VALIDATING THE CORPORATE ENTREPRENEURIAL ASSESSMENT INSTRUMENT IN SOUTH AFRICA

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Abstract

The Corporate Entrepreneurship Assessment Instrument (CEAI) was developed in North America to measure the attractiveness of the internal environment of companies to corporate entrepreneurs. The objective of this research was to validate the Corporate Entrepreneurship Assessment Instrument in South Africa.

Data from a study of South African middle managers was analysed to assess the CEAI's reliability and validity. While the CEAI is reasonably reliable, there are problems with its validity in South Africa. Some of the factors of the CEAI were correlated, contradicting one of the assumptions made by the original authors. Some items did not appear to contribute significantly to any of the factors, while others were ambiguous.

The data was examined further, and several options for improving the CEAI were proposed. These included changing the number of factors, changing the number of items in each factor, rewording or removing some of the items, and adding new items.

Declaration

I, Simon Alcock, declare that this research report is my own, unaided work. It is submitted in partial fulfilment of the requirements of the degree of Master of Business Administration in the University of the Witwatersrand, Johannesburg. It has not been submitted before for any degree or examination in this or any other university.

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1 Introduction

1.1 Context

1.1.1 Research, measurement, questionnaires, and validity

Research is the production of new knowledge. Researchers formulate ideas, express them in the form of hypotheses or propositions, and then look for evidence to support these ideas. If enough evidence can be found to support the ideas, they become part of the established repository of knowledge, and there they remain, until someone disproves them or improves upon them.

Measurement is central to research – if we cannot measure a phenomenon, how can we hope to understand it? Measurement comes in many forms, from the measurement of physical properties, to the measurement of abstract concepts like the personality of a job applicant. To measure physical properties like length or temperature, physical instruments are available that provide an estimate of the property in question, along with a tolerance. To measure more abstract properties, perhaps some aspect of the mood of a person, other techniques must be develop

One technique for measuring abstract properties is the questionnaire (Oppenheim, 1966). A questionnaire is a measuring instrument, like a ruler or a thermometer, but it measures properties that only exist in the minds of people. Questionnaires must be used carefully to ensure a correct measurement is obtained. While measuring the length of a piece of wood with a ruler is fairly straightforward, measuring an abstract property with a questionnaire is difficult. Designing a new questionnaire and making sure it works properly is especially difficult, because it is not easy to assess the suitability of a new questionnaire for its task just by looking at it.

The central concern of someone who develops a questionnaire is the validity of the new instrument (Thorndike, Cunningham, Thorndike & Hagen, 1991). Simply put, how well does the questionnaire measure what it is supposed to measure? If the new questionnaire is to measure intelligence in children, does it indeed measure intelligence and not some other quantity like enthusiasm?

1.1.2 Corporate Entrepreneurship

In this research, a questionnaire called the Corporate Entrepreneurship Assessment Instrument (CEAI) will be validated in South Africa. This instrument was developed only recently (Hornsby, Kuratko & Zahra, 2002), and its emergence demonstrates maturity of thinking in the field of corporate entrepreneurship. The idea that entrepreneurs exist inside organisations, and are a powerful force to be harnessed, has moved from rough idea, through theory, to commonly accepted belief, and the CEAI is potentially a useful new tool for top managers who seek to gauge the extent to which their corporate environment is friendly towards entrepreneurs.

Corporate entrepreneurship is seen as a tool for managers who wish to make their companies more competitive (Russell, 1999). In the modern business world, competitive advantage is everything, and companies find it harder and harder to rely on patents, proprietary technology, favoured positions, government protection, and other structural advantages. Companies are looking inward for sustainable competitive advantage, believing that the people in the best position to improve the business are its employees.

1.2 Purpose

The purpose of the research is to validate the CEAI for use in South Africa, and explore alternative structures for the instrument if it proves not to be valid. The final product of the research will be an instrument that is suitable for measuring a South African company's internal environment. Ideally, the instrument would be very similar or identical to the original CEAI, so that one instrument could be used for both North America and South Africa.

1.3 Terms used

The following is a list of terms used in this report. As far as possible, consistent terms have been used throughout the report. When sources have used different but equivalent terms, an effort has been made to make this equivalence apparent. In instances where several different terms have been

used in the literature to mean the same thing, these terms are grouped under one entry.

Construct Validity – one of the three kinds of evidence of validity (Thorndike et al, 1991). Test results and other data are compared with the relationships predicted by theory. If the experimental relationships match the theoretical relationships, this is evidence that both the instrument and the theory underlying it are valid. Discrepancies between the experimental and the theoretical relationships are evidence that at least one of the test and the theory is invalid.

Content-Related Evidence of Validity – one of the three kinds of evidence of validity. Evidence obtained by comparing items with the domain covered by the attribute under scrutiny. So, a mathematics test is valid if it covers the whole syllabus to be examined, and leaves out anything that is not related to the syllabus. Usually tested by an expert with knowledge of the subject matter.

CEAI – Corporate Entrepreneurship Assessment Instrument. A questionnaire developed recently by Hornsby et al (2002). The CEAI is based on a five-factor model of corporate entrepreneurship, and was validated on data gathered in the USA and Canada.

Criterion-Related Evidence of Validity – one of the three kinds of evidence of validity. Evidence provided by correlation between test results and another measurement of performance, usually one occurring only later. So, the validity of an aptitude test for accountants would be supported when school children who obtained high aptitude test scores go on to become successful accountants in later life.

Generalisability – a property of the information obtained by using an instrument. Information is generalisable if it can be used to draw conclusions about items other than the items sampled

Instrument – a questionnaire, test, or other tool used for gathering information about a specific attribute of an entity.

Internal Consistency – name given to a set of techniques used to obtain an estimate of reliability from the results of a single test. The set of techniques

includes Cronbach's alpha and some other formulae that provide approximations of alpha. (Similar: Internal Reliability – used in NCSS help – Hintze (2001))

Internal validity – property of a research project as a whole, not just an instrument. Internal validity is the rigorousness of the research plan – the internal controls that ensure that the conclusion drawn is warranted, given the results, and that there can be no other phenomenon affecting the results. Internal and external validity were defined by Campbell and Stanley (1963).

Reliability – a property of an instrument, independent of task. An instrument is valid if it produces the same results repeatedly.

Validity – a property of an instrument, given a task. An instrument is valid for a task if it provides information that is useful in carrying out the task correctly.

1.4 Problem statement & sub-problems

1.4.1 Sub-problem 1 – Reliability

Determine how reliable the Corporate Entrepreneurial Assessment Instrument is in South Africa.

1.4.2 Sub-problem 2 – Validity

Determine the validity of the Corporate Entrepreneurial Assessment Instrument for measuring entrepreneurial propensity in South Africa.

1.4.3 Sub-problem 3 – Alternate Structures

Explore alternative structures for the Corporate Entrepreneurial Assessment Instrument to explain any anomalies detected in the structure.

1.5 Significance

The final report will be useful to other South African researchers using the CEAI, as it will decrease the uncertainty surrounding the use of an untested instrument in a new environment. Researchers in other countries will also benefit if evidence of the CEAI's validity in South Africa can be found, because

such evidence would show that the CEAI's validity is not limited to the countries in which it was originally developed. Additional validity testing would be needed in new countries and cultures, but each new piece of validity evidence increases the confidence that can be placed on the instrument's results.

Once the CEAI has been sufficiently validated, it can be used a tool for monitoring the internal environment of a firm as part of a campaign to improve corporate entrepreneurship in that firm.

The final report will also provide an example of how the latest statistical techniques can be used to obtain evidence of reliability and validity. Specifically, the evidence of validity or otherwise obtained by CFA/SEM can be compared with the evidence obtained by other methods (EFA, etc). A positive link between these two kinds of evidence would suggest that SEM could be used as a 'one stop' solution to the problem of survey validation.

1.6 Assumptions, restrictions

The data available places a significant restriction on the research. Because the sample used represents only one company, it will be hard to make sweeping conclusions about all South African managers from the results. Nevertheless, evidence of validity in South Africa, combined with the evidence of validity in North America, would extend the usefulness and credibility of this instrument enormously.

The size of the sample is also a problem. Sixty-six is a low number of respondents for some of the techniques used in this research. Specifically, the power to reject latent variable models depends on sample size. Loehlin (2004) argues that samples of less than 100 individuals will have such wide confidence intervals that it will be hard to reject useful hypotheses. The problem of sample size means that any conclusions drawn in this report will need to be confirmed in further research before they can be regarded as rigorous.

This research/study is restricted by the data available – only 66 subjects responded to the questionnaire out of 167 polled. This limits the strength of

the conclusions that can be drawn from the research, and raises questions about self-selection bias. Only one organisation was surveyed, so the results of this research might not be properly generalizable to other organisations.

1.7 Subsequent chapters of the report

The following section of this report is a review of the key literature on relevant topics. These topics include corporate entrepreneurship, the corporate entrepreneurship assessment instrument, validation, and reliability. In the literature review, possible solutions to the research problem are explored and developed, using existing theory. The last part of the literature review is a summary of the hypotheses and propositions developed in the review.

The next section describes the methodology that was used in this research. Sampling, data collection, and data analysis are among the topics covered under methodology.

Next, the results are given. Some data was deemed too detailed to be included in the results chapter. In these cases, a summary or relevant information was given in the results chapter, and the remaining detail relegated to an appendix.

The interpretation chapter follows. In this chapter, the results are analysed as described in the methodology section, with the aim of confirming or falsifying the hypotheses and propositions set out in the literature review.

Last, conclusions are drawn from the research, and recommendations are made for future researchers and users of the CEAI.

A list of references used, and several appendices containing detailed information on the CEAI and the results of the analyses performed, are given at the end of this report.

2 Literature Review

2.1 Corporate entrepreneurship

An entrepreneur is “someone who organises a business venture and assumes the risk for it” (Wordweb definition). The word entrepreneur is hundreds of years old, and was developed by Cantillon (1734). Traditionally, the leader (more specifically, the founder) of a business is an entrepreneur. The leader is responsible for making decisions about what the business will do, how it will compete, and how it will succeed. In so doing, the entrepreneur exposes himself to the risk of failure, and assumes responsibility for the company’s future. In this sense of the word, employees are not entrepreneurs. They are there to carry out the decisions made by top management, and they do so for a fixed reward. Employees do not expose themselves to risk, and are not responsible for the wellbeing of the company.

The idea that employees of a company can also be entrepreneurs is more recent.

The objective of a business is to make a profit, and this objective is pursued by any available means.

2.1.1 Objectives of Corporate Entrepreneurship

Organisational wealth creation is an objective of corporate entrepreneurship (Antoncic & Hisrich, 2003A).

Entrepreneurship is the process whereby individuals innovate in response to opportunities, thus creating value for themselves and society (paraphrased from Muzyka, de Koning & Churchill (1995), in Echols & Neck (1998)).

Johnson (2001) provides the same definition, leaving out the word individual. So, entrepreneurship is the creation of something new to take advantage of an opportunity. It involves risk and creates value.

Lumpkin & Dess (1996) provide several models for the relationship between entrepreneurial orientation and firm performance.

Russell (1999) summarises the concept of corporate entrepreneurship as “the improvement of firm competencies and the extension of its opportunity set through internally generated innovation”

All these authors agree that corporate entrepreneurship has the potential to increase a company’s performance, whether this increase comes in the form of new wealth, improved agility, or some other form. Bearing in mind that it involves a measure of risk, it seems that corporate entrepreneurship might be a worthwhile cause for a company to adopt.

2.1.2 Dimensions of Corporate Entrepreneurship

Just as definitions of Corporate Entrepreneurship differ from author to author, there is disagreement over the dimensions of Corporate Entrepreneurship.

Starting with the simplest models, some authors consider corporate entrepreneurship to be a unidimensional construct. In perhaps the ultimate in elegance, Sundbo (1999) modelled corporate entrepreneurship as an attribute which is either present or absent in any company. He treated corporate entrepreneurship as a switch which was flipped in the company he investigated, and compared its functioning before the introduction of corporate entrepreneurship with its functioning after the introduction of corporate entrepreneurship. This approach may be useful – it is easy to understand, and it makes the analysis simpler.

Damanpour (1991) explored the relationships between innovation and various organisational attributes. In so doing, he simplified corporate entrepreneurship into a single variable – innovation – although many would argue that this approach omits important aspects of corporate entrepreneurship. A marginally more sophisticated model was proposed by Covin & Miles (1999), who viewed innovation as a necessary but not sufficient condition for corporate entrepreneurship. As well as innovation, they argued, companies should also have the objective of improving their competitive advantage by reinventing themselves. Knight (1997) agrees with this view, naming the two dimensions of corporate entrepreneurship innovativeness and proactiveness.

Adding another degree of complexity to this model of corporate entrepreneurship, we arrive at what could be considered the “middle of the road” view. Covin & Slevin (1986, 1991), name the dimensions of corporate entrepreneurship as risk-taking, innovativeness and proactiveness. There are variations on this theme. Miller & Friesen (1982) thought that proactiveness was not essential to corporate entrepreneurship, although Miller (1983) later changed his mind. Antoncic & Hisrich (2003A) replaced innovation with competitive aggressiveness, entirely doing away with the need to create something new.

At the other end of the complexity scale, Lumpkin & Dess (1996) insist that autonomy, innovativeness, risk-taking, proactiveness, and competitive aggressiveness make up a construct they call entrepreneurial orientation. However, it is unclear how many of these factors should be present before a firm can be considered entrepreneurial.

Some authors chose to strike out alone and created their own constructs of corporate entrepreneurship that are only marginally related to those mentioned above. Thornberry (2003) described four types of corporate entrepreneurship and stated that all the types satisfied several common requirements. These common elements were the creation of something new, a change in the way the firm’s resources are used, learning, value creation, and risk. The first and last elements are familiar from other works – they correspond to innovation and risk-taking, but the three remaining elements are not found in other works.

2.1.3 Types of entrepreneurial activities in companies

Many authors acknowledge that corporate entrepreneurship is related to activities that are performed in businesses. Activities are categorised as entrepreneurial if they satisfy certain criteria. Of these authors, some go a step further and list some activities that they consider inherently entrepreneurial.

One possible enumeration is that of Schollhammer (1982) (quoted by Zahra, 1993) who named five types of entrepreneurial activities – administrative, opportunistic, imitative, acquisitive, and incubative.

Antoncic & Hisrich (2003A) list four entrepreneurial activities: new business venturing, product/service innovation, process innovation, and self-renewal. Each of these four activities satisfies the criteria given by Antoncic & Hisrich for an activity to be entrepreneurial. Specifically, each activity involves taking risk, innovating, and being proactive.

Covin & Miles (1999) also identify four forms of corporate entrepreneurship: sustained regeneration, organizational rejuvenation, strategic renewal, and domain redefinition. Each form contains the seed of competitive advantage – so companies strive for competitive advantage through corporate entrepreneurship. There seems to be some overlap between these forms and the four activities of Antoncic & Hisrich (2003A), but this overlap is not complete.

Johnson (2001) also attempts to classify corporate entrepreneurship into forms, but unlike Covin & Miles (1999), he comes up with only three forms. Intrapreneurship is the creation of new ventures, dispersed entrepreneurship involves supporting potential entrepreneurs from within an organisation, and corporate venturing is building relationships with small ventures. Once again, some overlap exists between Johnson's classification and others, but it has its own peculiarities. One notable peculiarity is the unusual use of the term corporate venturing. In contrast to its usual meaning – the "spinning off" of a new venture from within a company (Thornberry, 2003; Antoncic & Hisrich, 2003B) – Johnson uses this term to mean the formation of relationships with small firms in a related area.

Thornberry (2003) identified his own four categories of corporate entrepreneurship. Corporate venturing is taken to mean spinning off a new venture from within the company. Intrapreneuring means instilling entrepreneurial values in the firm. Organisational transformation is like the self-renewal of Antoncic & Hisrich (2003A) and the organisational rejuvenation of Covin & Miles (1999). It involves changing the organisation from within, in order to increase efficiency. Industry rule-breaking means to change the rules – define new markets, invent new segments and niches that never existed before.

2.1.4 Fostering entrepreneurial activities in companies

Various aspects of corporate entrepreneurship have been discussed above. The objectives and potential rewards of corporate entrepreneurship have been explored, and corporate entrepreneurship found to be a worthy cause for companies to pursue. In the sections on the dimensions and types of corporate entrepreneurship, its characteristics were explored in more detail. So now that a clear picture of corporate entrepreneurship has been formed, how can it be encouraged in companies?

This question is central to corporate entrepreneurship research, and many authors provide suggestions on how corporate entrepreneurship can be encouraged.

A common theme that runs through much of the literature is the recognition that while it may be the intention of top management to make the company entrepreneurial, it is individuals who are the entrepreneurs. This leads Echols & Neck (1998) to suggest that one way of fostering corporate entrepreneurship is to select entrepreneurial employees. This was not their only recommendation though. They also said that the organisation should be structured so that it is easy for employees to detect and pursue opportunities. It seems that even if employees are naturally predisposed to entrepreneurship, this predisposition can be stifled by an inappropriate organisational design. Echols & Neck recommend that the company hierarchy be flattened and an entrepreneurial culture be instilled. These measures make it easier for employees to detect and pursue opportunities.

If the luxury of choosing employees for their natural entrepreneurial ability is not available, then can employees be taught to innovate? Echols & Neck (1998) recognise that most companies would have to ‘make do’ with existing employees in practice, and urge managers to encourage entrepreneurial thought in all employees. Thornberry (2003) concluded that it is possible to teach entrepreneurship, but warned that companies must be prepared to change to accommodate this new thinking.

Thornberry (2003) recommended adapting pay structures to corporate entrepreneurship. Many traditional pay structures are not flexible enough to

handle internal entrepreneurs. Kuratko, Ireland & Hornsby (2001) also emphasised the importance of appropriate rewards for corporate entrepreneurship.

Entrepreneurs need time to pursue opportunities. Thornberry (2003) warned that many modern employees work flat out for 10 to 12 hours per day, and have no time left for entrepreneurship. As well as time, potential entrepreneurs also need access to other resources without too much red tape. Stevenson & Jarillo (1990) and Russell (1999) named resources as an important requirement for successful corporate entrepreneurship.

