC	PEOP
min	2.15	2.00	2.83	1.79	1.87	2.16	2.17	2.60	0.60	1.80	2.20
max	4.69	4.00	5.00	4.79	4.43	4.04	4.90	4.80	5.00	4.14	5.00
mean	3.52	3.38	3.84	3.41	3.33	3.33	3.48	3.71	3.50	3.24	3.42
std dev	0.71	0.45	0.69	0.74	0.64	0.46	0.75	0.61	0.98	0.52	0.63
median	3.65	3.33	3.71	3.28	3.38	3.25	3.58	3.80	3.60	3.33	3.40

Figure 4.2 Radar plot of mean scores for agility dimensions and organisational areas – reduced questionnaire



4.2.3.1 Reliability - Part 2 of Questionnaire (Business Agility Orientation)

Summary for scale: Mean=17.4621 Std.Dev.=2.43106 Valid N:23 (Spreadsheet20)
Cronbach alpha: .807065 Standardized alpha: .811960
Average inter-item correlation: .481928

Table 4.11 Reliability analysis results – BAO (reduced questionnaire)

	Mean if deleted	Var if deleted	StDv if deleted	Item – Total Corr.	Alpha if deleted
Aware	13.93467	3.863187	1.965499	0.494455	0.802381
Willing	14.06052	4.482722	2.117244	0.532522	0.793819
Fast	13.65885	3.201470	1.789265	0.819448	0.691008
Range	14.07340	3.519407	1.876008	0.602430	0.769040
Ease	14.12092	3.895677	1.973747	0.572435	0.775917

Table 4.12 Reliability analysis results – BAO intercorrelations (reduced questionnaire)

Correlations	Aware	Willing	Fast	Range	Ease
Aware	1.000	0.127	0.617	0.391	0.356
Willing	0.127	1.000	0.431	0.467	0.675
Fast	0.617	0.431	1.000	0.712	0.568
Range	0.391	0.467	0.712	1.000	0.289
Ease	0.356	0.675	0.568	0.289	1.000

A high alpha of .807 is reported suggesting a high degree of measurement scale reliability.

4.2.3.2 Reliability - Part 3 of Questionnaire (IT Agility Orientation)

Summary for scale: Mean=15.8475 Std.Dev.=3.35053 Valid N:23 (Spreadsheet57)
Cronbach alpha: .926865 Standardized alpha: .931298
Average inter-item correlation: .738278

Table 4.13 Reliability analysis results – IAO (reduced questionnaire)

	Mean if deleted	Var if deleted	StdDev if deleted	Item – Total Corr.	Alpha if deleted
Aware	12.95514	7.087225	2.662184	0.802707	0.911262
Willing	12.97792	7.862969	2.804099	0.773646	0.920466
Fast	12.33661	6.013528	2.452250	0.920764	0.888081
Range	12.83299	7.546849	2.747153	0.795904	0.914593
Ease	12.28727	6.479181	2.545424	0.812079	0.912116

Table 4.14 Reliability analysis results – IAO intercorrelations (reduced questionnaire)

Correlations	Aware	Willing	Fast	Range	Ease
Aware	1.000	0.653	0.851	0.681	0.674
Willing	0.653	1.000	0.775	0.696	0.668
Fast	0.851	0.775	1.000	0.756	0.824
Range	0.681	0.696	0.756	1.000	0.727
Ease	0.674	0.668	0.824	0.727	1.000

A high alpha of .926 is reported suggesting a high degree of measurement scale reliability.

4.2.3.3 Validity

Table 4.15 Correlation analysis results – reduced questionnaire

Variable 1	Variable 2	Correlation coefficient	p
"Our organisational agility is effectively enabled by our IT/IS"	Business Agility Orientation Score (BAOS)	-.0449	.839
	IT Agility Orientation Score (IAOS)	.1185	.590
	Business Performance Score (BUSPERFS)	.2877	.183
	Agility Alignment Score (AAS)	0.0471	.831
"Our IT/IS	Business Agility	0.2806	.195

effectively supports our ability to be agile"	Orientation Score (BAOS)		
	IT Agility Orientation Score (IAOS)	**0.5331**	**.009**
	Business Performance Score (BUSPERFS)	**0.4303**	**.040**
	Agility Alignment Score (AAS)	**0.5152**	**.012**

As in Section 4.2.2 above, the statement ***"Our IT/IS effectively supports our ability to be agile"*** is significantly correlated (all $p<0.05$) with IT Agility Orientation Score, Business Performance Score and the Agility Alignment Score. Unlike 4.2.2 above however the correlation with BAOS disappears.