It is important to drive the entrepreneurship message through all levels of the company. Thornberry (2003) found that entrepreneurial efforts by employees were often discouraged by their line managers. The line managers had not bought into the vision of corporate entrepreneurship. Russell (1999) said much the same thing by emphasising strategy as a determinant of corporate entrepreneurship success.

Stevenson & Jarillo (1990) felt that it is important to let employees mingle and share their ideas. This process is best facilitated by the formation of informal networks. These networks allow employees to collaborate and gain knowledge from each other without going through official channels. It could be argued that flattening an organisation could have the same effect as these informal networks. When the organisation's hierarchy is flattened, employees have greater freedom to communicate, and it is easier for good ideas to spread.

This problem of management support for entrepreneurial efforts is explicitly mentioned by several authors, invariably in amongst other factors. Burgelman (1983), Stevenson & Jarillo (1990), and Thompson (2004) all identified management support (or an equivalent) as an important tool for fostering corporate entrepreneurship. It seems like the managers of corporate entrepreneurs have a great effect on the willingness of employees to innovate.

2.1.5 The entrepreneurial environment

When the CEAI was developed by Hornsby et al (2002), the authors used the following model of corporate entrepreneurship to show how entrepreneurial

activities are encouraged and fostered in companies. They grouped the variables that affect entrepreneurship into a construct called Internal Environment, which is made up of five Organisational Factors: Management Support, Work Discretion, Rewards/Reinforcement, Time Availability, and Organisational Boundaries. They also identified two enabling factors, without which innovative thinking cannot be implemented.

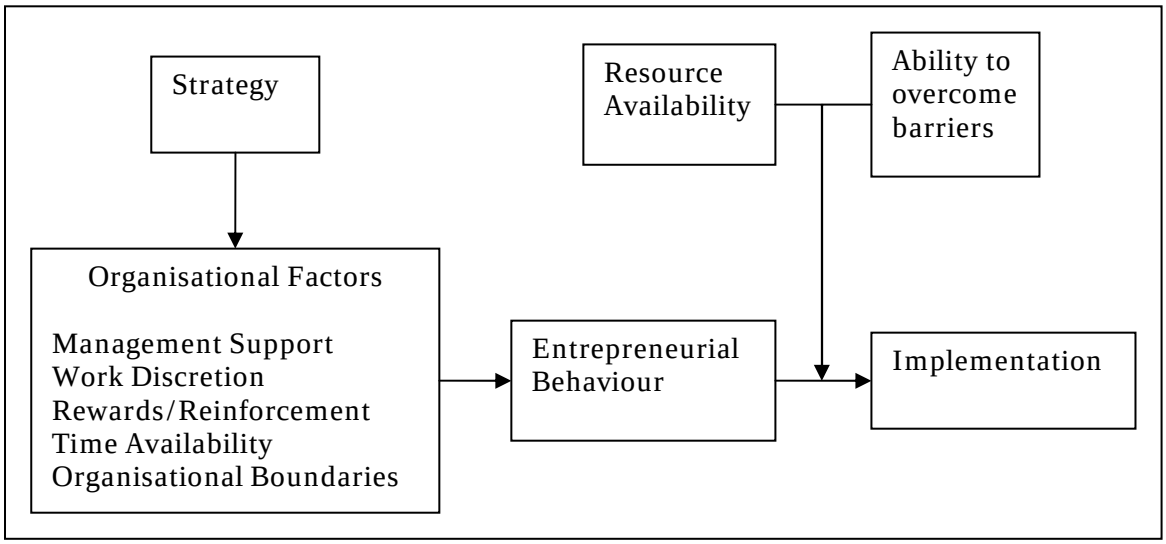

Figure 1: Hornsby, Kuratko & Zahra's (2002) model of Corporate Entrepreneurship

The factors that were identified by Hornsby et al (2002) are evident in the literature reviewed in the previous section.

Management support was identified by Burgelman (1983), Stevenson & Jarillo (1990) and Thompson (2004). It is expected that employees will be more likely to exhibit entrepreneurial behaviour if they are supported by their managers.

Work discretion was identified by Thornberry (2003) and Russell (1999). It is expected that employees will be more likely to exhibit entrepreneurial behaviour if they have freedom to decide how to work.

Rewards/Reinforcement was identified by Kuratko et al (2001) and Thornberry (2003). It is expected that employees will be more likely to exhibit entrepreneurial behaviour if they are appropriately rewarded for their efforts.

Time availability was identified by Thornberry (2003). It is expected that employees will be more likely to exhibit entrepreneurial behaviour if they have enough spare time to pursue opportunities that are not necessarily part of their day-to-day jobs.

Organisational boundaries was identified by Stevenson & Jarillo (1990). It is expected that employees will be more likely to exhibit entrepreneurial behaviour if they are able to mingle and share ideas.

Resource availability was identified by Stevenson & Jarillo (1990) and Russell (1999). They say that it is important for potential entrepreneurs to have access to resources, or they cannot implement their ideas. This factor was separated from the organisational factors by Hornsby et al (2002) in their model. The effect of this separation is to remove the influence of strategy on resource availability. This is reasonable, since it could be argued that top managers have less control over the amount of resources available in the company than they do over the five organisational factors.

Ability to overcome boundaries – identified by Echols & Neck (1998) and Thornberry (2003) – was treated in the same way as resource availability by Hornsby et al (2002). The ability to overcome boundaries lies in the employees, and is not directly affected by strategy. It thus makes sense to make this factor an enabling factor instead of an organisational factor. However, Thornberry (2003) suggests that many of the skills which entrepreneurs use can be taught. So perhaps it is possible to improve employees' ability to overcome boundaries.

The literature does not distinguish between organisational factors (those which cause entrepreneurial thought and behaviour) and enabling factors (resource availability and ability to overcome barriers). Hornsby et al (2002), however, separate the factors into these two categories, as depicted in Figure 1.

2.1.6 Alternative models of corporate entrepreneurship

Hornsby et al (2002) developed a very believable model of corporate entrepreneurship, but other models could be argued from the literature.

Using the model of Hornsby et al (2002) as a starting point, models can be proposed that are modifications of the original model. One possible modification could be to join the management support and work discretion factors. These factors seem quite closely related to each other, and it could be argued that if managers support corporate entrepreneurship efforts, they will see to it that their employees have some freedom to redesign their own jobs. A variation on this theme would be to remove the work discretion factor altogether. Other variations on the original model can be obtained in a similar manner.

The model could be modified by removing the distinction between organisational factors and enabling factors. In the new model, there would be seven factors spanning the gap between strategy and entrepreneurial behaviour. This model would be simpler than the original.

Other models could be proposed, but there is no need for them yet. If the original model proves problematic, other models will be explored. Russell (1999) is an especially abundant source of alternative models. Other sources are Burgelman (1983) and Damanpour (1991).

2.2 Corporate entrepreneurship assessment instrument

The Corporate Entrepreneurship Assessment Instrument (CEAI) was developed by Hornsby et al (2002) in response to a need for an instrument to measure entrepreneurship in companies. The instrument is based on a five-factor model of the corporate entrepreneurship environment. The instrument is premised upon the idea that the corporate environment is the main determinant of entrepreneurial behaviour. If a company wants to become more entrepreneurial, it needs to modify its internal environment so that it is more encouraging to possible entrepreneurs. The CEAI measures the extent to which the environment is encouraging, so if a company can raise its score on the CEAI, it should see more entrepreneurial behaviour emerging.

The CEAI is divided into five parts, each measuring one theoretical dimension of corporate entrepreneurship. Each part is made up of between five and

seventeen items, and initial testing showed that the CEAI is reasonably reliable and stable across North American middle managers.

Hornsby et al (2002) developed the CEAI in several stages. First, they generated 84 statements that were believed to measure the various aspects of a firm's internal environment. Second, they administered the prototype instrument to a sample of North American middle managers, and performed an exploratory factor analysis (EFA) on the results. The EFA produced five factors, and 48 items were found to load significantly onto at least one of the factors. The loadings agreed with the original five categories. Third, they administered the 48 significant items to a second sample of North American middle managers. They performed a confirmatory factor analysis (CFA) on the results, and again discarded items that did not load significantly onto one of the five factors. After the CFA, 43 items remained – the final CEAI.

2.3 Survey validation

The ultimate test of a survey is the generalisability of the results that it produces. For results to be generalisable, the instrument that produced them must be reliable, and it must be valid for the population about which a generalisation is being made. Also, the sample under investigation must represent the population fairly. So, generalisability encompasses reliability, validity, population, and selection. (Thorndike et al, 1991)

While guidelines for selecting a representative sample of a target population are standardised and unchanging, and specification of a target population is fairly straightforward, the validity and reliability of a new instrument must be determined from first principles before any generalisations can be made from its results.

This chapter describes how the reliability and validity of the CEAI in South Africa will be tested. Possible sources of evidence of validity and reliability of the CEAI in South Africa are explored. The aim of this chapter is to develop a set of testable hypotheses which will enable answers to the research problems to be found. Each hypothesis will correspond to at least one of the sub-problems, and each sub-problem will have at least one corresponding

hypothesis. All hypotheses will be testable – that is, it will be possible to find evidence that could potentially reject the hypotheses.

Since the object of this research project is to discover evidence of validity, and in doing so hypotheses will be tested, there will be references to at least two different kinds of evidence in later sections. This problem is repeated with the terms 'reliability' and 'validity'. The CEAI's validity is being tested, while at the same time, the tests used to verify or reject the validity of the CEAI must themselves be valid. Because of this confusing re-use of terms, some sections of this report might be clumsily worded. I will try very hard to clarify each use of these ambiguous terms without muddying the language.

The following section of this chapter explores possible sources of evidence of validity of the CEAI in South Africa. Next, possible sources of reliability evidence are explored. Next, the practicality of the CEAI is discussed. Next, the theory underlying the instrument itself is summarised. Next, alternative theories of corporate entrepreneurship (which may contradict, simplify, or extend the theories used in the construction of the CEAI) are explored. In each section, research hypotheses will be developed. The final section is a collection of the hypotheses, along with a map linking the hypotheses with the research questions.

2.3.1 Reliability

Before any instrument can be valid, it must first be reliable. An instrument that gives different results each time it is used is of little use for measuring anything. Reliability is the extent to which an instrument will produce repeatable results. There are several factors that can cause an instrument to produce different results when it is applied more than once (Thorndike et al). When estimating reliability, it is important to allow all the sources of variation to play a part. This ensures that the reliability of the instrument is not exaggerated.

Since reliability is a measure of the repeatability of results, it is often assessed by applying an instrument more than once and comparing the results from the two applications. The two applications can occur with negligible delay

(immediate retest), or with a significant delay between them (retest with delay). The applications can involve exactly the same instrument both times, or each application can involve a different form of the same instrument (parallel forms). To illustrate each of these techniques, imagine measuring a short distance – say the length of a metal bar. Using the immediate retest method, the bar would be measured with a ruler, the result recorded, and the bar measured with a ruler again, and the second result recorded. Retest with delay would be the same, except that the second measurement might take place the next day. Parallel forms would also be similar to immediate retest, but the second measurement might be with a tape measure instead of a ruler.

Each method of testing reliability has advantages and disadvantages. Generally, the more robust a method, the more resource-intensive it is. So, while immediately retesting with the same instrument is fast and easy, it also has the potential to mask some problems with an instrument and make it seem more reliable than it actually is. Retesting with a delay and a different form of an instrument will provide a rigorous estimate of reliability, but it requires more effort to accomplish.

There are ways of estimating reliability without applying an instrument more than once. All of these ways amount to splitting the results from one application into two virtual applications, and comparing the two halves. These methods of estimating reliability from a single sample are called internal consistency methods, and the most well known is called Cronbach's alpha. Cronbach's alpha is obtained from the number of items in an instrument and the average correlation between the items. It is popular because it is easy to interpret – it has a range of zero to one, just like a correlation coefficient. Cronbach's alpha can be thought of as the correlation between the sample and another imaginary sample.

Estimating the reliability of the CEAI using a two-test method would be straightforward. Two tests would be performed, and the results compared. Since the instrument is divided into five scales, five measures of reliability would be obtained. However, since data is already available, this method of checking reliability will not be used.

The data from a previous application of the CEAI in South African middle managers is already available. Unfortunately, the data is from only one test, so two-test reliability estimates cannot be calculated. The reliability of the instrument can still be estimated using one of the internal consistency (single-test) methods.

2.3.2 Validity

The CEAI will be (at least somewhat) valid for the task of measuring corporate entrepreneurship in South African managers if some evidence of its validity can be found. Evidence of validity can be of several different kinds. (Thorndike et al, 1991) First, it could be content-related evidence. Content-related evidence of validity is the kind of validity possessed by an instrument that has been designed by a master in a certain field. The master knows, almost instinctively, what the properties of the instrument must be for it to be valid. For example, a master watch-maker, having gained experience in making watches for many years, knows what the sources of error are that can diminish the accuracy of the watches he makes. Knowing these sources of error, he can produce a watch that is valid for the task of measuring time. The validity of the watch doesn't have to be verified, it can be assumed due to the level of experience of the watch maker. In practice, content validity is checked by breaking down the phenomenon to be measured into its constituent parts, and linking each part to a part of the measuring instrument. If each part of the phenomenon is covered by a part of the instrument, this is content-related evidence of validity.

Criterion-linked evidence of validity is the second kind of evidence (Thorndike et al, 1991). If a suitable criterion exists, then linking an instrument to this criterion is probably the simplest way of demonstrating its validity. Evidence of this sort comes in the form of a correlation coefficient between the instrument's results and the criterion. If the two are correlated, then the instrument is valid. The level of validity and the strength of the conclusions that can be drawn from the results depend on the correlation. If two instruments are available, the one with the higher correlation with the criterion will be the most valid.

Sometimes, a suitable criterion is unavailable, and the phenomenon is too nebulous to be suitably decomposed into constituent parts. In this case, construct validity may still be tested. This is the final kind of evidence of validity. Testing construct validity is a process. The process begins by predicting the interactions between the phenomenon to be measured (the construct) and other, related, phenomena. From these predicted interactions, a theoretical correlation matrix can be constructed. Even if the magnitudes of the correlations are not predictable, the directions will be. The final step is to find the actual correlations and compare them with the predicted correlations. If the correlations are as predicted, then both the theory and the instrument are validated – with the strength of the validity dependant on the accuracy of the predictions.

Content-related evidence

The CEAI is based on a wide range of theory. Corporate entrepreneurship theory covers several models of corporate entrepreneurship structure. When the CEAI was developed, a five-factor model was judged to be dominant (Hornsby et al, 2002). The five factors correspond to the five parts of the CEAI. Since the instrument was constructed from the theory, it is automatically valid to some extent. Assuming the theory is reasonably correct, the CEAI exhibits some degree of content validity. Of course, for the CEAI to be valid in South Africa on the bases of content-related evidence, the theory must apply to South Africa in the same way that it applies to North America. Also, content-related evidence gives us no numerical estimate of the validity. It may be possible to identify defects in the design of the instrument using this method, but it is impossible to say how detrimental these defects are. Even if no defects can be identified, the instrument may still not be useful for its task.

Construct Validity

When the CEAI was developed, its validity was not conclusively demonstrated. The instrument was shown to be reasonably stable across two samples of North American middle managers. However, no assessment was made of the

worth of the instrument in measuring corporate entrepreneurship. Hornsby et al (2002) recommend that the validity of the CEAI be investigated further.

It is possible that the idea of corporate entrepreneurship differs from country to country. At the very least, components of corporate entrepreneurship that are regarded as important in some countries, might be less important in others. It is even possible that the structure of entrepreneurship changes according to location, with new factors emerging and old factors falling away.

Abdalla (1999) used factor analysis to validate several related instruments. He showed that the instruments shared a common factor structure, and that this structure was stable. The instruments, in effect, validated each other. If the CEAI has the same structure in South Africa as it does in North America, it is likely that it is equally valid here for the task of measuring corporate entrepreneurship.

2.4 Adapting the CEAI to South Africa

If the CEAI proves to have a different structure in South Africa from the structure it exhibits in North America, it must be modified to fit. Byrne (1994) demonstrated how to modify a model to fit data, but cautioned that this process invalidates any statistical claims that are made from the modified model. She warns that any modifications that are suggested should be confirmed with a new survey and new data.

Harman (1968) and Hintze (2001) describe the use of exploratory factor analysis to obtain the factor structure of a data set. If the differences between the CEAI in the two locations are large, EFA could be used to explore other structures.

2.5 Hypotheses / propositions / research questions

2.5.1 Proposition 1 – Reliability

The CEAI produces reliable results when applied to South African middle managers.

This proposition addresses Sub-problem 1 – Reliability.

2.5.2 Hypothesis 2 – Validity

H_0 – The structure of results produced by the CEAI in South Africa is not significantly different from the structure proposed by Hornsby et al (2002).

H_A – Significant differences exist between the structure of the results produced by the CEAI in South Africa and the structure proposed by Hornsby et al (2002).

This hypothesis addresses Sub-problem 2 – Validity.

2.5.3 Proposition 3 – Alternate forms of the CEAI

The CEAI can be modified if necessary to correct for regional differences between South Africa and North America.

This proposition addresses Sub-problem 3 – Alternate Structures.

3 Methodology

This chapter describes the methods that were used to test the research hypotheses, the population and sample that was investigated, the data analysis techniques that were employed, and the reliability and validity of the methodology.

3.1 Methods

The main problem dealt with in this research was one of instrument validation. In other words, this research should produce evidence that the instrument in question – the CEAI – is valid for the task of measuring corporate entrepreneurship in South Africa. Techniques that have been used to solve this problem in the past include exploratory factor analysis, confirmatory factor analysis, correlation analysis, and others.

Before investigating the validity of the CEAI, its reliability had to be established. Methods for establishing reliability include retest, alternative-form, split-halves, and internal consistency (Hintze, 2001). Cronbach's alpha is a measure of internal consistency, and was used to estimate the reliability of the CEAI.

Once the instrument was shown to be reasonably reliable, some method of assessing its validity was needed. Abdalla (1997) used principal component factor analysis to group items from several questionnaires into factors, and compared the factors obtained to those obtained in previous studies. Hornsby et al (2002) also used factor analysis when developing the CEAI, and found that it has a stable five-factor structure that is consistent with the literature. If the CEAI also exhibits a five-factor structure in South Africa, with the same loadings as in North America, it is stable across the two geographical areas.

Confirmatory factor analysis (CFA) was used to analyse Zander's (2004) CEAI data. CFA is appropriate in this case because the hypothesised structure and factor loadings of the instrument are already known. Ideally, CFA should show that the structure of the CEAI when applied in South Africa is identical to the structure of the CEAI when applied in North America. If the two structures are

identical, then the CEAI can be used, unmodified, to gather data on companies from both locations.

The CFA uncovered differences between the structure of the CEAI in South Africa and the structure of the CEAI in North America, so further work was done to pinpoint these differences and modify the CEAI so that it is valid in South Africa. Exploratory factor analysis (EFA) was used to explore the differences in the South African structure of the CEAI.

The following diagram illustrates the process of checking the validity of the CEAI and modifying it if necessary.

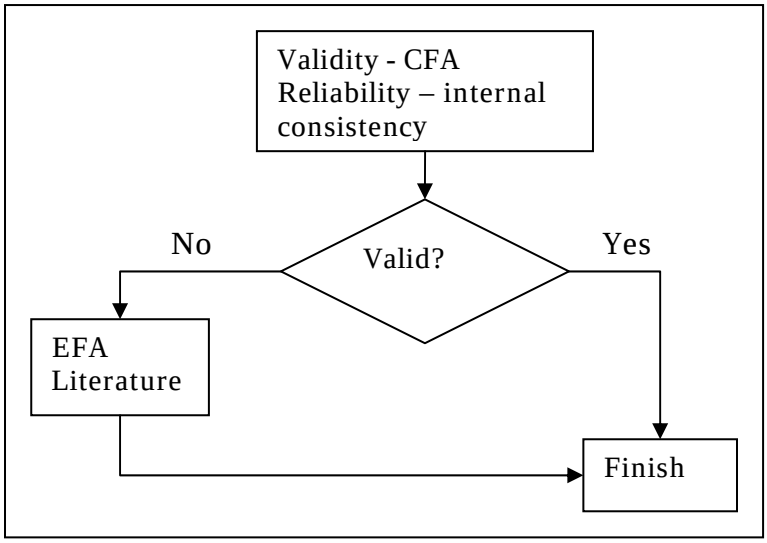

Figure 2: Process diagram - validity

3.2 Population & sample

The data to be analysed in this research was gathered by Zander (2004), so the population, sample, and collection methodologies have been fixed. Zander selected 167 respondents from the population of middle managers in a large South African retail organisation, using the stratified random sampling method (Leedy & Ormrod, 2001). The intended population was all South African middle managers, but only one organisation was polled. Zander did not explain why the population was restricted to a single organisation.

The population was stratified by length of service, and the sample size was chosen to ensure that each stratum was adequately represented. The sample

was chosen randomly, and a questionnaire sent to each respondent. Of the 167 individuals selected, 66 responded, for a response rate of 39.5%.

3.3 Data collection

Data was collected by Zander (2004). A self-report questionnaire was emailed to respondents. It contained five parts – one of which was the CEAI. The other parts recorded demographic information and information about the personality and preferences of the respondents.

The CEAI used five point Likert-like scales, which required the respondents to indicate the extent of their agreement with each statement in the instrument. The scales were not precisely Likert scales, as only the extreme points had labels. Where a true Likert scale would look like the example in Table 1, Zander (2004) used a scale like the one in Table 2.

Table 1: Likert Scale

Agree completely	Agree somewhat	Neither agree nor disagree	Disagree somewhat	Disagree completely
1	2	3	4	5

Table 2: Likert-like scale used by Zander (2004)

Agree				Disagree
1	2	3	4	5

Likert scales are sometimes criticised for not providing interval data. Zander's (2004) scale could be criticised because there is no way to tell what kind of data it will produce. A user might assume that the gaps between points on the scale are all 'equal', which might lead them to answer the question differently from a Likert-scaled question. Although this is pure speculation, the fact remains that it is not possible to assume that the scale used by Zander (2004) was exactly equivalent to a Likert scale.

The questionnaire was emailed to the respondents along with a covering letter, and a follow up letter was emailed to those who had not responded within a week.

3.4 Data analysis

3.4.1 Naming convention

Several techniques and computer programs were used to analyse the data; so to avoid confusion, the following conventions were used:

- The questions in the CEAI, and the coded results from each question, were called questions or items.
- The groupings of items in the original instrument were called subscales. Each subscale was named after the dimension of Corporate Entrepreneurship it was designed to measure.
- The groupings of items produced by exploratory factor analysis, and the independent variables examined by confirmatory factor analysis, were called factors. These factors were named after the dimension of Corporate Entrepreneurship they were designed to represent, or after the subscale to which the most items in the factor belonged.
- The items were named for their subscale and the order of items in the original questionnaire. So the second item in the Word Discretion subscale was named WD_2. This means that item names do not have to correspond to factor names – for example, an exploratory factor analysis might group WD_1, WD_3, WD4, and RR_1 into the same factor. If these items were the only one in the factor, the factor would be named Work Discretion, even though it contains an item from the Reward/Recognition subscale.

3.4.2 Reliability

To estimate the reliability of the CEAI, Cronbach's alpha was calculated for each of its scales. This technique provides a number that can be interpreted as the likely correlation between the data and another theoretical data set obtained by applying the instrument again to the same sample.

NCSS was used to find Cronbach's alpha for each of the five scales of the CEAI. Zander's (2004) data was loaded into NCSS and all further analysis was done

in NCSS. The data was not rescaled. The correlation matrix procedure was used to calculate Cronbach's alpha and to confirm that the correlations were in the right direction.

When calculating Cronbach's alpha, it was important to reverse-score any questions that had been negatively worded, as alpha can only be high if most of the correlations between items are positive. Failure to reverse-score negatively worded questions produces a correlation matrix with negative entries, leading to an underestimate of alpha.

3.4.3 Validity check with CFA

To gauge the validity of the CEAI in South Africa, confirmatory factor analysis (CFA) was applied to the data, with the structure assumed to be identical to the structure used by Hornsby et al (2002). CFA programs provide several goodness-of-fit coefficients, which quantify the degree to which the data is consistent with the expected model.

To confirm the factor structure of the CEAI, a structural equation modelling computer program called LISREL was used. LISREL is a leading structural equation modelling program, so much SEM literature has been written with LISREL in mind.

To assess the validity of the CEAI in South Africa, two CFAs were performed. The only difference between the two was the covariances between the factors – one model allowed these covariances to vary freely, while the other fixed them to zero. Fixing the factor covariances to zero is equivalent to using orthogonal rotation in an exploratory factor analysis – the factors are forced to be perpendicular to each other.

In SEM jargon, a model with all factors allowed to correlate freely is called the measurement model. This model should be tested before any further testing is done, to check that the factors are stable and plausible. The measurement model is useful because it lacks some of the complexity of a fully-fledged structural equation model. In the case of the CEAI, testing the measurement model will verify that the items load onto their factors as theorised, and if not, will point out the areas in which model fit is a problem.

The measurement model CFA was performed in LISREL on the data obtained by Zander (2004). The data was not rescaled, and all the program options were left at their default settings. The model was specified exactly as described by Hornsby, Kuratko & Zahra (2002), except for the addition of covariance paths between the five factors. Figure 3 shows the model tested in LISREL (some items have been left out for simplicity).

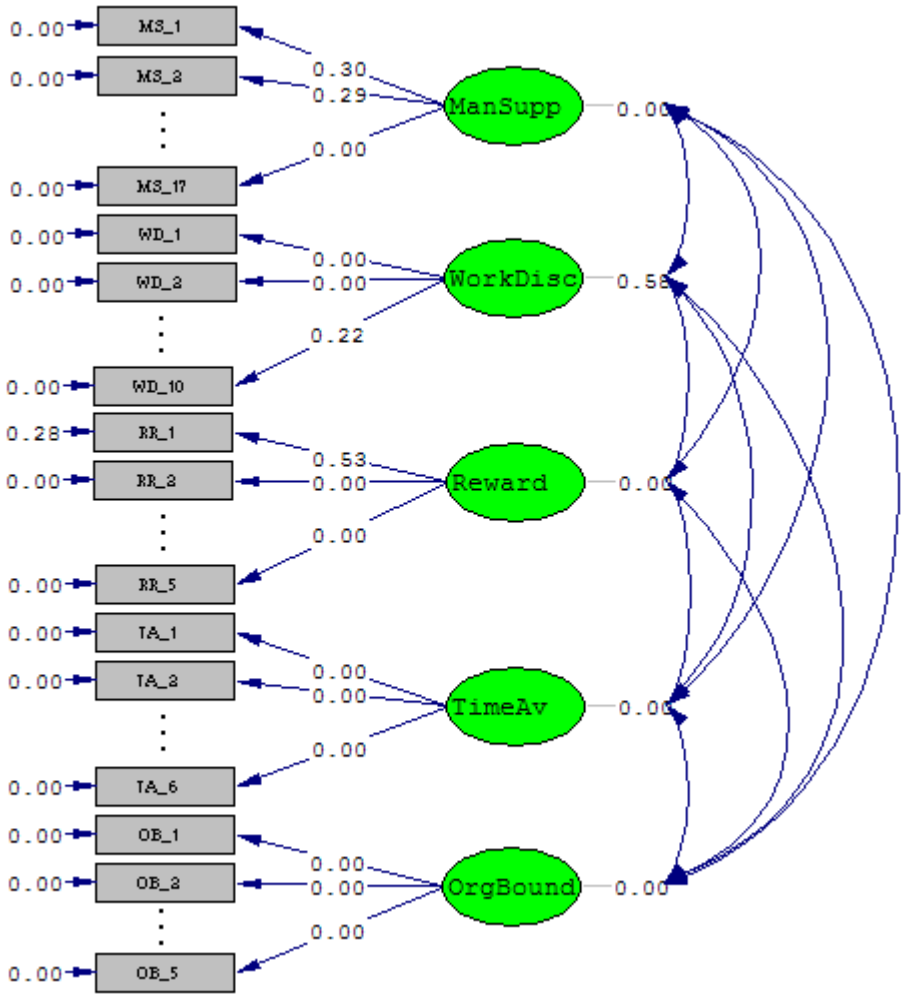

Figure 3: CFA - Measurement model - correlated factors

To test the model as specified by Hornsby, Kuratko and Zahra (2002) more closely, a confirmatory factor analysis was performed, in LISREL, on a model identical to the measurement model but for the factor covariances. These were constrained to zero, as the original questionnaire was designed to have orthogonal factors. Figure 4 shows the model as tested in LISREL.

The two models tested form a nested set (Loehlin, 2004). This means that the chi-square statistics can be compared directly, and the statistical significance of the difference between the two statistics can be evaluated. The difference between the chi-squares of two nested models is an indicator of the significance of the differences between the models. So the difference in chi-square between the two models tested in this research will indicate the significance of allowing the factors to covary.

Other useful information provided by LISREL includes:

- Fit indices – LISREL provides a wide selection of indices that indicate how well the model fits the data. Numerous people have developed these indices, and each has advantages and disadvantages. Some of the most useful are the GFI (Goodness of Fit index), the CFI (Comparative Fit Index), and the RMSEA (Root Mean Squared Error of Approximation). The RMSEA is especially useful as it allows significance testing of hypotheses of exact fit, good fit, or poor fit. The fit indices are a quick indication of whether or not the model is feasible. No index will provide all the information needed to decide whether the model is acceptable or not, but the researcher can get a good idea of how well the model fits by consulting several indices. When assessing model fit, it is important to know the limitations of each index.
- Modification indices – LISREL suggests ways to improve the fit by modifying the model. These suggestions (modification indices) take the form “Adding a path from variable X to variable Y will decrease chi-square by Z points”. LISREL lists the modifications that will produce the biggest improvement in fit, and the user can then decide whether these modifications make sense. It is important to note that any statistical claims made from a model modified in this way will be invalid. Ideally, a researcher would modify the model and then retest it with new data.
- Parameter estimates – Fitting a structural equation model is a two-stage process – first the non-measured parameters are estimated, and then the fit of the model is evaluated. (Actually the process is iterative,

with estimation and fitting being improved incrementally) The LISREL outputs discussed in the paragraphs above concern the fit of the model, but LISREL also provides information about the parameters of the model. Parameters that are estimated include path values, factor correlations, error magnitudes, and error correlations. LISREL also provides standard errors for its parameter estimates, so the statistical significance of a path or other parameter can be calculated.

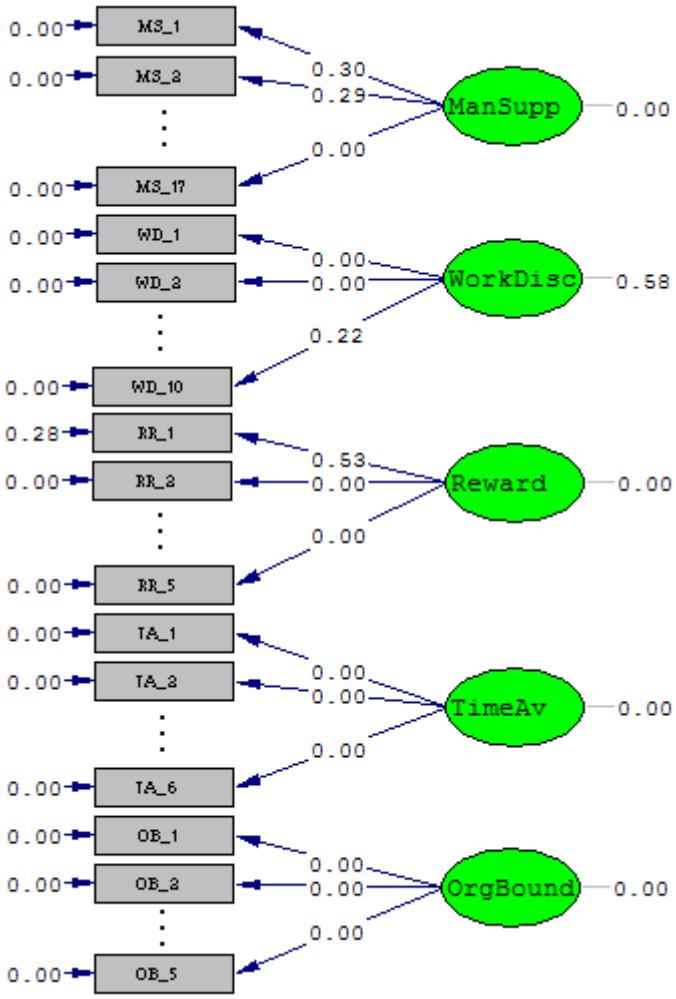

Figure 4: CFA - Hornsby, Kuratko & Zahra (2002) model - uncorrelated factors

3.4.4 Exploratory factor analysis

After irregularities were found during the CFA, exploratory factor analysis (EFA) was used to further analyse the data, with the objective of discovering the cause of the irregularities and finding an alternative model that more closely fits the data.

Where CFA evaluates the fit of a predefined model against data, EFA makes few assumptions about the underlying structure of the data. EFA is useful for exploring data for which little theory exists, or for which the theory doesn't seem to work.

NCSS was used to run an exploratory factor analysis procedure on the data. Raw scores were imported into the program, and the analysis was run without modifying the data. Zander (2004) rescaled the data before factor analysis, but this seems unnecessary because of the way the items were scaled. Zander used a five-point scale with only the two end points labelled, so it could be argued that users would then treat the intermediate points as equally spaced by definition, since they have no labels.

The EFA process consists of several steps, usually performed with the help of a computer program. First, the number of factors is chosen according to one or more criteria. Next, some settings are chosen, like rotation method. Then, the computer program works out the best way to arrange the data into the chosen number of factors, given the chosen rotation method and other options. Finally, the program provides the results of the analysis, including factor loadings, structure, variance explained, and factor score estimates. EFA programs factor data by decomposing it into eigenvalues and eigenvectors. Although the eigenvalues and eigenvectors are not the final output, they still provide valuable information about the structure of the data.

To choose a sensible number of factors, several sources were considered. First, the theory underlying the questionnaire says that it should have five factors, so five was a possibility. In EFAs of data with no theory or doubtful theory, the Kaiser criterion can be used to select the number of factors. The Kaiser criterion says that they number of factors is the number of eigenvalues greater than one. The scree test is also commonly used. This involves plotting the eigenvalues and looking for the point at which the slope starts to level out.

Both the Kaiser criterion and the scree test were applied to the CEAI data to see if a number of factors other than five was a possibility.

To allow for the possibility that more than five factors might be found, EFAs were performed on the five sections of the data individually. Since each set of

questions was designed to measure one aspect of corporate entrepreneurship, it was expected that these EFAs would find one factor to be most appropriate in each case.

EFA without rotation produces results that are hard to interpret, so only EFAs with rotation were performed. Rotations come in two kinds – orthogonal and oblique. Orthogonal rotations force the factors to remain perpendicular to each other (factor correlations are zero), while oblique rotations allow some correlation between factors. Ideally, both kinds of rotation would have been used on the CEAI data, but the program used to perform the analyses cannot do oblique rotations. Thus, only Varimax, an orthogonal rotation, was used.

Eight EFAs were performed in all (excluding the single factor EFAs mentioned above). The EFAs varied in number of factors used from one to eight, and Varimax rotation was used in all cases. A statistics computer program called NCSS performed the analyses.

NCSS provides a large amount of data on each EFA. The data that was used in this research included eigenvalues, factor loadings, factor structure, and factor scores.

The factor loadings and structure were especially useful, as some sources say that examining the factor structure is the best way to judge whether the correct number of factors has been obtained. In this research, the factor structures of EFAs from one factor to eight factors were compared, in another attempt to make a sensible model.

3.5 Validity & reliability of methodology

Since the prime purpose of this research is to establish the validity of the CEAI, a discussion here of its validity and reliability is redundant. Nevertheless, it is important that the techniques used to analyse the data are themselves reliable and valid.

All the techniques that will be used in this research are well known and documented.