There are no significant correlations reported between ***"Our organisational agility is effectively enabled by our IT/IS"*** and any of the four above scores as was the case in Section 4.2.2 above.

4.2.4 Limitations of Pilot Study

The pilot of the research instrument has a number of limitations which caution too high a reliance on these initial results. Only four organisations were studied and a larger sample of organizations will be needed in any extension of this research. The limited sample sizes also increase the possibility that the effects of multicollinearity have biased the reliability measures and these must, accordingly, be viewed with suspicion.

The validity tests, whilst showing some interesting and supportive results, also show some contradicting results which are not easily explainable. A larger sample of organizations will be needed to overcome this weakness.

4.2.5 Summary

The reliability of the measurement scales appears high when either the full or reduced indicator set is used although concerns of multicollinearity mitigate against relying too heavily on these results.

The validity assessment, albeit limited as befitting the scope of this research, does provide support for the internal validity of the construct used in this research. The question ***"Our IT/IS effectively supports our ability to be agile"*** is significantly correlated with the postulated measure of Agility Alignment (particularly in the case where the responses are restricted to the organization representing 60% of the respondents). It is further significantly correlated with the individual Business Agility Orientation Score (in the case of the full indicator set. The disappearance of this correlation for the reduced indicator set is, it is suggested, an artifact of applying the analysis to a limited number of observations) and the IT Agility Orientation Score. Its correlation with the Business Performance measure also adds comfort in that a relationship between improved agility alignment and improved business performance is tentatively suggested.

The lack of any correlations with the question ***"Our organisational agility is effectively enabled by out IT/IS"*** is, quite frankly, puzzling given the similarity of the wording as well as the high correlation between the two "predictor" questions. There was a preponderance of IT management respondents as opposed to business management respondents amongst the 23 respondents and this may have led to a more positive assessment of the Section 3 questions and ***"Our IT/IS effectively supports our ability to be agile".*** This explanation is unsatisfactory though and further testing with larger sample sets for a number of organizations is needed when extending this research beyond this pilot.

5 Summary and Conclusions

The preceding sections have covered much ground ranging from the concepts of uncertainty, flexibility and agility and their inter-relationship through how flexibility and agility might be measured and the related concept of alignment to the synthesis of these ideas to form a conceptual model, and related measurement instruments, for measuring IT's support of organizational agility.

The nature of this research was primarily exploratory with the main intention being concept development. A detailed and comprehensive review of the flexibility and agility literature was undertaken. It was noted that there is significant confusion and variety in authors' views of how the concepts of flexibility and agility are defined and how they interrelate with much of this confusion seeming to originate from a lack of clarity between the terms "uncertainty" and "risk".

Agility incorporates the concept of flexibility and adds more focus on customer value, leveraging human knowledge and skills and on adopting a variety of organizational forms and increased inter-organisational cooperation. In reviewing the literature the key elements of this fuller concept of agility were distilled. An agile organization was defined as an organization that had the potential to be responsive and resilient. Responsiveness, in turn, referred to awareness of the business environment, a willingness to change on the part of organizational stakeholders and, central to the concept of agility, and ability to change with speed. Resilience, in turn, referred to the range of responses open to an organization as well as the ease with which and organization can change. Using previous research instruments as a basis (thus increasing face and content validity) a set of indicators for each of these elements of agility was created.

The use of indicators was chosen to measure organizational agility as there is wide consensus on the multidimensional and polymorphic nature of both the flexibility and agility concepts and the suitability of indicators to operationalising the measurement of such concepts. A particular approach to measuring alignment between business strategy and IT strategy was used as a basis for this research. This approach, following the work of Venkatraman (1989), posits that a business has a characteristic strategic "personality" or "orientation" that is more enduring than the tactics an organization uses over time. By measuring and comparing the respective business and IT strategic orientations one can assess the degree of alignment between the two. In the case of this research we conceptualised a business agility orientation and compared this to a matching IT agility orientation. The resulting alignment measure then represented the degree to which IT supported organizational agility.

The measurement instruments developed were then subjected to pilot testing. High measurement scale reliability was reported and, given the limited focus of this pilot testing, encouraging internal validity was found. Crucial to any extension of this research is the use of a shorter set or questionnaires and the extension of validity testing.

The good correlation found between the agility measure and the measures of business performance, as used in this research, suggest that the agility alignment measure may be a good predictor of business performance and, if found to be so, will be of definite value to management. Further research suggested includes assessing what factors influence the relative components of agility alignment, what factors enable or inhibit alignment and how enduring this alignment is over time. The mapping of the agility elements to particular IT approaches, methodologies, technologies and techniques is also suggested as is the assessing the relative efficacy of such. This would serve as a guide to management in deciding what options, from an IT perspective, are available for improving organizational agility.