Cronbach's alpha is a commonly used measure of reliability (Leedy & Ormrod, 2001).

Exploratory factor analysis is a mature technique, dating back roughly 100 years (Harman, in Whitla).

Confirmatory factor analysis is less commonly used than EFA, but is highly suitable for assessing a theoretical model against survey data (Loehlin, 2004).

4 Results

4.1 Cronbach's alpha

For the Management Support scale, almost all correlations were positive. One correlation was negative but insignificant. None of the items were negatively worded; so all correlations were expected to be positive.

For the Work Discretion scale, one item – WD_2 – was negatively worded. All correlations that did not involve WD_2 were positive, but the correlations that did involve WD_2 were inconclusive: some were negative and some were positive. Item analysis showed that the average correlation of WD_2 with the other items was very small, and that Cronbach's alpha would be improved by the omission of WD_2. It appears that WD_2 is a poor indicator of Work Discretion, since it is almost completely unrelated to the other items in the scale. However, WD_2 may capture some important aspect of Work Discretion that no other item captures.

For the Rewards/Reinforcement scale, none of the items were negatively worded. As expected, no correlations were negative.

For the Time Availability scale, three items were negatively worded. Many of the correlations were negative. After reversing the necessary scores, the correlation matrix was recalculated. In the new test, only two correlations were negative, and both were insignificant.

For the Organisational Boundaries scale, none of the items were negatively worded. As expected, no correlations were negative.

Table 3: Cronbach's alpha for the five dimensions of the CEAI

Factor	Alpha
Management Support	0.90
Work Discretion	0.82
Rewards/Reinforcement	0.83
Time Availability	0.67
Organisational Boundaries	0.71

4.2 Confirmatory factor analysis – measurement model

4.2.1 Chi-square

In SEM, the chi-square statistic is a measure of how much of the covariance in the data remains unexplained by the model. Chi-square is only meaningful in conjunction with its degrees of freedom. Complicated models will leave fewer degrees of freedom than simple models, and will hopefully explain more of the covariance in the data. Therefore, maximising the fit of a structural model is a balancing act that aims to explain as much covariance as possible, while preserving degrees of freedom. A perfectly fitting model should produce an insignificant chi-square – SEM programs will calculate the p-value that corresponds to the chi-square statistic and the associated degrees of freedom. It is then a simple matter to compare this p-value to the chosen significance level, and decide whether to reject the hypothesis of perfect fit or not.

Table 4: Chi-square statistic for hypothesis of perfect fit – measurement model

Chi-square	1214.96
Degrees of freedom	850
P-value	0.00

Table 4 gives the chi-square, degrees of freedom, and p-value for the hypothesis of perfect fit of the measurement model. Clearly, this hypothesis can be rejected – the measurement model does not fit the data exactly.

4.2.2 Fit indices

LISREL provides fit indices that supplement the chi-square statistic. Table 5 gives the goodness of fit index (GFI), comparative fit index (CFI), the RMSEA (root mean square error of approximation), and the 90% confidence interval for the RMSEA.

The goodness of fit index and the comparative fit index give similar information. A GFI of 0.8 or more, or a CFI of 0.9 or more, means that the model has good fit. Note that these indices do not test for perfect fit, and they do not have an associated significance test. There are situations in which they can be misleading, so it is a good idea to interpret the GFI and the CFI in conjunction with chi-square and other indices.

The RMSEA is a measure of unexplained covariance that can be statistically tested. RMSEA has an advantage over chi-square, in that values other than zero can be tested for significance. Experience and experimentation has shown that RMSEA of 0.1 means that the model fits poorly, while RMSEA of 0.05 means that the fit is good (not exact). RMSEA cannot be used to test for exact fit, as it has a minimum value of zero that corresponds to a positive chi-square. LISREL gives RMSEA and a 90% confidence interval for RMSEA. If the confidence interval includes 0.05, then the hypothesis of good fit cannot be rejected at a 5% significance level (one tailed test). If the confidence interval includes 0.1, then the hypothesis of poor fit cannot be rejected.

Table 5: Fit Indices – measurement model

Goodness of Fit Index	0.53
Comparative Fit Index	0.81
RMSEA	0.081
90% confidence interval for RMSEA	0.071 – 0.091

Table 5 shows that the measurement model does not fit the data well. GFI and CFI are less than their targets of 0.8 and 0.9 respectively. RMSEA falls between 0.05 and 0.1, as does the 90% confidence interval for RMSEA. This means that the hypothesis of good fit can be rejected, as can the hypothesis of poor fit. The measurement model exhibits merely mediocre fit.

4.2.3 Modification Indices

The modifications suggested by LISREL included:

Add a path from Management Support to:

- WD_3 – This organization provides the chance to be creative and try my own methods of doing the job. (Considered part of Work Discretion in CEAI)
- WD_7 – It is basically my own responsibility to decide how my job gets done. (Considered part of Work Discretion in CEAI)
- WD_9 – I have much autonomy on my job and am left on my own to do my own work. (Considered part of Work Discretion in CEAI)

- RR_5 – My manager would tell his boss if my work was outstanding. (Considered part of Reward/Recognition in CEAI)
- OB_1 – In the past three months, I have always followed standard operating procedures or practices to do my major tasks. (Considered part of Organisational Boundaries in CEAI)

Add a path from Reward/Recognition to:

- MS_5 – Promotion usually follows the development of new and innovative ideas. (Considered part of Management Support in CEAI)
- WD_5 – This organization provides the chance to do something that makes use of my abilities. (Considered part of Work Discretion in CEAI)

Add a path from Time Availability to:

- WD_4 – This organisation provides freedom to use my own judgement. (Considered part of Work Discretion in CEAI)

Add a path from Organisational Boundaries to:

- MS_4 – Upper management is aware and very receptive to my ideas and suggestions. (Considered part of Management Support in CEAI)
- MS_16 – There is considerable desire among people in the organization for generating new ideas without regard to crossing departmental or functional boundaries. (Considered part of Management Support in CEAI)

Add a covariance between:

- MS_1 and MS_2 (Management Support factor, adjacent items)
- MS_1 and MS_4 (Management Support factor)
- MS_3 and MS_4 (Management Support factor, adjacent items)
- MS_5 and WD_8
- MS_5 and RR_5
- MS_7 and OB_1

- MS_9 and MS_10 (Management Support factor, adjacent items)
- MS_9 and WD_10
- MS_11 and WD_9
- MS_12 and MS_13 (Management Support factor, adjacent items)
- MS_16 and MS_17 (Management Support factor, adjacent items)
- MS_17 and WD_4
- WD_3 and WD_4 (Work Discretion factor, adjacent items)
- WD_4 and TA_6
- WD_7 and WD_8 (Work Discretion factor, adjacent items)
- RR_4 and RR_5 (Reward/Recognition factor, adjacent items)
- TA_2 and TA_3 (Time Availability factor, adjacent items)
- TA_2 and TA_4 (Time Availability factor)

4.2.4 Parameter estimates

The full report of the measurement model CFA is appended to this report as an appendix. Reproducing all of them here would not be useful, but the most interesting parameters are given below. These parameters were singled out because they have low loadings on their intended factors. WD_2, especially, has virtually no relationship with its factor, Work Discretion.

Qu_xx = estimate*Factor, Errorvar = error variance, Rý = variance explained

	(std error)	(std error)
	z-value	z-value
WD_2 =	0.046*WorkDisc,	Errorvar = 1.10 , Rý = 0.0019
	(0.14)	(0.19)
	0.33	5.70
TA_4 =	0.22*TimeAv,	Errorvar = 1.06 , Rý = 0.045
	(0.15)	(0.19)

1.49 5.61

4.3 Confirmatory factor analysis – uncorrelated factors

4.3.1 Chi-square

In the previous section – Confirmatory factor analysis – measurement model, the meaning of the chi-square statistic was explained.

Table 6: Chi-square statistic for hypothesis of perfect fit – uncorrelated factors model

Chi-square	1261.19
Degrees of freedom	860
P-value	0.00

Table 6 gives the chi-square, degrees of freedom, and p-value for the hypothesis of perfect fit of the uncorrelated factors model. Like the measurement model, this model can also be rejected – it does not fit the data exactly.

4.3.2 Fit indices

In the previous section, the meanings of the following fit indices were explained.

Table 7: Fit Indices – uncorrelated factors model

Goodness of Fit Index	0.53
Comparative Fit Index	0.79
RMSEA	0.085
90% confidence interval for RMSEA	0.075 – 0.095

Table 7 gives much the same results for the uncorrelated factors model as were seen for the measurement model. The GFI and CFI show that the model does not fit well, while the RMSEA rejects both the hypothesis of good fit and the hypothesis of poor fit.

The same conclusion can be drawn from the tests of both models: the hypotheses of exact or good fit must be rejected. The model of Hornsby et al (2002) does not explain all the covariances in the survey data. Therefore, exploratory factor analysis and other exploratory techniques are appropriate.

The computer programs used to run confirmatory factor analysis will suggest areas in which the model can be modified to improve its fit. These suggestions take the form of additional paths that can be added to the model. The suggestions can be useful, but invalidate any statistical significance tests that might be performed on the modified model. Ideally, these modifications should be re-tested with new data.

4.3.3 Modification indices

The modifications suggested by LISREL included:

Add a path from Management Support to:

- WD_3 – This organization provides the chance to be creative and try my own methods of doing the job. (Considered part of Work Discretion in CEAI)
- WD_4 – This organization provides freedom to use my own judgment. (Considered part of Work Discretion in CEAI)
- WD_5 – This organization provides the chance to do something that makes use of my abilities. (Considered part of Work Discretion in CEAI)
- OB_1 – In the past three months, I have always followed standard operating procedures or practices to do my major tasks. (Considered part of Organisational Boundaries in CEAI)

Add a path from Reward/Recognition to:

- MS_5 – Promotion usually follows the development of new and innovative ideas. (Considered part of Management Support in CEAI)
- WD_5 – This organization provides the chance to do something that makes use of my abilities. (Considered part of Work Discretion in CEAI)

Add a path from Time Availability to:

- WD_4 – This organisation provides freedom to use my own judgement. (Considered part of Work Discretion in CEAI)

Add a path from Organisational Boundaries to:

- MS_4 – Upper management is aware and very receptive to my ideas and suggestions. (Considered part of Management Support in CEAI)
- MS_16 – There is considerable desire among people in the organization for generating new ideas without regard to crossing departmental or functional boundaries. (Considered part of Management Support in CEAI)

Add a covariance between factors:

- Work Discretion and Management Support
- Reward/Recognition and Management Support
- Reward/Recognition and Work Discretion

Add a covariance between items:

- MS_1 and MS_2 (Management Support factor, adjacent items)
- MS_1 and MS_4 (Management Support factor)
- MS_3 and MS_4 (Management Support factor, adjacent items)
- MS_5 and WD_8
- MS_7 and OB_1
- MS_9 and MS_10 (Management Support factor, adjacent items)
- MS_9 and WD_10
- MS_11 and WD_9
- MS_12 and MS_13 (Management Support factor, adjacent items)
- MS_16 and MS_17 (Management Support factor, adjacent items)
- MS_17 and WD_4
- WD_3 and WD_4 (Work Discretion factor, adjacent items)
- WD_4 and TA_6
- WD_4 and OB_1

- WD_7 and WD_8 (Work Discretion factor, adjacent items)
- TA_2 and TA_3 (Time Availability factor, adjacent items)
- TA_2 and TA_4 (Time Availability factor)

4.3.4 Parameter estimates

WD_2 = 0.026*WorkDisc, Errorvar = 1.10 , Rý = 0.00062

(0.14) (0.19)

0.19 5.70

TA_4 = 0.22*TimeAv, Errorvar = 1.06 , Rý = 0.043

(0.15) (0.19)

1.47 5.61

4.4 Exploratory factor analysis

4.4.1 Number of factors – Kaiser's criterion

Kaiser's criterion, applied to the data in Table 8, seems to indicate that there are at least six, possibly seven factors. However, no clear boundary is evident from the numbers – there are eigenvalues both slightly greater than one and slightly less than one. In any case, Kaiser's criterion produces more than five factors.

Table 8: Eigenvalues from unrotated EFAs 1 to 8 factors

1 Factor	2 Factors	3 Factors	4 Factors	5 Factors	6 Factors	7 Factors	8 Factors
9.939834	9.990307	10.03965	10.08053	10.1141	10.14404	10.16619	10.18863
3.054959	3.266801	3.34698	3.388312	3.432475	3.456533	3.489893	3.519845
2.396702	2.493649	2.674027	2.717399	2.775683	2.802703	2.822362	2.854895
1.847532	1.908988	1.964655	2.101764	2.171164	2.208039	2.246623	2.273239
1.631113	1.706363	1.780227	1.855174	2.003412	2.028988	2.060161	2.082161
1.038095	1.090929	1.140834	1.196563	1.23161	1.323406	1.364365	1.398311
0.812824	0.898885	0.945384	1.009704	1.06523	1.105776	1.180512	1.201816
0.60984	0.696377	0.780942	0.827107	0.861671	0.901176	0.925949	0.98071
0.56998	0.640143	0.723432	0.770294	0.818718	0.857599	0.893976	0.914455

4.4.2 Number of factors – scree plot

Where Kaiser's criterion suggests more factors than the theory, the scree test does the opposite – it reveals a sharp change in slope just after the first eigenvalue, suggesting that one factor would be most appropriate. A plot of the eigenvalues of a five-factor EFA of the data is given in Figure 5.

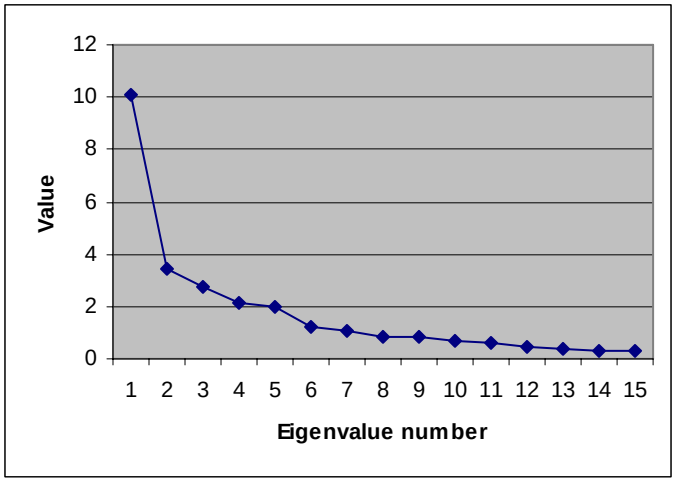

Figure 5: Scree plot – five factor un-rotated EFA

4.4.3 Number of factors – single factor EFAs

EFAs were also performed individually on the data for each theoretical factor. The results were mixed. All factors except Management Support have only one eigenvalue greater than one. Management Support has two eigenvalues greater than one. Rewards/Recognition and Organisational Boundaries both have scree plots with a sharp transition in slope (Figure 8 and Figure 10). The other three factors have scree plots with a gentle transition (Figure 6, Figure 7, and Figure 9). In combination, these results suggest that some factors are uni-dimensional, while other factors exhibit some multi-dimensionality.

Factor	**Dimensions**
Management Support	2
Work Discretion	1 or 2
Reward/Recognition	1
Time Availability	1 or 2
Organisational Boundaries	1

The single factor EFAs suggest that, if no overlap between dimensions of individual factors is assumed, the complete questionnaire should have between six and eight dimensions.

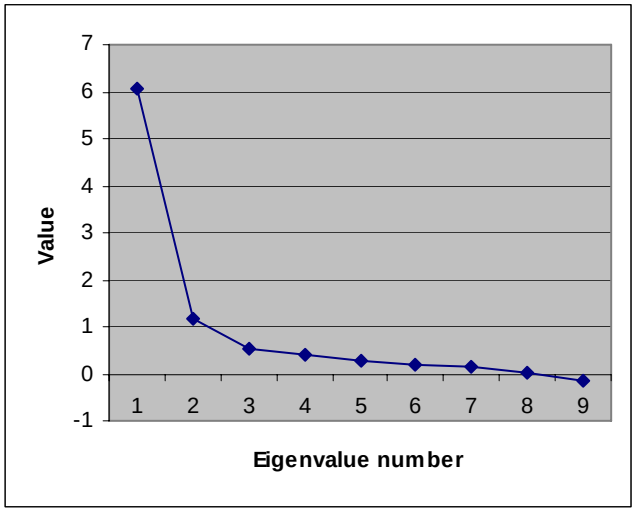

Figure 6: Scree plot for Management Support single factor EFA

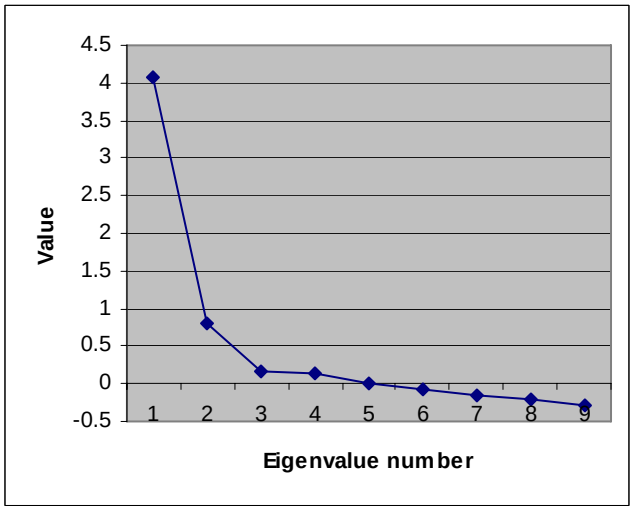

Figure 7: Scree plot for Work Discretion single factor EFA

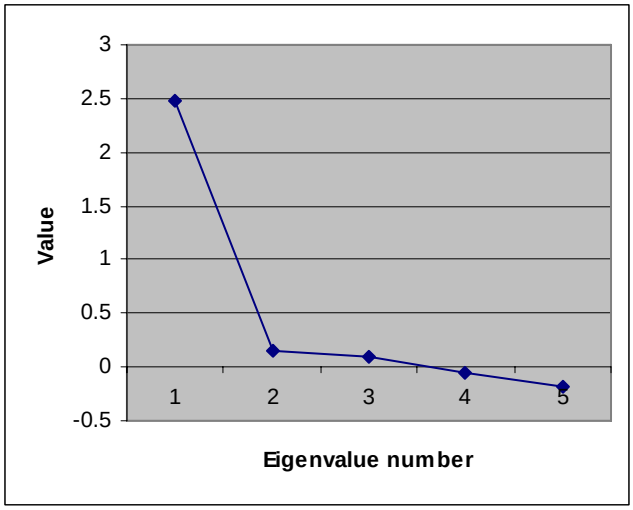

Figure 8: Scree plot for Reward/Recognition single factor EFA

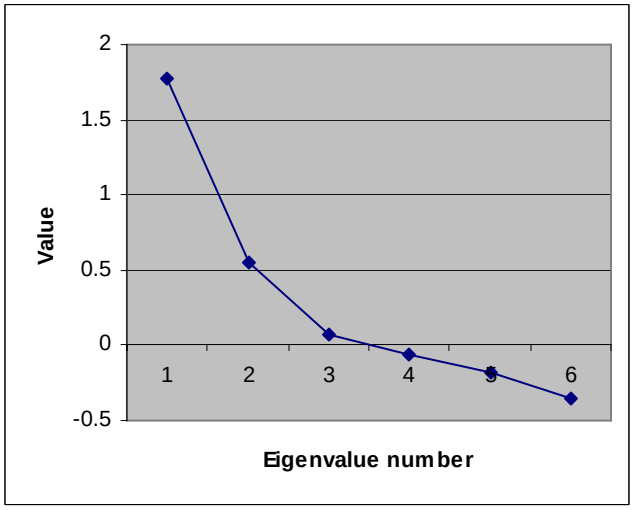

Figure 9: Scree plot for Time Availability single factor EFA

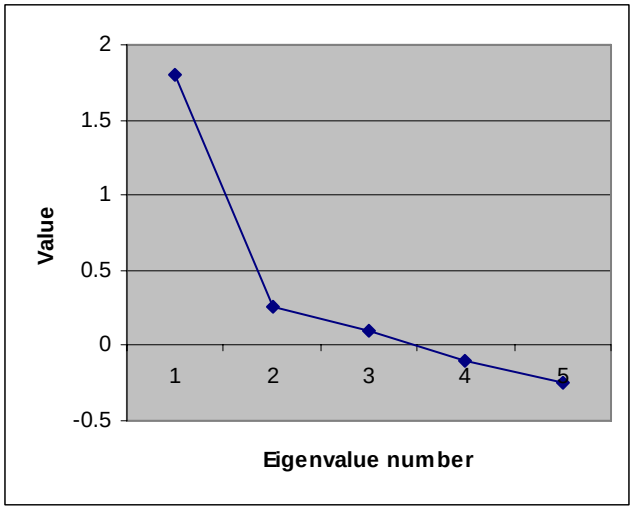

Figure 10: Scree plot for Organisational Boundaries single factor EFA

4.4.4 Factor structure

The complete factor structures for each EFA are given in Appendix 4. Given here is a summary of the structure for each EFA. Table 9 shows the number of items from each subscale that load onto the factors in the EFAs. The dominant subscale in each factor is enclosed in a box to make the table easier to interpret. The factor structures for the EFAs are sorted by number of factors, so it is easy to see how the factor structure develops as more factors are added.

Table 9: Factor structures for EFAs

	Questionnaire Subscale				
	MS	**WD**	**RR**	**TA**	**OB**
1-factor EFA factor structure					
Factor 1	12	8	4	0	0
No Factor	5	2	1	6	5
2-factor EFA factor structure					
Factor 1	12	6	4	0	1
Factor 2	1	1	0	1	5
No Factor	4	3	1	5	0
3-factor EFA factor structure					
Factor 1	13	6	4	0	1
Factor 2	3	1	1	0	5
Factor 3	0	5	0	0	0
No Factor	2	1	0	6	0
4-factor EFA factor structure					
Factor 1	17	4	0	0	0
Factor 2	3	0	1	0	5

Factor 3	0	7	0	0	0
Factor 4	0	0	3	3	0
No Factor	0	1	1	3	0

5-factor EFA factor structure

Factor 1	16	3	0	0	0
Factor 2	2	0	0	0	5
Factor 3	0	7	0	0	0
Factor 4	0	0	0	5	0
Factor 5	1	1	5	0	0
No Factor	0	1	0	1	0

6-factor EFA factor structure

Factor 1	17	4	0	0	0
Factor 2	2	0	0	0	5
Factor 3	1	8	0	0	0
Factor 4	0	0	0	4	0
Factor 5	1	1	5	0	0
Factor 6	0	0	0	2	1
No Factor	0	1	0	1	0

7-factor EFA factor structure

Factor 1	12	2	0	0	1
Factor 2	0	0	0	0	4
Factor 3	0	7	0	0	0
Factor 4	0	0	0	4	0
Factor 5	1	1	5	0	0
Factor 6	0	0	0	2	1
Factor 7	4	0	0	0	0
No Factor	0	1	0	1	0

8-factor EFA factor structure

Factor 1	12	3	0	0	1
Factor 2	1	0	0	0	4
Factor 3	0	7	0	0	0
Factor 4	0	0	0	3	0
Factor 5	1	1	5	0	0
Factor 6	0	0	0	3	1
Factor 7	5	0	0	0	0
Factor 8	0	2	0	0	0
No Factor	0	0	0	1	0

5 Interpretation

5.1 Reliability

Cronbach's alpha for the five dimensions of corporate entrepreneurship varied from 0.67 to 0.90 (details in Table 3). Alphas more than 0.8 can be considered good, while alphas of 0.7 are acceptable. Thus, Management Support, Work Discretion, and Rewards/Reinforcement are reliable, while the remaining two factors are fairly reliable. The CEAI would be more credible if all the dimensions had reliabilities of 0.8 or greater.

5.2 Validity

CFA programs usually provide an abundance of information about the degree of fit between the model and the data. In the case of the CEAI, each piece of information confirms that the model does not fit the data exactly. Based on data collected with CEAI in South Africa, the CEAI's hypothesised structure is problematic, and the CEAI is not valid for the task of measuring corporate entrepreneurship in South Africa.

5.3 Areas for improvement

Knowing that the model does not fit is of little use on its own, but CFA programs also provide information that can be used to pinpoint the problem areas in a model.

In the case of the CEAI, there were two types of problem – insignificant paths that were specified in the theory, and paths that would improve the fit, but were not specified in the theory.

5.3.1 Insignificant loadings

Confirmatory factor analysis showed that insignificant paths join WD_2 to the Work Discretion factor and TA_4 to the Time Availability factor. The insignificance of these paths suggests that these two questions are not significant indicators of the intended factors in South African middle managers. When the CEAI was first developed, several questions were

dropped from the final instrument for just this reason – they did not load significantly onto their intended factors.

A five-factor exploratory factor analysis failed to assign WD_2 or TA_4 to any of the factors. This reinforces the findings of the CFA described in the previous paragraph.

5.3.2 Suggested new causal paths

Paths that could improve the fit of the model were numerous. In fact, any new path will improve the fit of a model in CFA, but the software only lists the best candidates, i.e. those paths that will lead to the greatest improvement in fit. The suggested paths are listed in the results above.

New causal paths lead from a factor to an item not originally associated with that factor. Paths of this kind suggest that some items measure more than one factor. An example is MS_4. MS_4 falls into the Management Support factor, and loads significantly onto this factor in the CFA. But MS4 also correlates with Organisational Boundaries, and according to LISREL, adding a path from Organisational Boundaries to MS_4 would significantly improve the fit of the model.

An item-by-item analysis of each of the paths suggested by LISREL is unnecessary. The very existence of these paths shows that there is some overlap between the factors of the CEAI. The EFA shows similar information – some items in the EFA load significantly onto two factors.

5.3.3 Suggested new covariance paths

LISREL also suggested new paths leading from an indicator to another indicator. In eleven cases, the two indicators belonged to the same factor, and in the other seven cases, the two indicators belonged to different factors. Of the cases in which the two indicators belonged to the same factor, nine involved adjacent questions, and the other two involved questions that were a maximum of three lines apart. Of the cases in which the two indicators belonged to different factors, all but one involved at least one indicator that was also mentioned under the suggested causal paths section. In many of

these cases, the other indicator belonged to the factor mentioned in the causal paths section. Thus, some of the information in the suggested covariance section is similar to the information in the suggested causal paths section.

The fact that so many suggested covariance paths involved adjacent items raises the possibility that the ordering of items in the original questionnaire affected the way it was answered. It appears that placing similar items consecutively in the questionnaire led to a "memory" effect, in which the results of a question were abnormally correlated with the results of the previous question.

5.3.4 Factor correlation

In the CFA in which uncorrelated factors were assumed, LISREL suggested adding in some factor correlations. Only some of the factors were suggested as candidates for covariance – Work Discretion, Management Support, and Reward/Recognition. This suggests that the Time Availability and Organisational Boundaries factors really are orthogonal, or at least are correlated to an insignificant degree.

The difference in chi-square between the uncorrelated factor CFA and the measurement model (correlated factor) CFA was almost 50, on 10 degrees of freedom. Therefore, allowing the factors to co-vary improves the fit of the model significantly.

The correlated factor CFA gave correlation coefficients for the five factors. Time Availability and Organisational Boundaries did not correlate significantly with any of the other factors, but Management Support, Work Discretion, and Reward/Recognition all correlated significantly with each other.

Table 10: Significant correlations between factors

Factor	Factor	Correlation Coefficient
Management Support	Work Discretion	0.66
Management Support	Reward/Recognition	0.54
Work Discretion	Reward/Recognition	0.52

The EFA also produced evidence that correlated factors are preferable to orthogonal factors in the CEAI, even though an EFA with oblique rotation was not performed. In EFAs with less than five factors, items from the Management Support, Work Discretion and Reward/Recognition factors grouped together to form one main factor. In contrast, items from the Time Availability and Organisational Boundaries factors tended to stay separate.

5.4 Alternative models for the CEAI

Exploratory factor analysis of the data suggested a minimum of five underlying factors, and the theory leads one to expect that five factors will be found. The scree test points to a single factor being a viable solution, while the Kaiser criterion selects at least six factors, with seven or eight also a possibility. This conflicting information suggests that models with more or less than five factors might be appropriate for the CEAI. In section 2.1.6, some alternative factor structures suggested in the literature were examined. The results of the EFAs suggest that some of these alternative structures may be viable.

5.4.1 Single factor model

In the EFA, the first eigenvalue was very large compared to the others; so one factor should be able to explain much of the variance that a higher-factor model might explain. A single-factor model also has the advantage of being simple.

The very large first eigenvalue must be due to the moderately high positive correlations between the 17-item Management Support factor, the 10-item Work Discretion factor, and the 5-item Reward/Recognition factor. A single factor could explain much of the variance in the 32 items belonging to these factors (more than half of all items). Thus, a future version of the CEAI could comprise just the items from the three correlated factors, and omit the items from the other two factors. Of course, omitting the items from two of the factors might lead to the loss of important information.

5.4.2 Three factor model

Given that one factor explains much of the variance in the MS, WD, and RR subscales, but very little of the other two subscales, a three factor model might be appropriate. To develop a three-factor version of the CEAI, the WD and RR factors would need some new items, and the third factor (combining MS, WD and RR) would have to be trimmed. If ten sound items could be chosen or developed for each of the three subscales, the modified CEAI would be reliable, easy to interpret, and would account for much of the detail in the current 43-item version.

5.4.3 Five factor model

Although the hypothesised five-factor model of the CEAI was comprehensively rejected in confirmatory factor analysis, five factors might still be a viable model.

The theory describes five factors, the EFAs show that five factors is not worse than any other number, and the CFA found that most items loaded significantly onto their intended factors, even though there were some problems.

In the five-factor EFA, the most significantly loaded items on each factor are all from one section of the questionnaire. Some items do load onto the 'wrong' factor, but their loadings are small. So in general, the EFA arranges the items into groups that correspond roughly with the theory.

If the five-factor model is to remain as the accepted structure of the CEAI, some work must be done to reduce the loading of items onto the 'wrong' factors, and to equalise the number of items in each factor. Items with low or ambiguous loadings should be dropped or reworded.

The assumption that factors are orthogonal must also be reconsidered. Both EFA and CFA found strong evidence that this is not the case, and later versions of the CEAI should either be modified to reduce factor correlations, or re-specified as having correlated factors.

5.4.4 Models with 6 or more factors

Applying the Kaiser criterion to the results of the EFA suggested that six, seven, or eight factors might be plausible. EFAs of the individual subscales also found that some of them might not be uni-dimensional, as previously assumed. However, six+ factor EFAs tended to produce some factors that were very weak, with only two or three items. It is questionable whether a factor with only three items is useful in a qualitative instrument like the CEAI, so any experimentation with more than six factors should be done with caution.

5.5 Low sample size

In the limitations section, the problem of low sample size was mentioned briefly. It is important to review this issue and point out any effects the low sample size may have had on the analyses.

The main problem with having a small sample is that any statistical tests will have low power. For example, if the null hypothesis is that the statistic is zero, and the true value of the statistic is close to zero, the test will be unable to reject the null hypothesis, even though it is false. Put another way, the effect under examination has to be large, or else the test will be unable to detect it.

In this research, several null hypotheses were tested (all of them in the CFAs) – exact fit of the model, insignificance of parameters and errors, insignificance of factor correlations, and RMSEA of various values. Despite the small sample size, it was possible to reject many of these hypotheses, leading to useful conclusions – the model does not fit the data exactly, many model parameters are significant, some factors are significantly correlated. In fact, the effects under examination were large enough to be clearly observable even with a small sample. Therefore, low sample size did not meaningfully affect the conclusions of this research through low power.

Another problem of low sample size is the sampling error introduced into quantities that are not necessarily under statistical examination. (In fact, this error is exactly the reason for the low power of the statistical tests.) Although sampling error is most obviously present in statistical tests, all variables,

whether tested or not, are prone to sampling error. An example of non-statistical variables affected by sampling error is the factor loadings in an exploratory factor analysis. These factor loadings determine which factor a given item will be grouped into, so any error in the factor loadings might change the allocation of items to factors. It was obvious in the results of the EFA that the items did not load onto the factors in exactly the expected way. It is entirely possible that some of these unexpected results are real effects caused by an unusual aspect of South African culture or some other variable. However, it is likely that some of the apparent anomalies in the results are caused by sampling error. It is hard to judge which effects might be real and which ones might be spurious, as no significance tests were performed. In this case, the best advice is probably to interpret the results of the EFAs as suggestions, rather than hard facts.

6 Conclusions

6.1 Reliability

The subscales of the CEAI exhibit good to moderate reliability, and more work could be done to improve the reliabilities of some of the subscales. In the CEAI, two of the subscales with less than ten items had alphas of around 0.7. A new version of the CEAI with at least ten items per scale, and alphas of 0.8 or above, would be more credible.

6.2 Validity

In its current form, the CEAI is not valid for measuring Corporate Entrepreneurship in South Africa. Items are not grouped into their subscales clearly enough, and there is overlap and even misallocation of some items. Two items appear to have no significant relationship to any of factors, and many load onto more than one factor.

6.3 Factor structure

To improve the CEAI, some modifications are needed to factor structure, item wording, and item selection.

Orthogonal factor structure is not appropriate for this instrument. Correlations of up to 0.66 were found between the Management Support, Reward/Recognition, and Work Discretion factors. However, two of the factors (Time Availability and Organisational Boundaries) are independent of each other and the other three factors. Orthogonal factor structure is attractive because it is easy to interpret. Rewording items that tend to load onto more than one factor, or dropping some of the factors that correlate with others could improve the orthogonality of the CEAI. A new version of the CEAI could even be created by grouping the three correlated factors into one new factor. If the current factor structure is to be maintained, then the assumption of orthogonality must be dropped.

WD_2 did not load significantly onto any of the factors, and should be dropped or reworded in future versions of the CEAI. TA_4 is also a candidate for re-wording, for the same reason.

Having 17 items in one sub-scale and 5 in others is troublesome, as the 17-item factor overwhelms the others. Future versions of the CEAI would benefit from having a more balanced set of questions. Balancing the number of items in the subscales might also equalise the alphas for the subscales. It is currently hard to judge the reliability of the CEAI as a whole because of the wide range of alphas.

Evidence was found that the CEAI might make more sense as a single- or three-subscale instrument. New structures of one or three factors are an interesting area for further study. However, balancing the number of items in each scale, as described above, might help to resolve this problem.

6.4 Suggestions for further research

Any research that broadens the validity of the CEAI would be helpful. Its validity in North America has been demonstrated once, and this research has shown that its validity in South Africa is questionable. Ideally, further research would cover as wide a population as possible, so that the validity of the CEAI is extended. A large study performed across diverse contexts would be the perfect opportunity to examine any group differences in Corporate Entrepreneurship.

Although the factor structure of the CEAI has been closely examined in this and other research (Hornsby, Kuratko & Zahra, 2002), and a stable factor structure is a prerequisite for validity, no formal validity test has yet been performed on the CEAI. Perhaps this is due to the difficulty of performing such a test. Nevertheless, a formal study or experiment showing that high scores on the CEAI produce high levels of corporate entrepreneurship in organisations is needed before the CEAI can be accepted completely. An important part of any such research would be the selection of an appropriate criterion against which the CEAI can be validated.

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Appendix 1 – The Corporate Entrepreneurial Assessment Instrument

Underlined items were not included in the final version of the CEAI.