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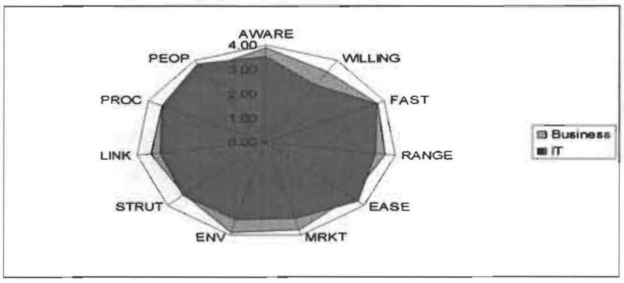
APPENDIX A Summarized results for Four Oganisations

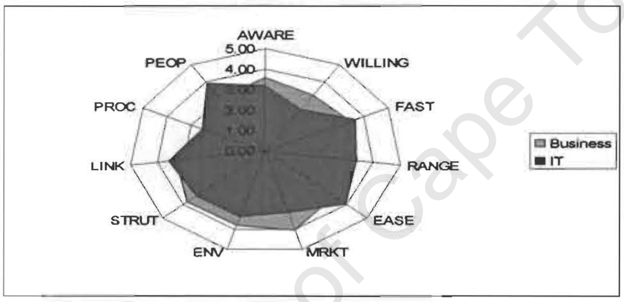
Eskom

	AWARE	WILLING	FAST	RANGE	EASE	MRKT	ENV	STRUT	LINK	PROC	PEOP
Business	3.89	3.46	3.77	3.68	3.46	3.78	3.87	3.31	3.58	3.55	3.56
IT	3.53	2.83	3.73	3.40	3.73	3.29	3.34	3.35	3.28	3.55	3.86



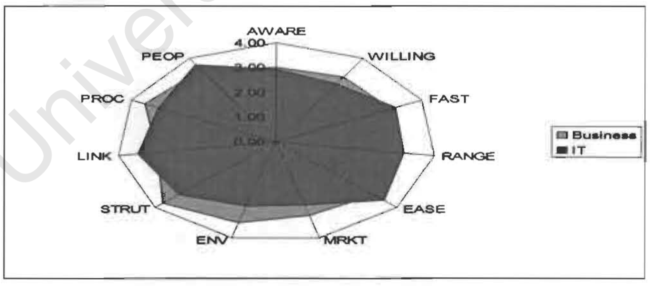
Rhombeg

	AWARE	WILLING	FAST	RANGE	EASE	MRKT	ENV	STRUT	LINK	PROC	PEOP
Business	3.59	3.24	3.45	3.41	3.36	4.03	3.77	3.79	3.30	2.48	3.10
IT	3.21	2.41	3.66	3.38	3.93	3.15	3.35	3.35	3.58	2.56	3.94



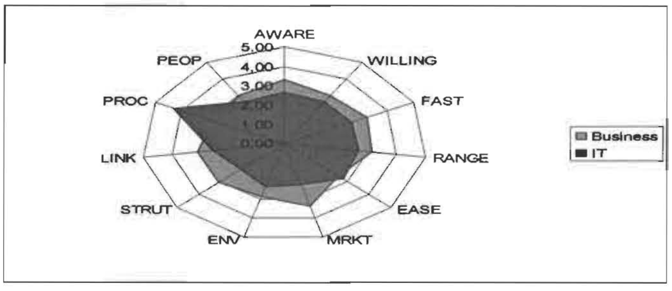
Spaceage

	AWARE	WILLING	FAST	RANGE	EASE	MRKT	ENV	STRUT	LINK	PROC	PEOP
Business	3.01	3.10	3.15	2.95	3.24	3.08	3.36	3.76	3.00	3.63	3.45
IT	2.93	2.78	3.30	3.22	3.58	2.62	2.68	3.24	3.49	3.24	3.70



Futuregrowth

	AWARE	WILLING	FAST	RANGE	EASE	MRKT	ENV	STRUT	LINK	PROC	PEOP
Business	3.28	2.95	3.22	3.11	2.50	3.38	2.84	3.05	3.10	2.74	2.96
IT	2.67	2.60	2.63	2.65	2.75	2.19	2.33	2.03	2.56	4.30	2.58



APPENDIX B Research Questionnaire

Organisational Agility

Dear Respondent

Thank you for taking time to complete this questionnaire. Your responses will be used in research into the role Information Technology and Systems (IT/IS) plays in Oganisational Agility (i.e. the ability to respond fast to unforeseen changes and cope with significant change).