Factor 1: Management support for corporate entrepreneurship

1. My organization is quick to use improved work methods
2. My organization is quick to use improved work methods that are developed by workers
3. In my organization, developing one's own ideas is encouraged for the improvement of the corporation
4. Upper management is aware and very receptive to my ideas and suggestions
5. Promotion usually follows the development of new and innovative ideas

   Those employees who come up with innovative ideas on their own often receive management encouragement for their activities
6. The ''doers'' are allowed to make decisions on projects without going through elaborate justification and approval procedures
7. Senior managers encourage innovators to bend rules and rigid procedures in order to keep promising ideas on track
8. Many top managers have been known for their experience with the innovation process
9. Money is often available to get new project ideas off the ground

   Individuals with successful innovative projects receive additional reward and compensation for their ideas and efforts beyond the standard reward system
10. There are several options within the organization for individuals to get financial support for their innovative projects and ideas

11. Individual risk takers are often recognized for their willingness to champion new projects, whether eventually successful or not
12. People are often encouraged to take calculated risks with new ideas around here
13. The term ‘‘risk taker’’ is considered a positive attribute for people in my work area
14. This organization supports many small and experimental projects realizing that some will undoubtedly fail
15. A worker with a good idea is often given free time to develop that idea
16. There is considerable desire among people in the organization for generating new ideas without regard to crossing departmental or functional boundaries
17. People are encouraged to talk to workers in other departments of this organization about ideas for new projects

Factor 2: Work discretion

1. I feel that I am my own boss and do not have to double check all of my decisions
2. Harsh criticism and punishment result from mistakes made on the job
3. This organization provides the chance to be creative and try my own methods of doing the job
4. This organization provides freedom to use my own judgment
5. This organization provides the chance to do something that makes use of my abilities
6. I have the freedom to decide what I do on my job
7. It is basically my own responsibility to decide how my job gets done
8. I almost always get to decide what I do on my job
9. I have much autonomy on my job and am left on my own to do my own work

10. I seldom have to follow the same work methods or steps for doing my major tasks from day to day

Factor 3: Rewards/reinforcement

1. My manager helps me get my work done by removing obstacles
2. The rewards I receive are dependent upon my work on the job
3. My supervisor will increase my job responsibilities if I am performing well in my job
4. My supervisor will give me special recognition if my work performance is especially good
5. My manager would tell his boss if my work was outstanding

   There is a lot of challenge in my job

Factor 4: Time availability

1. During the past three months, my work load was too heavy to spend time on developing new ideas
2. I always seem to have plenty of time to get everything done
3. I have just the right amount of time and work load to do everything well
4. My job is structured so that I have very little time to think about wider organizational problems
5. I feel that I am always working with time constraints on my job
6. My co-workers and I always find time for long-term problem solving

Factor 5: Organizational boundaries

1. In the past three months, I have always followed standard operating procedures or practices to do my major tasks

   There are many written rules and procedures that exist for doing my major tasks

2. On my job I have no doubt of what is expected of me
3. There is little uncertainty in my job

During the past year, my immediate supervisor discussed my work performance with me frequently

4. My job description clearly specifies the standards of performance on which my job is evaluated
5. I clearly know what level of work performance is expected from me in terms of amount, quality, and timeliness of output

Appendix 2 – LISREL Output – 5 factor CFA, uncorrelated factors

```
                                  DATE:  9/29/2005
                                    TIME: 21:43


                                  L I S R E L  8.71

                                        BY

                                Karl G. J”reskog & Dag S”rbom


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 The following lines were read from file C:\Documents and
Settings\Administrator\Desktop\MBA\Results\SEM\CFA_UnCor.SPJ:

 CFA - All items, uncorrelated factors
 Raw Data from file 'C:\Documents and
Settings\Administrator\Desktop\MBA\Results\SEM\All_data.PSF'
 Sample Size = 66
 Latent Variables  ManSupp WorkDisc Reward TimeAv OrgBound
 Relationships
 MS_1     = ManSupp
 MS_2     = ManSupp
 MS_3     = ManSupp
 MS_4     = ManSupp
 MS_5     = ManSupp
 MS_6     = ManSupp
 MS_7     = ManSupp
 MS_8     = ManSupp
 MS_9     = ManSupp
 MS_10    = ManSupp
 MS_11    = ManSupp
 MS_12    = ManSupp
 MS_13    = ManSupp
 MS_14    = ManSupp
 MS_15    = ManSupp
 MS_16    = ManSupp
 MS_17    = ManSupp
 WD_1     = WorkDisc
 WD_2     = WorkDisc
 WD_3     = WorkDisc
 WD_4     = WorkDisc
 WD_5     = WorkDisc
 WD_6     = WorkDisc
 WD_7     = WorkDisc
 WD_8     = WorkDisc
 WD_9     = WorkDisc
 WD_10    = WorkDisc
 RR_1     = Reward
 RR_2     = Reward
 RR_3     = Reward
 RR_4     = Reward
 RR_5     = Reward
 TA_1     = TimeAv
 TA_2     = TimeAv
 TA_3     = TimeAv
 TA_4     = TimeAv
```

```
TA_5     = TimeAv
TA_6     = TimeAv
OB_1     = OrgBound
OB_2     = OrgBound
OB_3     = OrgBound
OB_4     = OrgBound
OB_5     = OrgBound
Set the Variance of ManSupp to 1.00
Set the Covariances of WorkDisc and ManSupp to 0.00
Set the Variance of WorkDisc to 1.00
Set the Covariances of Reward and ManSupp to 0.00
Set the Covariances of Reward and WorkDisc to 0.00
Set the Variance of Reward to 1.00
Set the Covariances of TimeAv and ManSupp to 0.00
Set the Covariances of TimeAv and WorkDisc to 0.00
Set the Covariances of TimeAv and Reward to 0.00
Set the Variance of TimeAv to 1.00
Set the Covariances of OrgBound and ManSupp to 0.00
Set the Covariances of OrgBound and WorkDisc to 0.00
Set the Covariances of OrgBound and Reward to 0.00
Set the Covariances of OrgBound and TimeAv to 0.00
Set the Variance of OrgBound to 1.00
Path Diagram
End of Problem

Sample Size =    66

W_A_R_N_I_N_G: Total sample size is smaller than the number of parameters.
               Parameter estimates are unreliable.

CFA - All items, uncorrelated factors

        Covariance Matrix

              MS_1       MS_2       MS_3       MS_4       MS_5       MS_6
            --------   --------   --------   --------   --------   --------
    MS_1        0.57
    MS_2        0.28       0.61
    MS_3        0.21       0.20       0.40
    MS_4        0.24       0.23       0.24       0.49
    MS_5        0.17       0.23       0.20       0.18       0.77
    MS_6        0.27       0.16       0.25       0.15       0.25       0.94
    MS_7        0.11       0.05       0.17       0.08       0.12       0.53
    MS_8        0.18       0.19       0.14       0.17       0.20       0.38
    MS_9        0.22       0.19       0.22       0.25       0.19       0.33
   MS_10        0.21       0.19       0.27       0.27       0.17       0.42
   MS_11        0.08       0.13       0.27       0.13       0.08       0.32
   MS_12        0.22       0.22       0.26       0.16       0.22       0.44
   MS_13        0.19       0.22       0.22       0.08       0.30       0.44
   MS_14        0.21       0.20       0.19       0.14       0.10       0.40
   MS_15        0.10       0.17       0.15       0.07       0.30       0.28
   MS_16        0.09       0.09       0.13      -0.02       0.12       0.29
   MS_17        0.14       0.16       0.17       0.13       0.15       0.21
    WD_1        0.23       0.26       0.18       0.18       0.15       0.42
    WD_2        0.10       0.02       0.01       0.12      -0.01      -0.10
    WD_3        0.13       0.17       0.15       0.10       0.16       0.31
    WD_4        0.19       0.15       0.17       0.17       0.14       0.35
    WD_5        0.16       0.09       0.22       0.25       0.23       0.22
    WD_6        0.14       0.14       0.17       0.12       0.04       0.25
    WD_7        0.02       0.08       0.12       0.07       0.01       0.15
    WD_8        0.04      -0.02       0.08       0.08      -0.18       0.23
    WD_9        0.02       0.04       0.02       0.10       0.07       0.15
   WD_10        0.07      -0.03       0.13       0.03      -0.05       0.20
    RR_1        0.08       0.05       0.16       0.13       0.32       0.25
    RR_2        0.12       0.04       0.20       0.06       0.27       0.19
    RR_3        0.13      -0.01       0.23       0.15       0.18       0.25
    RR_4        0.01      -0.03       0.14       0.06       0.35       0.16
    RR_5       -0.01      -0.06       0.14       0.08       0.42       0.02
    TA_1       -0.02      -0.03       0.06       0.05       0.08      -0.11
    TA_2       -0.01      -0.01      -0.06      -0.02       0.00      -0.10
    TA_3        0.11       0.07       0.03       0.11       0.17       0.08
    TA_4       -0.11       0.00       0.00       0.00       0.07      -0.32
    TA_5       -0.15       0.06       0.05       0.16      -0.05      -0.17
    TA_6        0.10       0.04       0.04       0.08       0.03       0.23
    OB_1       -0.09       0.06      -0.04       0.15       0.07      -0.31
```

OB_2	0.00	0.14	0.11	0.20	0.25	-0.05
OB_3	0.12	0.00	-0.03	0.05	0.10	-0.02
OB_4	0.10	0.19	0.12	0.32	0.15	0.01
OB_5	0.09	0.05	0.07	0.18	0.04	0.01

Covariance Matrix

	MS_7	MS_8	MS_9	MS_10	MS_11	MS_12
MS_7	0.87					
MS_8	0.35	0.72				
MS_9	0.39	0.34	0.93			
MS_10	0.57	0.42	0.64	1.13		
MS_11	0.49	0.17	0.33	0.59	0.93	
MS_12	0.55	0.35	0.36	0.63	0.41	0.90
MS_13	0.44	0.30	0.27	0.54	0.37	0.66
MS_14	0.53	0.37	0.38	0.70	0.43	0.50
MS_15	0.27	0.24	0.20	0.56	0.40	0.35
MS_16	0.45	0.20	0.10	0.26	0.34	0.32
MS_17	0.30	0.23	0.13	0.43	0.33	0.36
WD_1	0.34	0.18	0.32	0.40	0.25	0.47
WD_2	0.04	0.11	0.12	0.18	0.03	0.21
WD_3	0.40	0.25	0.49	0.66	0.44	0.57
WD_4	0.43	0.27	0.43	0.52	0.34	0.52
WD_5	0.22	0.24	0.32	0.49	0.30	0.28
WD_6	0.27	0.17	0.31	0.24	0.18	0.39
WD_7	0.19	0.05	0.21	0.14	0.12	0.23
WD_8	0.28	0.02	0.22	0.14	0.15	0.19
WD_9	0.14	0.15	0.23	0.11	-0.05	0.16
WD_10	0.35	0.24	0.12	0.33	0.26	0.54
RR_1	0.27	0.13	0.28	0.39	0.20	0.37
RR_2	0.26	0.30	0.34	0.40	0.27	0.48
RR_3	0.21	0.18	0.15	0.31	0.38	0.20
RR_4	0.23	0.15	0.15	0.40	0.23	0.22
RR_5	0.07	0.15	0.17	0.16	0.11	0.17
TA_1	-0.09	-0.06	0.09	-0.02	-0.09	-0.02
TA_2	0.02	-0.08	-0.08	-0.09	0.01	-0.10
TA_3	0.13	0.08	0.10	0.10	-0.02	0.07
TA_4	-0.13	-0.03	-0.04	-0.07	0.06	-0.09
TA_5	-0.03	-0.03	0.11	0.13	0.02	0.03
TA_6	0.22	0.21	0.12	0.21	0.10	0.26
OB_1	-0.50	-0.05	-0.14	-0.27	-0.25	-0.35
OB_2	-0.12	-0.06	0.14	0.08	-0.08	-0.02
OB_3	-0.08	-0.03	0.16	-0.04	-0.17	-0.06
OB_4	-0.08	0.21	0.14	0.09	-0.08	0.09
OB_5	-0.07	0.00	0.10	0.09	-0.13	0.10

Covariance Matrix

	MS_13	MS_14	MS_15	MS_16	MS_17	WD_1
MS_13	0.91					
MS_14	0.57	0.98				
MS_15	0.36	0.40	0.79			
MS_16	0.24	0.27	0.33	1.17		
MS_17	0.29	0.34	0.30	0.46	0.71	
WD_1	0.39	0.28	0.20	0.20	0.14	0.97
WD_2	-0.07	0.00	-0.01	-0.08	0.02	-0.01
WD_3	0.43	0.39	0.32	0.13	0.37	0.31
WD_4	0.42	0.34	0.24	0.15	0.37	0.52
WD_5	0.29	0.41	0.22	-0.04	0.16	0.29
WD_6	0.31	0.27	0.11	0.06	0.10	0.46
WD_7	0.16	0.09	0.07	-0.13	0.02	0.35
WD_8	0.14	0.16	0.06	-0.19	-0.10	0.28
WD_9	0.07	0.04	0.06	-0.11	-0.04	0.31
WD_10	0.36	0.34	0.25	0.12	0.25	0.37
RR_1	0.34	0.26	0.27	0.02	0.18	0.28
RR_2	0.44	0.30	0.28	-0.05	0.13	0.33
RR_3	0.20	0.16	0.27	0.14	0.10	0.28
RR_4	0.32	0.26	0.38	0.11	0.21	0.20
RR_5	0.25	0.06	0.22	-0.05	0.09	0.24
TA_1	0.11	-0.14	-0.23	-0.28	-0.14	0.22
TA_2	-0.15	-0.02	0.04	0.01	0.14	-0.07
TA_3	-0.06	0.19	0.11	0.06	0.20	0.00
TA_4	-0.01	-0.13	-0.07	-0.20	0.00	-0.27

TA_5	-0.07	-0.06	-0.11	0.00	0.01	0.01
TA_6	0.23	0.28	0.13	0.18	0.28	0.11
OB_1	-0.29	-0.24	-0.20	-0.47	-0.14	-0.23
OB_2	0.02	0.06	-0.02	-0.22	-0.14	0.05
OB_3	-0.01	-0.07	-0.10	-0.32	-0.10	0.00
OB_4	0.04	0.17	-0.07	-0.49	-0.02	0.02
OB_5	0.12	0.11	-0.02	-0.14	0.01	0.13

Covariance Matrix

	WD_2	WD_3	WD_4	WD_5	WD_6	WD_7
WD_2	1.10					
WD_3	0.24	0.94				
WD_4	0.00	0.60	0.81			
WD_5	0.16	0.37	0.35	0.66		
WD_6	-0.01	0.29	0.44	0.26	0.72	
WD_7	-0.01	0.22	0.33	0.15	0.41	0.59
WD_8	-0.05	0.20	0.28	0.10	0.38	0.50
WD_9	-0.02	0.17	0.26	0.13	0.36	0.30
WD_10	0.09	0.43	0.49	0.30	0.54	0.36
RR_1	-0.08	0.27	0.34	0.22	0.23	0.17
RR_2	0.14	0.42	0.46	0.45	0.28	0.20
RR_3	0.10	0.23	0.22	0.36	0.17	0.07
RR_4	0.07	0.26	0.19	0.36	0.05	0.01
RR_5	-0.08	0.18	0.22	0.33	0.19	0.05
TA_1	0.06	-0.08	-0.09	0.06	0.15	0.17
TA_2	-0.05	-0.01	0.07	0.00	-0.16	-0.08
TA_3	0.02	0.09	0.16	0.15	-0.02	-0.07
TA_4	0.11	0.01	-0.13	0.05	-0.07	0.01
TA_5	0.03	0.00	-0.12	-0.06	0.08	0.11
TA_6	-0.19	0.24	0.41	0.09	0.20	0.02
OB_1	0.05	-0.29	-0.28	0.06	-0.10	-0.04
OB_2	-0.22	-0.06	-0.03	0.23	0.05	0.02
OB_3	-0.23	-0.06	0.01	0.01	0.00	0.07
OB_4	0.02	0.11	0.24	0.27	0.15	0.01
OB_5	-0.20	0.07	0.22	0.14	0.21	0.11

Covariance Matrix

	WD_8	WD_9	WD_10	RR_1	RR_2	RR_3
WD_8	0.80					
WD_9	0.30	0.42				
WD_10	0.30	0.33	1.11			
RR_1	0.13	0.17	0.41	0.73		
RR_2	0.15	0.18	0.41	0.48	1.10	
RR_3	0.17	0.13	0.29	0.26	0.49	0.93
RR_4	-0.04	0.11	0.26	0.38	0.50	0.51
RR_5	-0.10	0.17	0.32	0.40	0.57	0.36
TA_1	0.09	0.15	-0.12	-0.08	0.08	0.06
TA_2	-0.09	-0.04	0.05	0.00	-0.02	-0.03
TA_3	-0.02	0.04	0.04	0.10	-0.01	0.05
TA_4	-0.10	-0.07	-0.14	-0.27	-0.17	-0.15
TA_5	0.10	0.06	-0.11	-0.12	-0.30	-0.12
TA_6	0.04	0.07	0.25	0.20	0.28	0.01
OB_1	-0.16	0.03	-0.23	-0.17	-0.12	-0.13
OB_2	-0.05	0.03	-0.20	0.22	0.20	0.08
OB_3	0.04	0.09	-0.16	0.05	0.10	-0.11
OB_4	0.02	0.15	0.01	0.22	0.38	-0.09
OB_5	0.07	0.19	0.19	0.18	0.23	-0.01

Covariance Matrix

	RR_4	RR_5	TA_1	TA_2	TA_3	TA_4
RR_4	0.92					
RR_5	0.65	1.02				
TA_1	0.14	0.20	1.05			
TA_2	0.03	0.08	-0.37	0.71		
TA_3	0.10	0.05	-0.31	0.40	0.74	
TA_4	-0.17	0.00	0.26	0.11	0.03	1.11
TA_5	-0.12	-0.11	0.49	-0.34	-0.18	0.38
TA_6	-0.04	0.07	-0.28	0.10	0.14	-0.20
OB_1	-0.12	0.03	0.25	0.05	0.10	0.34

```
OB_2        0.17        0.23        0.03        0.05        0.02        0.15
OB_3       -0.01        0.19        0.20        0.09        0.08        0.19
OB_4        0.13        0.24       -0.08        0.11        0.31        0.02
OB_5        0.06        0.18        0.05        0.06        0.07       -0.06
```

Covariance Matrix

```
            TA_5        TA_6        OB_1        OB_2        OB_3        OB_4
        --------    --------    --------    --------    --------    --------
TA_5        1.00
TA_6       -0.17        0.86
OB_1        0.23       -0.20        0.85
OB_2        0.12        0.06        0.25        1.26
OB_3        0.08       -0.06        0.30        0.49        0.90
OB_4       -0.10        0.17        0.36        0.43        0.42        2.00
OB_5        0.01        0.19        0.09        0.45        0.33        0.68
```

Covariance Matrix

```
            OB_5
        --------
OB_5        0.75
```

CFA - All items, uncorrelated factors

Number of Iterations = 30

LISREL Estimates (Maximum Likelihood)

Measurement Equations

```
    MS_1 = 0.31*ManSupp, Errorvar.= 0.48  , Rý = 0.16
          (0.093)                   (0.085)
           3.29                      5.60

    MS_2 = 0.30*ManSupp, Errorvar.= 0.52  , Rý = 0.15
          (0.097)                   (0.093)
           3.08                      5.62

    MS_3 = 0.35*ManSupp, Errorvar.= 0.27  , Rý = 0.31
          (0.074)                   (0.050)
           4.69                      5.48

    MS_4 = 0.27*ManSupp, Errorvar.= 0.42  , Rý = 0.14
          (0.087)                   (0.074)
           3.05                      5.62

    MS_5 = 0.31*ManSupp, Errorvar.= 0.67 , Rý = 0.12
          (0.11)                    (0.12)
           2.82                      5.63

    MS_6 = 0.60*ManSupp, Errorvar.= 0.58 , Rý = 0.38
          (0.11)                    (0.11)
           5.35                      5.39

    MS_7 = 0.67*ManSupp, Errorvar.= 0.42  , Rý = 0.52
          (0.10)                    (0.081)
           6.55                      5.16

    MS_8 = 0.49*ManSupp, Errorvar.= 0.49  , Rý = 0.33
          (0.10)                    (0.089)
           4.89                      5.46

    MS_9 = 0.55*ManSupp, Errorvar.= 0.63 , Rý = 0.33
          (0.11)                    (0.12)
           4.86                      5.46

   MS_10 = 0.87*ManSupp, Errorvar.= 0.38  , Rý = 0.66
          (0.11)                    (0.081)
           7.80                      4.72

   MS_11 = 0.60*ManSupp, Errorvar.= 0.57 , Rý = 0.39
```

```
       (0.11)                  (0.11)
        5.41                    5.39

MS_12 = 0.75*ManSupp, Errorvar.= 0.34  , Rý = 0.62
       (0.10)                  (0.069)
        7.45                    4.88

MS_13 = 0.69*ManSupp, Errorvar.= 0.43  , Rý = 0.52
       (0.10)                  (0.084)
        6.58                    5.16

MS_14 = 0.73*ManSupp, Errorvar.= 0.45  , Rý = 0.54
       (0.11)                  (0.087)
        6.75                    5.11

MS_15 = 0.53*ManSupp, Errorvar.= 0.51  , Rý = 0.36
       (0.10)                  (0.094)
        5.11                    5.43

MS_16 = 0.43*ManSupp, Errorvar.= 0.99  , Rý = 0.16
       (0.13)                  (0.18)
        3.21                    5.61

MS_17 = 0.47*ManSupp, Errorvar.= 0.49  , Rý = 0.31
       (0.100)                 (0.089)
        4.75                    5.47

 WD_1 = 0.64*WorkDisc, Errorvar.= 0.55 , Rý = 0.43
       (0.11)                   (0.11)
        5.68                     5.20

 WD_2 = 0.026*WorkDisc, Errorvar.= 1.10 , Rý = 0.00062
       (0.14)                   (0.19)
        0.19                     5.70

 WD_3 = 0.52*WorkDisc, Errorvar.= 0.67 , Rý = 0.28
       (0.12)                   (0.12)
        4.41                     5.44

 WD_4 = 0.67*WorkDisc, Errorvar.= 0.37  , Rý = 0.55
       (0.100)                  (0.075)
        6.69                     4.89

 WD_5 = 0.38*WorkDisc, Errorvar.= 0.52  , Rý = 0.22
       (0.10)                   (0.094)
        3.81                     5.51

 WD_6 = 0.71*WorkDisc, Errorvar.= 0.22  , Rý = 0.69
       (0.089)                  (0.053)
        7.94                     4.20

 WD_7 = 0.57*WorkDisc, Errorvar.= 0.26  , Rý = 0.56
       (0.085)                  (0.054)
        6.79                     4.85

 WD_8 = 0.55*WorkDisc, Errorvar.= 0.50  , Rý = 0.37
       (0.10)                   (0.094)
        5.22                     5.30

 WD_9 = 0.47*WorkDisc, Errorvar.= 0.20  , Rý = 0.53
       (0.072)                  (0.040)
        6.55                     4.95

WD_10 = 0.70*WorkDisc, Errorvar.= 0.63 , Rý = 0.44
       (0.12)                   (0.12)
        5.76                     5.18

 RR_1 = 0.52*Reward, Errorvar.= 0.45  , Rý = 0.38
       (0.10)                  (0.089)
        5.09                    5.06

 RR_2 = 0.73*Reward, Errorvar.= 0.57 , Rý = 0.49
       (0.12)                  (0.12)
        5.97                    4.69
```

```
RR_3 = 0.58*Reward, Errorvar.= 0.60 , Rý = 0.36
      (0.12)                  (0.12)
       4.94                    5.11

RR_4 = 0.78*Reward, Errorvar.= 0.32  , Rý = 0.66
      (0.11)                  (0.087)
       7.28                    3.63

RR_5 = 0.78*Reward, Errorvar.= 0.41 , Rý = 0.60
      (0.11)                  (0.10)
       6.85                    4.06

TA_1 = 0.73*TimeAv, Errorvar.= 0.51 , Rý = 0.52
      (0.13)                  (0.14)
       5.55                    3.58

TA_2 =  - 0.55*TimeAv, Errorvar.= 0.40  , Rý = 0.43
         (0.11)                  (0.097)
         -5.02                    4.19

TA_3 =  - 0.47*TimeAv, Errorvar.= 0.52 , Rý = 0.30
         (0.11)                  (0.11)
         -4.08                    4.88

TA_4 = 0.22*TimeAv, Errorvar.= 1.06 , Rý = 0.043
      (0.15)                  (0.19)
       1.47                    5.61

TA_5 = 0.61*TimeAv, Errorvar.= 0.62 , Rý = 0.38
      (0.13)                  (0.14)
       4.67                    4.50

TA_6 =  - 0.30*TimeAv, Errorvar.= 0.77 , Rý = 0.10
         (0.13)                  (0.14)
         -2.32                    5.48

OB_1 = 0.31*OrgBound, Errorvar.= 0.76 , Rý = 0.11
      (0.13)                  (0.14)
       2.41                    5.48

OB_2 = 0.68*OrgBound, Errorvar.= 0.80 , Rý = 0.37
      (0.15)                  (0.17)
       4.65                    4.61

OB_3 = 0.57*OrgBound, Errorvar.= 0.57 , Rý = 0.36
      (0.12)                  (0.12)
       4.60                    4.65

OB_4 = 0.89*OrgBound, Errorvar.= 1.20 , Rý = 0.40
      (0.18)                  (0.27)
       4.87                    4.45

OB_5 = 0.65*OrgBound, Errorvar.= 0.33  , Rý = 0.56
      (0.11)                  (0.099)
       5.87                    3.32
```

Correlation Matrix of Independent Variables
Note: This matrix is diagonal.

ManSupp	WorkDisc	Reward	TimeAv	OrgBound
1.00	1.00	1.00	1.00	1.00

Goodness of Fit Statistics

Degrees of Freedom = 860
Minimum Fit Function Chi-Square = 1522.23 (P = 0.0)
Normal Theory Weighted Least Squares Chi-Square = 1261.19 (P = 0.0)
Estimated Non-centrality Parameter (NCP) = 401.19
90 Percent Confidence Interval for NCP = (310.31 ; 500.06)

Minimum Fit Function Value = 23.42
Population Discrepancy Function Value (F0) = 6.17
90 Percent Confidence Interval for F0 = (4.77 ; 7.69)
Root Mean Square Error of Approximation (RMSEA) = 0.085
90 Percent Confidence Interval for RMSEA = (0.075 ; 0.095)
P-Value for Test of Close Fit (RMSEA < 0.05) = 0.00

Expected Cross-Validation Index (ECVI) = 22.05
90 Percent Confidence Interval for ECVI = (20.65 ; 23.57)
ECVI for Saturated Model = 29.11
ECVI for Independence Model = 64.58

Chi-Square for Independence Model with 903 Degrees of Freedom = 4111.38
Independence AIC = 4197.38
Model AIC = 1433.19
Saturated AIC = 1892.00
Independence CAIC = 4334.53
Model CAIC = 1707.50
Saturated CAIC = 4909.41

Normed Fit Index (NFI) = 0.63
Non-Normed Fit Index (NNFI) = 0.78
Parsimony Normed Fit Index (PNFI) = 0.60
Comparative Fit Index (CFI) = 0.79
Incremental Fit Index (IFI) = 0.80
Relative Fit Index (RFI) = 0.61

Critical N (CN) = 41.97

Root Mean Square Residual (RMR) = 0.17
Standardized RMR = 0.19
Goodness of Fit Index (GFI) = 0.53
Adjusted Goodness of Fit Index (AGFI) = 0.48
Parsimony Goodness of Fit Index (PGFI) = 0.48

The Modification Indices Suggest to Add the

Path to	from	Decrease in Chi-Square	New Estimate
MS_4	OrgBound	8.7	0.27
MS_5	Reward	8.5	0.32
MS_16	OrgBound	8.9	-0.42
WD_3	ManSupp	12.4	0.38
WD_4	ManSupp	10.4	0.27
WD_4	TimeAv	11.0	-0.31
WD_5	ManSupp	7.9	0.27
WD_5	Reward	12.5	0.35
OB_1	ManSupp	11.3	-0.38

The Modification Indices Suggest to Add a Covariance

between	and	Decrease in Chi-Square	New Estimate
WorkDisc	ManSupp	19.5	0.60
Reward	ManSupp	13.0	0.51
Reward	WorkDisc	9.5	0.44
MS_2	MS_1	9.9	0.20
MS_4	MS_1	9.0	0.17
MS_4	MS_3	13.4	0.16
MS_10	MS_9	8.6	0.20
MS_13	MS_12	12.3	0.19
MS_17	MS_16	9.6	0.27
WD_4	MS_17	10.4	0.18
WD_4	WD_3	21.4	0.32
WD_8	MS_5	8.1	-0.21
WD_8	WD_7	22.2	0.24
WD_9	MS_11	8.7	-0.13
WD_10	MS_9	8.6	-0.24
TA_3	TA_2	12.4	0.29
TA_4	TA_2	11.0	0.32
TA_6	WD_4	10.2	0.23
OB_1	MS_7	11.9	-0.26
OB_1	WD_4	8.0	-0.20

Time used: 0.828 Seconds

Appendix 3 – NCSS Output – 5 factor EFA

Factor Analysis Report

Eigenvalues after Varimax Rotation

No.	Eigenvalue	Individual Percent	Cumulative Percent	Scree Plot
1	6.902776	31.73	31.73	|||||||
2	3.120984	14.35	46.07	|||
3	4.374658	20.11	66.18	|||||
4	2.400347	11.03	77.21	|||
5	3.698073	17.00	94.21	||||
6	1.231610	5.66	99.87	||
7	1.065230	4.90	104.77	|
8	0.861671	3.96	108.73	|
9	0.818718	3.76	112.49	|
10	0.673147	3.09	115.59	|
11	0.574302	2.64	118.23	|
12	0.485089	2.23	120.45	|
13	0.417846	1.92	122.38	|
14	0.336669	1.55	123.92	|
15	0.304049	1.40	125.32	|
16	0.214251	0.98	126.31	|
17	0.151719	0.70	127.00	|
18	0.138785	0.64	127.64	|
19	0.095149	0.44	128.08	|
20	0.046091	0.21	128.29	|
21	0.020831	0.10	128.39	|
22	-0.014900	-0.07	128.32	|
23	-0.019335	-0.09	128.23	|
24	-0.078701	-0.36	127.87	|
25	-0.104298	-0.48	127.39	|
26	-0.145038	-0.67	126.72	|
27	-0.169324	-0.78	125.94	|
28	-0.184461	-0.85	125.09	|
29	-0.203005	-0.93	124.16	|
30	-0.253856	-1.17	122.99	|
31	-0.286364	-1.32	121.68	|
32	-0.301001	-1.38	120.29	|
33	-0.310334	-1.43	118.87	|
34	-0.318675	-1.46	117.40	|
35	-0.341804	-1.57	115.83	|
36	-0.373932	-1.72	114.11	|
37	-0.379456	-1.74	112.37	|
38	-0.403644	-1.86	110.51	|
39	-0.412737	-1.90	108.62	|
40	-0.421974	-1.94	106.68	|
41	-0.447740	-2.06	104.62	|
42	-0.490945	-2.26	102.36	|
43	-0.514076	-2.36	100.00	|

Factor Loadings after Varimax Rotation

	Factors				
Variables	Factor1	Factor2	Factor3	Factor4	Factor5
MS_1	-0.517857	0.193948	-0.041331	-0.063740	-0.060336
MS_2	-0.554667	0.252511	0.026344	0.064336	-0.152605
MS_3	-0.601849	0.152253	-0.077676	0.166400	0.185184
MS_4	-0.542937	0.477759	-0.043118	0.135792	-0.016334
MS_5	-0.372799	0.264565	0.177609	0.036933	0.438220
MS_6	-0.548692	-0.137770	-0.254505	-0.119611	0.086490
MS_7	-0.577713	-0.354699	-0.323480	-0.137392	0.149300
MS_8	-0.536480	0.014790	-0.111994	-0.051641	0.142541
MS_9	-0.538882	0.138800	-0.296067	0.092255	0.125052
MS_10	-0.741902	-0.088490	-0.166771	0.038712	0.276503
MS_11	-0.559070	-0.287935	-0.078972	0.049723	0.225591
MS_12	-0.669475	-0.156613	-0.378568	-0.047922	0.228806
MS_13	-0.564280	-0.130698	-0.248259	0.013183	0.332267
MS_14	-0.644905	-0.087176	-0.156146	-0.159704	0.153637
MS_15	-0.494104	-0.183590	0.006750	-0.141691	0.368711
MS_16	-0.417519	-0.474243	0.148232	-0.149034	0.005824
MS_17	-0.587661	-0.153330	0.062541	-0.233655	0.116876

WD_1	-0.390410	0.001205	-0.508509	0.057659	0.185222
WD_2	-0.121650	-0.066221	0.051511	0.162675	0.034129
WD_3	-0.535344	-0.109154	-0.329083	-0.084739	0.242568
WD_4	-0.518698	0.023029	-0.575688	-0.303358	0.197890
WD_5	-0.472305	0.243259	-0.188266	0.031711	0.462047
WD_6	-0.289396	0.080966	-0.747540	0.067198	0.096211
WD_7	-0.111495	0.073855	-0.764034	0.170795	0.018429
WD_8	-0.057851	-0.037847	-0.730823	0.088996	-0.089216
WD_9	-0.043966	0.242463	-0.730368	0.040425	0.159787
WD_10	-0.186627	-0.158733	-0.571781	-0.210628	0.298233
RR_1	-0.281189	0.091886	-0.295495	-0.213892	0.525402
RR_2	-0.223675	0.113972	-0.302657	-0.131586	0.648482
RR_3	-0.228517	-0.084083	-0.117923	0.058075	0.541239
RR_4	-0.170059	-0.018828	0.030993	0.002974	0.836392
RR_5	-0.009094	0.222902	-0.076182	-0.022942	0.790380
TA_1	0.110393	0.170896	-0.175839	0.717381	0.147337
TA_2	0.049055	0.143657	0.175155	-0.565520	0.015236
TA_3	-0.224829	0.248565	0.117617	-0.470190	0.010749
TA_4	0.020289	0.203738	0.167827	0.283578	-0.087254
TA_5	-0.077523	0.108197	-0.058588	0.613910	-0.204242
TA_6	-0.272815	0.000186	-0.208590	-0.466248	0.008225
OB_1	0.228814	0.631741	0.223663	0.253801	-0.080651
OB_2	-0.034598	0.544890	0.040960	0.020682	0.175256
OB_3	0.078848	0.567183	-0.065089	0.007488	0.030923
OB_4	-0.094736	0.592621	-0.081449	-0.211383	0.067466
OB_5	-0.036998	0.571066	-0.296259	-0.216994	0.092400

Factor Structure Summary after Varimax Rotation

	Factors			
Factor1	**Factor2**	**Factor3**	**Factor4**	**Factor5**
MS_10	OB_1	WD_7	TA_1	RR_4
MS_12	OB_4	WD_6	TA_5	RR_5
MS_14	OB_5	WD_8	TA_2	RR_2
MS_3	OB_3	WD_9	TA_3	RR_3
MS_17	OB_2	WD_4	TA_6	RR_1
MS_7	MS_4	WD_10		WD_5
MS_13	MS_16	WD_1		MS_5
MS_11				
MS_2				
MS_6				
MS_4				
MS_9				
MS_8				
WD_3				
WD_4				
MS_1				
MS_15				
WD_5				
MS_16				

Factor Score after Varimax Rotation

	Factors				
Row	**Factor1**	**Factor2**	**Factor3**	**Factor4**	**Factor5**
1	-0.5436	-0.6529	-1.4276	0.4691	1.6028
2	0.8917	0.1176	1.0635	0.6928	-3.1239
3	-0.8509	1.1153	1.6527	0.2040	0.4332
4	-2.3295	-1.6255	-1.1246	0.2579	-1.9111
5	0.1342	-0.7030	0.5373	-0.1307	0.5973
6	-0.6712	0.1541	-0.2508	0.4265	1.1037
7	0.3233	-0.9416	0.1321	-1.4405	0.5373
8	-1.7004	-2.5312	0.2134	-0.4961	-2.1624
9	1.0381	-0.7203	0.5715	-1.3447	-0.1027
10	0.2287	1.1519	-1.4218	-0.3436	-0.9687
11	-0.7683	0.6257	-0.2933	0.6316	1.3916
12	-0.7835	2.4969	-0.7535	-1.0444	-2.0782
13	0.3623	1.5824	-0.0348	-1.0816	0.9104
14	0.9314	0.5091	-2.1613	1.1158	0.1348
15	-1.1409	0.9766	-1.1857	0.1061	0.6740
16	0.2370	0.8441	0.0352	1.6731	0.1770
17	-0.7563	1.1810	-1.3571	-0.5718	0.7438
18	0.2872	0.8414	0.6633	-1.9112	-0.2962
19	0.4400	-0.2541	0.1643	-1.1773	-0.2215