Please be assured that your responses will be kept in the strictest confidence. At no stage will any of your responses be made known to anyone other than this researcher. No identifying information is asked of you other than your level within the organisation (executive/general management, senior management or other) and, for multi-unit organisations, you business unit.

The questionnaire consists of 3 parts. It is estimated that you will need about 45 minutes to complete this questionnaire. The questionnaire can be completed on-line if you so wish (and assuming your organisation allows you to connect to the Internet). Please go to: http://gsbnet.uct.ac.za/stringer/agilityquest.htm to do so. Alternatively complete the questionnaire and fax or e-mail it to the fax number/e-mail address given below.

Please note that some questions may appear to be identical – this research is attempting to, amongst other things, identify the questions that more accurately reflect Organisational Agility and which will help us design a more concise version of the questionnaire. Your responses are crucial and it is important that you please answer all the questions as accurately as you can.

Once again, thank you for your willingness to assist in this study. It is greatly appreciated. If you have any questions, please do not hesitate to contact me.

Appreciatively

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mobile: + 27 (0) 83 441 9798

Please complete and return the questionnaire by 6 September 2002 to:

- **by completing on-line:** **http://gsbnet.uct.ac.za/stringer/agilityquest.htm**
- **by fax:** **+ 27 (0) 21 406 1421**
- **by e-mail:** **stringer@gsb.uct.ac.za**

Lance Stringer, MCom Candidate, Department of Information Systems, University of Cape Town
Professor Paul Licker, Research Supervisor, Department of Information Systems, University of Cape Town

PART 1 **(Please ensure you complete this information as it is vital to grouping questionnaires and assessing the value of the measurements)**

Your name (optional):

Your organisation:
Your business unit:

Your "level" within the organisation (tick the appropriate box):

Executive or General management:		
Senior management:		
Other:		

How would you rate your organisation's performance over the past 2 years, relative to your competitors:

	Not as Good	*About the same*	*Far Better*
Financial Performance (e.g. profitability & return on equity)			
Market Growth (e.g. market share gains, sales growth, revenue growth)			
Product/Service Innovation			
Company Reputation amongst customers			

Any comments or ideas which you would like to make known:

PART 2: ***Please indicate (by circling the appropriate number), the extent to which you believe each of the following statements to be true for your organisation***:

#	Statement	1=100% False				5=100% True	Not Applic.
0	Our organizational agility is effectively enabled by our IT/IS	1	2	3	4	5	n/a
1	We deliberately and regularly try to identify or anticipate the marketplace changes that may impact our business severely, even if they are "unthinkable" in the ordinary course of events	1	2	3	4	5	n/a
2	Intelligence gathering and scanning of the following is extremely important to our organization:						
	• Economic and market changes	1	2	3	4	5	n/a
	• Competitor strategies and activity	1	2	3	4	5	n/a
	• Customer needs, wants and desires	1	2	3	4	5	n/a
	• Government policies and regulation (including labour-related, deregulation, privatisation)	1	2	3	4	5	n/a
	• Global changes (including social/political "causes", regional stability, trade policies)	1	2	3	4	5	n/a
	• Socio-political developments locally	1	2	3	4	5	n/a
3	We will compete on whatever basis we need to	1	2	3	4	5	n/a
4	We believe in focusing on our core competencies and core product/service offerings and not in being easily distracted and side-tracked by seemingly attractive opportunities outside of our traditional lines-of-business	1	2	3	4	5	n/a
5	Over the past 3 years, our organization has been able to quickly respond to and accommodate changing market and product/service requirements, even where these have been radical	1	2	3	4	5	n/a
6	Over the past 3 years we have missed significant opportunities because of our inability to change fast enough	1	2	3	4	5	n/a
7	We systematically and purposefully involve our customers in:						
	• Product design	1	2	3	4	5	n/a
	• Product/service quality reviews	1	2	3	4	5	n/a
	• Trying to understand what the future may hold in terms of our products and services	1	2	3	4	5	n/a
8	Over the past 3 years our organization has been "caught by surprise" (i.e. significantly impacted) by changes in/by:						
	• Markets and/or Customers	1	2	3	4	5	n/a
	• Competitors	1	2	3	4	5	n/a
	• Suppliers and/or Distributors	1	2	3	4	5	n/a
	• Government and/or Labour activity	1	2	3	4	5	n/a
	• Economic conditions (e.g. recessions, forex rates, commodity prices)	1	2	3	4	5	n/a
	• Technology developments (e.g. potentially leading to product/service obsolescence, substitutability)	1	2	3	4	5	n/a
9	Our markets and demand for our products and services are so turbulent that we battle to keep up with the changes we are constantly having to make to our business	1	2	3	4	5	n/a

		1=100% False				5=100% True	Not Applic.
10	Over the past 3 years, we have been able to easily:						
	• Introduce new product/service offerings	1	2	3	4	5	n/a
	• Make substantial changes to existing product/service offerings	1	2	3	4	5	n/a
	• Enter new target markets (<u>same</u> industries as organization operative in)						
	○ Locally	1	2	3	4	5	n/a
	○ Abroad	1	2	3	4	5	n/a
	• Enter new target markets (<u>different</u> industries as organization operative in)						
	○ Locally	1	2	3	4	5	n/a
	○ Abroad	1	2	3	4	5	n/a
	• Implement new or significantly changed processes						
	○ Production/manufacturing	1	2	3	4	5	n/a
	○ Sales/distribution	1	2	3	4	5	n/a
	○ Administration	1	2	3	4	5	n/a
11	We have often been caught unawares by socio-political changes that have had a significant impact on our business	1	2	3	4	5	n/a
12	Management seem reluctant to "change with the times"	1	2	3	4	5	n/a
13	We tend to ignore what's going on around our business and prefer to get the work done	1	2	3	4	5	n/a
14	We routinely identify socio-economic impacts on our business in time and before they harm our business	1	2	3	4	5	n/a
15	Relative to our competitors we are more adept at implementing quickly the changes that need to be made because of changing government, regulatory or labour policies	1	2	3	4	5	n/a
16	We have invested in a number of capabilities and initiatives that provide a hedge against adverse economic changes	1	2	3	4	5	n/a
17	Over the past 3 years our organization has weathered, with relatively little cost or effort, the changes caused by, for example, changing global and regulatory requirements	1	2	3	4	5	n/a
18	We ensure that we build into our organization a capacity to absorb the impact of developments within our local and global business environment	1	2	3	4	5	n/a
19	Management believe that predicting the future with any real assurance is difficult and prefer to "keep their options open"	1	2	3	4	5	n/a
20	Top management don't particularly worry about anything beyond the next 2-3 years	1	2	3	4	5	n/a
21	We will reorganise ourselves, drastically if necessary, to accommodate changes in our markets, products, etc	1	2	3	4	5	n/a
22	As an organization we commit to our decisions and will not allow ourselves to be distracted easily from our course without good cause	1	2	3	4	5	n/a
23	Management are quick to identify new opportunities or discard failures or divest from declining businesses/markets	1	2	3	4	5	n/a

		1=100% False				5=100% True	Not Applic.
24	Our decision-making and problem-solving processes, at the following levels, are quick						
	• Executive & General management	1	2	3	4	5	n/a
	• Senior management	1	2	3	4	5	n/a
	• Middle management	1	2	3	4	5	n/a
25	We adopt a range of organizational forms/contractual arrangements with potential business partners (e.g. joint ventures, "virtual organizations", subsidiary arrangements, out/co-sourcing arrangements etc)	1	2	3	4	5	n/a
26	We invest in a wide range of capabilities and/or businesses and alliances so that we have a hedge against unpredictable changes.	1	2	3	4	5	n/a
27	We are constrained by the way we are organized and structured and cannot easily take advantage of new opportunities or evade threats to our survival and/or growth	1	2	3	4	5	n/a
28	We are able to change strategic direction with ease (cost and effort)	1	2	3	4	5	n/a
29	We monitor the quality of and the cost/profit associated with our various customer channels	1	2	3	4	5	n/a
30	Compared to our competitors we are far better at supplier chain and customer relationship management	1	2	3	4	5	n/a
31	Our management is very willing and prepared to change suppliers or distributors if this is required for business growth	1	2	3	4	5	n/a
32	In order to keep things manageable and overheads down, it is important to limit the number of ways of linking to the market and interacting with customers even if this sometimes goes against how the customer would like to interact with us	1	2	3	4	5	n/a
33	Our supply chain needs to be responsive and fast	1	2	3	4	5	n/a
	Our distribution chain needs to be responsive and fast	1	2	3	4	5	n/a
34	We are able to quickly adopt new customer channels or change existing customer channels to accommodate changes in the way customers want to interact with us.	1	2	3	4	5	n/a
35	We are very constrained in terms of the types of products/services our distribution channels/intermediaries can accommodate	1	2	3	4	5	n/a
36	The products/services our customers require are very diverse and non-standardised	1	2	3	4	5	n/a
37	Our supply and distribution chains can easily accommodate:						
	• Large or sudden changes in volumes	1	2	3	4	5	n/a
	• Large or sudden changes in product types or specifications	1	2	3	4	5	n/a
	• New product introductions	1	2	3	4	5	n/a
38	Easy and effective linking (i.e. interfacing to or integrating with) our:						
	• Suppliers is extremely important to the success of our business	1	2	3	4	5	n/a
	• Distributors/Intermediaries is extremely important to the success of our business	1	2	3	4	5	n/a