20	-0.7563	1.1810	-1.3571	-0.5718	0.7438
21	-0.1197	-0.3887	1.2555	-0.9754	0.6035
22	-1.0726	0.1772	0.3326	0.0197	0.2735
23	-1.9182	-0.1848	-0.7310	0.6760	-0.4342
24	-0.4034	-0.4051	1.0402	0.7969	-0.0642
25	-0.5793	0.0393	-0.2618	1.5258	-0.5326
26	-0.5588	-0.9950	1.4648	-0.4854	-0.5242
27	-0.4132	0.4225	-0.1973	-1.2214	-0.1226
28	1.1571	-0.9699	0.6832	1.0360	1.2510
29	-0.3748	0.2984	0.4235	-0.7662	-0.4497
30	0.0775	0.3548	0.2714	-0.1334	-0.4988
31	-0.2002	-1.1592	1.0512	0.7957	0.7688
32	1.4563	0.0181	-1.6406	0.0292	1.5125
33	0.7636	1.1454	-1.0722	0.0233	1.2070
34	-0.1644	0.2176	1.5918	2.5285	-0.2728
35	-2.4186	1.0679	1.0843	0.4935	1.4107
36	-0.5306	-0.7656	2.4206	0.1138	-0.4568
37	0.0241	-0.0161	0.8285	0.1407	-0.1598
38	1.2374	0.8861	-0.9959	0.8406	0.4212
39	0.3491	0.8423	0.9828	1.9239	-1.2403
40	0.5307	-1.4296	1.2751	0.7357	1.7175
41	1.6414	0.0733	0.0674	-1.6758	-0.2767
42	-1.2273	-0.5279	-0.7465	-1.8241	0.7481
43	-0.9951	-2.5249	-0.4173	0.6007	1.2557
44	0.5617	-0.8851	-0.0882	-0.4499	-0.5368
45	-0.5175	1.3695	-0.9119	-1.6534	-1.4147
46	1.1860	1.5029	1.3735	-1.6457	1.1273
47	0.5948	-0.1410	-1.1316	-1.8318	-0.1683
48	0.6224	-0.7831	-0.0104	-0.7396	0.3901
49	-0.8474	-1.5942	-0.5928	0.7519	0.3850
50	-0.8464	-0.8186	0.6927	-0.3471	-0.2900
51	1.8483	-0.0295	-0.0725	-0.7758	-1.7462
52	0.7289	0.9413	2.4076	-0.7478	0.6701
53	0.4543	-0.7543	-0.6852	1.0924	1.1307
54	-1.7427	0.7621	0.5786	0.1300	0.0407
55	0.0548	-0.5464	1.1946	0.4514	-0.0758
56	0.8608	2.4778	-0.2340	2.3475	-1.0202
57	-0.7571	0.3904	-0.2113	1.0473	-0.1281
58	0.1059	0.5568	-0.8784	1.0934	0.3676
59	0.3961	-0.1326	0.9219	-1.2493	0.1574
60	-0.9803	-0.1706	-0.6920	1.5617	-1.7653
61	3.8405	-2.2518	-1.3898	1.3968	0.9243
62	0.9273	-1.7344	-2.2334	-0.9464	-3.0666
63	0.1431	-1.0395	-0.9290	-2.2437	1.4081
64	0.9478	1.7555	0.9504	-0.3580	-0.4856
65	0.1595	0.0220	-1.3737	1.3193	0.2700
66	1.4254	-0.4221	0.9386	1.1354	-0.4952

Appendix 4 – Factor structures for non 5-factor EFAs

2 Factors

Factor 1	Factor 2
MS_12	MS_16
WD_4	OB_5
MS_10	OB_1
MS_7	OB_3
MS_13	WD_9
WD_3	OB_2
MS_14	OB_4
WD_5	TA_1
MS_6	
WD_1	
MS_11	
RR_1	
MS_9	
RR_2	**Missing**
MS_15	MS_1
WD_6	MS_2
WD_10	MS_4
MS_3	MS_5
MS_8	RR_5
MS_17	TA_2
RR_4	TA_3
RR_3	TA_4
OB_1	TA_5
	TA_6
	WD_2
	WD_7
	WD_8

3 Factors

Factor 1	Factor 2	Factor 3
MS_12	OB_2	WD_7
MS_10	OB_4	WD_8
MS_7	OB_1	WD_9
WD_4	OB_3	WD_6
MS_14	OB_5	WD_1
MS_13	RR_5	
WD_3	MS_4	
MS_15	MS_5	
MS_11	WD_5	
MS_6	MS_16	
MS_17		
WD_5		
RR_1		
MS_8		**Missing**
RR_2		MS_1
MS_9		MS_2
MS_3		TA_1
WD_1		TA_2
WD_10		TA_3
OB_1		TA_4
RR_4		TA_5
MS_16		TA_6
RR_3		WD_2
WD_6		

4 Factors

Factor 1	Factor 2	Factor 3	Factor 4
MS_10	OB_1	WD_7	TA_5
MS_12	OB_2	WD_6	TA_1
MS_14	OB_4	WD_9	TA_2
MS_13	OB_3	WD_8	RR_1
MS_3	OB_5	WD_10	RR_2
MS_11	RR_5	WD_4	RR_4
MS_7	MS_16	WD_1	
MS_17	MS_4		
WD_3	MS_5		
MS_15			
MS_6			

MS_8
WD_5
MS_9
WD_4
MS_4
MS_2
MS_1
MS_5
MS_16
WD_1

Missing
RR_3
TA_3
TA_4
TA_6
WD_2

5 Factors

Factor 1	Factor 2	Factor 3	Factor 4	Factor 5
MS_10	OB_1	WD_7	TA_1	RR_4
MS_12	OB_4	WD_6	TA_5	RR_5
MS_14	OB_5	WD_8	TA_2	RR_2
MS_3	OB_3	WD_9	TA_3	RR_3
MS_17	OB_2	WD_4	TA_6	RR_1
MS_7	MS_4	WD_10		WD_5
MS_13	MS_16	WD_1		MS_5
MS_11				
MS_2				
MS_6				
MS_4				
MS_9				
MS_8				
WD_3				
WD_4				
MS_1				
MS_15				
WD_5				
MS_16				

Missing
TA_4
WD_2

6 Factors

Factor 1	Factor 2	Factor 3	Factor 4	Factor 5	Factor 6
MS_10	OB_1	WD_7	TA_1	RR_4	TA_4
MS_12	OB_5	WD_6	TA_2	RR_5	TA_5
MS_3	OB_4	WD_8	TA_3	RR_2	OB_1
MS_2	OB_3	WD_9	TA_5	RR_3	
MS_14	OB_2	WD_4		RR_1	
MS_6	MS_16	WD_10		WD_5	
MS_1	MS_4	WD_1		MS_5	
MS_4		WD_3			
MS_13		MS_12			
MS_7					
MS_17					
MS_9					
MS_8					
MS_11					
WD_4					
WD_3					
MS_15					
WD_5					
WD_1					

Missing
TA_6
WD_2

MS_16

MS_5

7 Factors

Factor 1	Factor 2	Factor 3	Factor 4	Factor 5	Factor 6	Factor 7
MS_10	OB_5	WD_7	TA_2	RR_4	TA_4	MS_4
MS_12	OB_3	WD_9	TA_1	RR_5	OB_1	MS_1
MS_7	OB_2	WD_8	TA_3	RR_2	TA_5	MS_2
MS_14	OB_4	WD_6	TA_5	RR_3		MS_3
MS_13		WD_10		WD_5		
MS_17		WD_4		RR_1		
WD_3		WD_1		MS_5		
MS_11						
WD_4						
MS_15						
MS_16						
OB_1						
MS_6						

MS_9	**Missing**
MS_8	TA_6
	WD_2

8 Factors

Factor 1	Factor 2	Factor 3	Factor 4	Factor 5	Factor 6	Factor 7	Factor 8
MS_10	OB_5	WD_7	TA_2	RR_4	TA_4	MS_4	WD_2
MS_12	OB_4	WD_9	TA_3	RR_5	TA_5	MS_1	WD_5
MS_14	OB_3	WD_6	TA_1	RR_3	OB_1	MS_2	
MS_7	OB_2	WD_8		RR_2	TA_1	MS_3	
WD_3	MS_16	WD_10		MS_5		MS_5	
MS_13		WD_4		RR_1			
MS_11		WD_1		WD_5			
MS_17							
WD_4							
MS_15							
MS_9							
OB_1							
MS_8							
MS_6		**Missing**					
WD_5		TA_6					
MS_16							

Appendix 5 – Step-by-step guide to confirmatory factor analysis in LISREL

LISREL is a computer program for structural equation modelling (SEM). SEM encompasses confirmatory factor analysis (CFA), and so LISREL can be used to perform CFAs. This is a guide to performing a CFA with LISREL.

Obtaining LISREL

Several options are available for obtaining a copy of LISREL. A full version costs several hundred dollars, so if it is not to be used for large amounts of work, one of the limited versions might be appropriate. A student version is available for free – it has all the functionality of the full version, but can only analyse a limited number of variables. A 15-day trial version is also available for free – it has all the functionality of the full version, but only works for 15 days. Both limited versions can be downloaded from the LISREL website.

Files

LISREL has several file types that must be understood before it can be used. Data files (.psf and .dsf) store data to be analysed. Data can be raw scores, correlations, or covariances. Raw scores are simplest, as LISREL will calculate the required covariance matrix automatically, and will have the sample size at hand immediately.

- Syntax files (.spl and .ls8) contain instructions on how LISREL should process the data.
- Path diagram files (.pth) are diagrammatic representations of structural models. Path diagram files also contain some additional information about the data to be processed and the outputs required.
- Project files (.lpj and .spj) are like syntax files, in that they contain instructions, but they also contain information about the outputs that LISREL should produce.
- Output files (.out, .fit, and others) contain information generated by LISREL about an analysis. LISREL does not change the contents of

data files or syntax files during an analysis, so most of the information generated is stored in the newly created output files.

It is clear that LISREL is not a typical Windows program that stores all the information for a task in one file. LISREL, in its current form, is actually a collection of command-line based programs and a graphical interface that manages the files and programs. Knowing this makes LISREL's quirks easier to understand.

Data

The easiest way to get data into LISREL is to create an empty data file, and import data into it from a .csv (comma separated values) or .txt (text) file.

Syntax

It is possible to write a syntax file by hand, but this is not necessary. It is much simpler to draw a path diagram and have LISREL build the syntax itself from the diagram.

Path diagrams

Drawing a path diagram is the easiest way to specify a structural model in LISREL. To draw a path diagram, follow these steps:

- Create an empty path diagram file using LISREL's file menu. LISREL requires the model to be saved immediately, so have a project directory ready.
- Link a data file to the path diagram by clicking "Setup: Variables", "Add/Read Variables", "Browse", and choosing the data file. Make sure the "Add/Read Variables" option is set to the correct type of data file.
- Before closing the "Labels" window, add the necessary latent (unobserved) variables by clicking "Add Latent Variables".
- The path diagram window will now have two lists of variable names on the left of the screen. Drag and drop the variable names onto the blank path diagram, and join them with paths using the "Draw path" tools. In this way, the theorised relationships between variables can be represented schematically, and any mistakes will be easy to see.

- Once the model is complete, click "Setup: Build Syntax", and LISREL will automatically build a project file containing the instructions for testing the model.

In this roundabout way, all the files needed to test a structural model or confirmatory factor analysis will have been assembled. Click the icon with the capital "L" to run LISREL on the specified model and data. LISREL will update the path diagram with some of the outputs, and place the rest of the outputs into the various output files. The most useful of these is the .out file, as it contains information on the degree of fit of the model, the parameters, and the suggestions for modifications.

Appendix 6 – Raw data

Respondent	MS_1	MS_2	MS_3	MS_4	MS_5	MS_6	MS_7	MS_8	MS_9	MS_10	MS_11
1	4	2	5	4	4	5	4	4	4	4	5
2	3	3	4	4	1	1	1	1	2	2	4
3	4	4	4	5	4	3	2	3	3	3	3
4	4	4	4	4	2	5	5	5	5	5	4
5	3	2	4	4	3	3	3	2	3	4	3
6	4	3	4	4	4	4	3	3	4	4	4
7	4	4	4	3	3	4	3	3	4	3	4
8	4	3	4	5	1	4	4	4	3	5	5
9	4	3	3	3	2	3	2	3	2	2	3
10	5	4	4	4	2	3	2	5	3	2	2
11	4	4	5	5	4	2	3	4	4	4	4
12	3	4	4	5	3	3	3	4	4	3	3
13	4	4	4	4	4	3	2	3	2	3	2
14	4	3	4	4	1	3	2	3	5	4	3
15	4	4	4	5	4	5	3	4	3	4	5
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18	4	3	3	4	4	3	2	4	3	2	2
19	3	3	3	3	3	2	3	3	4	3	3
20	4	3	4	4	3	3	4	4	5	5	3
21	4	3	4	4	3	3	2	2	3	3	4
22	4	4	4	4	3	3	3	4	5	4	4
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31	4	4	4	4	3	2	2	3	2	3	4
32	3	3	4	4	2	2	2	2	2	2	3
33	4	3	4	4	4	2	3	3	3	3	3
34	4	4	4	4	4	2	2	4	3	2	2
35	4	5	5	5	5	4	2	5	5	5	4
36	4	4	4	3	3	2	2	3	3	3	4
37	4	3	4	4	2	2	2	4	2	3	3
38	2	3	4	4	2	1	3	2	4	2	5
39	4	3	4	4	3	2	2	3	3	2	3
40	3	3	4	3	4	2	2	3	2	3	3
41	3	2	3	3	2	2	2	2	4	1	3
42	5	3	5	5	3	4	4	4	5	4	4
43	4	2	5	4	4	4	5	4	4	3	5
44	3	3	4	3	3	4	4	3	2	2	3
45	5	4	5	5	3	4	2	4	3	2	3
46	3	3	4	4	3	2	1	2	2	2	2

47	4	3	3	4	3	4	4	3	3	3	3
48	3	2	4	3	2	4	3	3	2	2	4
49	2	4	4	4	4	5	4	4	5	4	4
50	4	4	4	3	4	3	4	3	3	3	4
51	2	2	3	3	2	2	1	3	2	1	2
52	4	2	3	4	3	2	2	4	4	3	2
53	3	3	4	4	3	2	3	4	4	4	4
54	4	4	5	5	4	4	4	4	4	4	4
55	4	3	4	4	3	3	3	2	3	3	3
56	5	4	5	5	4	4	1	2	4	1	1
57	3	4	5	4	2	3	3	4	4	4	4
58	4	4	4	4	4	3	2	3	4	2	4
59	4	3	4	4	3	3	3	4	3	2	3
60	5	3	4	4	2	4	3	3	4	4	3
61	1	1	2	2	1	2	2	3	1	1	1
62	4	4	3	3	2	2	2	2	3	1	1
63	4	3	4	3	3	4	4	3	3	3	4
64	3	3	3	5	3	2	2	3	3	2	2
65	4	3	4	4	2	2	2	2	4	4	4
66	3	3	3	3	3	2	2	2	2	2	3

MS_12	MS_13	MS_14	MS_15	MS_16	MS_17	WD_1	WD_2	WD_3	WD_4	WD_5	WD_6
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4	4	3	2	3	4	4	2	5	4	4	4
3	3	3	2	4	4	4	4	3	4	4	3
4	4	4	3	3	3	5	2	4	4	4	4

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4	3	3	3	4	3	4	2	3	3	4	4
3	2	2	2	2	4	3	1	4	4	3	5
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3	2	1	1	2	2	4	3	2	3	3	4
4	3	2	1	4	4	5	2	4	5	1	5
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4	4	4	3	1	3	5	5	5	4	5	5
2	3	2	3	4	2	2	2	2	2	3	3

WD_7	WD_8	WD_9	WD_10	RR_1	RR_2	RR_3	RR_4	RR_5	TA_1	TA_2	TA_3	TA_4
5	5	5	5	5	5	5	5	4	4	2	2	2
4	4	3	1	2	1	3	1	1	2	2	2	4
3	3	3	2	4	4	4	4	4	3	2	2	3
5	5	5	4	4	3	3	3	1	3	2	2	3
4	3	4	3	4	3	4	4	4	3	2	2	2
5	4	5	4	4	3	5	5	5	3	3	4	4
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4	5	4	5	3	1	5	3	1	1	3	4	1

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5	4	5	4	4	5	5	5	5	4	2	2	1
5	3	5	4	3	3	1	1	4	3	4	4	4
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4	4	4	3	4	3	4	4	5	5	1	2	2
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4	3	4	2	2	3	2	2	3	5	2	2	4
4	3	4	4	4	3	4	5	5	3	2	2	3
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5	4	5	5	4	2	1	1	2	3	2	2	1
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5	5	5	5	3	5	4	4	3	4	2	2	3
4	3	4	4	3	2	2	3	3	3	2	1	4

TA_5	**TA_6**	**OB_1**	**OB_2**	**OB_3**	**OB_4**	**OB_5**
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5	4	4	4	3	3	3
3	3	3	5	4	5	5
3	3	2	3	3	3	3
3	4	2	5	4	1	5
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3	4	3	5	2	2	5
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5	5	4	5	3	4	5
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4	3	4	4	3	4	4
5	2	4	5	5	4	5
4	2	4	4	4	3	4

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2	3	3	5	5	2	4
1	4	1	4	3	2	5
3	4	1	2	2	2	2
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3	3	3	5	2	5	5
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4	3	3	5	4	4	4
3	3	2	4	3	3	4
4	1	5	5	5	3	4
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1	4	2	1	2	5	5
4	3	4	5	4	4	4
3	2	4	3	3	4	4
4	1	4	4	4	1	5