		1=100% False				5=100% True	Not Applic.
39	The biggest obstacles to changing our business processes are:						
	• People knowledge/skills	1	2	3	4	5	n/a
	• IT/IS constraints/limitations/inflexibility	1	2	3	4	5	n/a
	• Lack of integration between our internal processes	1	2	3	4	5	n/a
	• Lack of integration with our business partners	1	2	3	4	5	n/a
	• Management unwillingness to change	1	2	3	4	5	n/a
	• Management unawareness of the need for change	1	2	3	4	5	n/a
	• Too costly or difficult to change	1	2	3	4	5	n/a
	• We cannot change fast enough	1	2	3	4	5	n/a
40	We measure (and benchmark) the performance of our processes	1	2	3	4	5	n/a
41	As far as our business processes are concerned, we believe that "if it ain't broke, don't touch it", even when we could improve the processes	1	2	3	4	5	n/a
42	Our business processes, on the whole, allow us to speedily accommodate and exploit new business opportunities	1	2	3	4	5	n/a
43	How flexible (i.e. able to accommodate large changes e.g. in volume or product/service types or new products/services) are the following processes:						
	• Production/manufacturing	1	2	3	4	5	n/a
	• Sales/distribution	1	2	3	4	5	n/a
	• Marketing	1	2	3	4	5	n/a
	• Customer-facing processes	1	2	3	4	5	n/a
	• Human resources	1	2	3	4	5	n/a
	• Back-office administration	1	2	3	4	5	n/a
	• Financial administration	1	2	3	4	5	n/a
	• Product design	1	2	3	4	5	n/a
44	Our processes and systems have been designed to be easily changeable	1	2	3	4	5	n/a
45	Our business processes seldom prevent us from embarking on a new business initiative	1	2	3	4	5	n/a
46	We purposefully assess and build on our peoples'						
	• Involvement and commitment	1	2	3	4	5	n/a
	• Capability	1	2	3	4	5	n/a
	• Empowerment	1	2	3	4	5	n/a
47	Our organization has specific processes, systems and procedures for ensuring we manage knowledge and learning	1	2	3	4	5	n/a
48	We actively and purposefully assess knowledge and skills within our organization to ensure we have the right people	1	2	3	4	5	n/a
49	Our people display a high level of innovativeness compared to our competitors	1	2	3	4	5	n/a
50	Our people display a willingness to change when necessary	1	2	3	4	5	n/a

		1=100% False				5=100% True	Not Applic.
51	Our people display a high level of proactiveness compared to our competitors	1	2	3	4	5	n/a
52	Our people are capable of coping with sudden change	1	2	3	4	5	n/a
53	Our people and work practices are inflexible and a problem when we need to change	1	2	3	4	5	n/a
54	We have forgone significant opportunities as our people do not have the right knowledge, skills or attitude to embrace these opportunities	1	2	3	4	5	n/a
55	We believe in using flexible work practices so that we can accommodate changes and new business directions with ease	1	2	3	4	5	n/a
56	We are easily able to re-configure the way we deploy our human resources	1	2	3	4	5	n/a

PART 3: ***Please indicate (by circling the appropriate number) the extent to which you believe each of the following statements to be true for your organisation's IT/IS*** *(whether provided internally or by external service providers)*

		1=100% False				5=100% True	Not Applic.
0	Our IT/IS effectively supports our ability to be agile	1	2	3	4	5	n/a
1	Our IT/IS enables our supply chain to:						
	• be as responsive and fast as it needs to be	1	2	3	4	5	n/a
	• easily accommodate - large or sudden changes in volume	1	2	3	4	5	n/a
	- large or sudden changes in product types or specifications	1	2	3	4	5	n/a
	- new product introductions	1	2	3	4	5	n/a
	• change and re-configure as easily as it needs to be	1	2	3	4	5	n/a
	• easily and effectively interface or integrate with our suppliers' systems and processes	1	2	3	4	5	n/a
2	Our IT/IS allows us to manage our supply chain better than our competitors	1	2	3	4	5	n/a
3	Our IT/IS allows us to change suppliers relatively easily if required	1	2	3	4	5	n/a
4	The IT/IS of our main supply partners is an inhibitor to a fast and responsive supply chain	1	2	3	4	5	n/a
5	Our IT/IS enables our distribution chain to:						
	• be as responsive and fast as it needs to be	1	2	3	4	5	n/a
	• easily accommodate - large or sudden changes in volume	1	2	3	4	5	n/a
	- large or sudden changes in product types or specifications	1	2	3	4	5	n/a
	- new product introductions	1	2	3	4	5	n/a
	• change and re-configure as easily as it needs to be	1	2	3	4	5	n/a
	• easily and effectively interface or integrate with our distributors' systems and processes	1	2	3	4	5	n/a
6	Our IT/IS allows us to manage our distribution chain better than our competitors	1	2	3	4	5	n/a
7	Our IT/IS allows us to change distributors/intermediaries relatively easily if required	1	2	3	4	5	n/a
8	The IT/IS of our main distribution/intermediation partners is an inhibitor to a fast and responsive distribution chain	1	2	3	4	5	n/a
9	Our IT/IS allows us to:						
	• systematically and purposefully involve our customers in						
	- product design	1	2	3	4	5	n/a
	- product/service quality reviews	1	2	3	4	5	n/a
	- trying to understand what the future may hold in terms of our products and services	1	2	3	4	5	n/a
	• quickly adopt new customer channels or change customer channels to accommodate changes in the way customers want to interact with us	1	2	3	4	5	n/a
	• link to the market and to customers in whatever way is necessary	1	2	3	4	5	n/a
	• monitor the quality and cost/profit of our customer channels	1	2	3	4	5	n/a

		1=100% False				5=100% True	Not Applic.
10	Our IT/IS allows us to manage our customer relationships better than our competitors	1	2	3	4	5	n/a
11	**Indicate the extent to which IT/IS provides effective support for:**						
	• flexible work practices to accommodate changes and new business directions with ease	1	2	3	4	5	n/a
	• easy re-configuration of the way we deploy our human resources	1	2	3	4	5	n/a
	• knowledgeable, skilled, willing people ready to embrace new business opportunities	1	2	3	4	5	n/a
	• diversity of products/services our distribution channels/intermediaries can accommodate/handle	1	2	3	4	5	n/a
	• a high level of proactiveness of our people compared to our competitors	1	2	3	4	5	n/a
	• the ability of our people to cope with sudden change	1	2	3	4	5	n/a
	• a high level of innovativeness of our people compared to our competitors	1	2	3	4	5	n/a
	• quick decision-making and problem-solving processes, at the following 'levels':						
	o Executive & General level	1	2	3	4	5	n/a
	o Senior management	1	2	3	4	5	n/a
	o Middle management	1	2	3	4	5	n/a
	• improving our business processes	1	2	3	4	5	n/a
	• assessing knowledge and skills within our organization to ensure we have the right people	1	2	3	4	5	n/a
	• assess and building on our peoples':						
	o Involvement and commitment	1	2	3	4	5	n/a
	o Capability	1	2	3	4	5	n/a
	o Empowerment	1	2	3	4	5	n/a
	• remaining abreast of socio-political changes that may significantly impact our business	1	2	3	4	5	n/a
	• our ability to change fast	1	2	3	4	5	n/a
12	**Our IT/IS allows us to:**						
	• identify or anticipate marketplace changes that may impact our business severely	1	2	3	4	5	n/a
	• gather intelligence and scan for:						
	o Economic and market changes	1	2	3	4	5	n/a
	o Competitor strategies and activity	1	2	3	4	5	n/a
	o Customer needs, wants and desires	1	2	3	4	5	n/a
	o Government policies and regulation (including labour-related, deregulation, privatisation)	1	2	3	4	5	n/a
	o Global changes (including social/political "causes", regional stability, trade policies)	1	2	3	4	5	n/a
	o Socio-political developments locally	1	2	3	4	5	n/a
	• compete on whatever basis we need to	1	2	3	4	5	n/a
	• quickly respond to and accommodate changing market and product/service requirements, even where these are radical	1	2	3	4	5	n/a
	• cope with the turbulence of our markets and demand for our products and services and the resultant changes we are constantly having to make to our business	1	2	3	4	5	n/a

13 **Our IT/IS allows us to:**

	1=100% False				5=100% True	Not Applic.
• with ease:						
○ introduce new product/service offerings	1	2	3	4	5	n/a
○ make substantial changes to existing product/service offerings	1	2	3	4	5	n/a
○ enter new target markets (same industries as organization operative in)						
▪ locally	1	2	3	4	5	n/a
▪ abroad	1	2	3	4	5	n/a
• enter new target markets (same different industries as organization operative in)						
○ locally	1	2	3	4	5	n/a
○ abroad	1	2	3	4	5	n/a
• implement new or significantly changed processes						
○ production/manufacturing	1	2	3	4	5	n/a
○ sales/distribution	1	2	3	4	5	n/a
○ administration	1	2	3	4	5	n/a
• identify socio-economic impacts on our business in time and before they harm our business	1	2	3	4	5	n/a
• implement quickly and, relative to our competitors more adeptly the changes that need to be made because of changing government, regulatory or labour policies	1	2	3	4	5	n/a
• weather, with relatively little cost or effort, the changes caused by, for example, changing global and regulatory requirements	1	2	3	4	5	n/a
• build into our organization a capacity to absorb the impact of developments within our local and global business environment	1	2	3	4	5	n/a
• re-organise ourselves, drastically if necessary, to accommodate changes in our markets, products, etc	1	2	3	4	5	n/a
• quickly identify new opportunities or discard failures or divest from declining businesses/markets	1	2	3	4	5	n/a
• adopt a range of organizational forms/contractual arrangements with potential business partners (e.g. joint ventures, "virtual organizations", subsidiary arrangements, out/co-sourcing arrangements etc)	1	2	3	4	5	n/a
• re-organize and re-structure to easily take advantage of new opportunities or evade threats to our survival and/or growth						
• change strategic direction with ease (cost and effort)	1	2	3	4	5	n/a
• measure (and benchmark) the performance of our processes	1	2	3	4	5	n/a
• enable our business processes so that we can speedily accommodate and exploit new business opportunities	1	2	3	4	5	n/a
• be flexible (i.e. able to accommodate large changes e.g. in volume or product/service types or new products/services) in the following processes:						
○ production/manufacturing	1	2	3	4	5	n/a
○ sales/distribution	1	2	3	4	5	n/a
○ marketing	1	2	3	4	5	n/a
○ customer-facing processes	1	2	3	4	5	n/a
○ human resources	1	2	3	4	5	n/a
○ back-office administration	1	2	3	4	5	n/a
○ financial administration	1	2	3	4	5	n/a
○ product design	1	2	3	4	5	n/a

	1=100% False				5=100% True	Not Applic.
14 IT/IS:						
• allows our processes and systems to be easily changeable	1	2	3	4	5	n/a
• enables our business processes so that we can always embark on new business initiatives	1	2	3	4	5	n/a
• facilitates managing knowledge and learning	1	2	3	4	5	n/a
• allows investing in a wide range of capabilities and/or businesses and alliances so that we have a hedge against unpredictable changes	1	2	3	4	5	n/a
• permits us to "keep our options open" strategically and operationally	1	2	3	4	5	n/a
• does not prevent us investing in capabilities and initiatives that provide a hedge against adverse socio-political or economic changes	1	2	3	4	5	n/a
15 IT/IS is the main cause for:						
• inability to maintain a diverse, non-standardised range of products/services as required by our customers	1	2	3	4	5	n/a
• poor ability to understand what is going on around our business	1	2	3	4	5	n/a
• poor people knowledge/skills	1	2	3	4	5	n/a
• an unwillingness to change when necessary	1	2	3	4	5	n/a
• lack of integration between our internal processes	1	2	3	4	5	n/a
• lack of integration with our business partners	1	2	3	4	5	n/a
• management unwillingness to change	1	2	3	4	5	n/a
• management unawareness of the need for change	1	2	3	4	5	n/a
• it being too costly or difficult to change	1	2	3	4	5	n/a
• not being able to change fast enough	1	2	3	4	5	n/a
• being "caught by surprise" (i.e. have been significantly impacted) by changes in/by:						
○ markets and/or customers	1	2	3	4	5	n/a
○ competitors	1	2	3	4	5	n/a
○ suppliers and/or distributors	1	2	3	4	5	n/a
○ government and/or labour activity	1	2	3	4	5	n/a
○ economic conditions (e.g. recessions, forex rates, commodity prices)	1	2	3	4	5	n/a
○ technology developments (e.g. potentially leading to product/service obsolescence, substitutability)	1	2	3	4	5	n/a
• an inability to commit to decisions	1	2	3	4	5	n/a
• unacceptably short-term (2-3 years) focus of management	1	2	3	4	5	n/a
• inability to focus on our core competencies and core product/service offerings	1	2	3	4	5	n/a

Please complete and return the questionnaire by 6 September 2002 to:

- **by completing on-line: http://gsbnet.uct.ac.za/stringer/agilityquest.htm**
- **by fax: +27 (0) 21 406 1421**
- **by e-mail: stringer@gsb.uct.ac.za**