PENDEKATAN SEM

UNTUK PUBLIKASI INTERNASIONAL BIDANG MANAJEMEN TEKNOLOGI

Fourry Handoko, Ph.D

MK

PENDEKATAN SEM
UNTUK PUBLIKASI INTERNASIONAL BIDANG MANAJEMEN TEKNOLOGI

Fourry Handoko, Ph.D

Penerbit:
PT. Muara Karya (Anggota IKAPI)
Surabaya, 2019

Judul:

Pendekatan SEM

Untuk Publikasi Internasional Bidang Manajemen Teknologi

Oleh : Fourry Handoko, Ph.D

Penerbit : PT. Muara Karya
ISBN : 978-602-53690-8-7

Diterbitkan oleh :

PT. Muara Karya (IKAPI)
Gedung Papaya Lt. 2.
Jl. Margorejo Indah 60 - 68,
Surabaya 12620 – Indonesia
Phone : +62-31-99842196
Fax : +62-31-99842196
Email : admin@muarakarya.com

KATA PENGANTAR

Melakukan Publikasi adalah sebuah tantangan tersendiri bagi seorang peneliti atau penulis. Apalagi untuk melakukan publikasi pada jurnal internasional. Terlebih lagi Jurnal Internasional Bereputasi.

Oleh sebab itu dibutuhkan sebuah panduan untuk membantu seorang peneliti, terutama peneliti yang mengangkat tema manajemen dan teknologi untuk dapat menulis publikasi internasional dengan cara yang cepat dan tepat, serta dapat membantu seorang peneliti untuk menulis dengan suatu aliran logika yang bagus. Tulisan terkait hasil penelitian yang berbasis manajemen dan teknologi yang menggunakan pendekatan statistik SEM.

Buku ini akan memberikan solusi terkait permasalahan tersebut yaitu memberikan panduan bagi peneliti untuk membuat tulisan publikasi internasional, khususnya terkait hasil penelitian yang berbasis manajemen dan teknologi yang menggunakan pendekatan statistik Struktural *Equation Modelling*.

April, 2020

Penulis

DAFTAR ISI

Bagian Kesatu

Publikasi Internasional

Isinya adalah alasan terkait membuat publikasi Internasional…..

Introduction Publication is the final stage of research and therefore a responsibility for all researchers. Scholarly publications are expected to provide a detailed and permanent record of research. Because publications form the basis for both new research and the application of findings, they can affect not only the research community but also, indirectly, society at large. Researchers therefore have a responsibility to ensure that their publications are honest, clear, accurate, complete and balanced, and should avoid misleading, selective or ambiguous reporting. Journal editors also have responsibilities for ensuring the integrity of the research literature and these are set out in companion guidelines. This document aims to establish international standards for authors of scholarly research publications and to describe responsible research reporting practice. We hope these standards will be endorsed by research institutions, funders, and professional societies; promoted by editors and publishers; and will aid in research integrity training. Responsible research publication:

1. Soundness and reliability

1.1 The research being reported should have been conducted in an ethical and responsible manner and follow all relevant legislation. [See also the Singapore Statement on Research Integrity, www.singaporestatement.org].

1.2 The research being reported should be sound and carefully executed.

1.3 Researchers should use appropriate methods of data analysis and display (and, if needed, seek and follow specialist advice on this).

1.4 Authors should take collective responsibility for their work and for the content of their publications. Researchers should check their publications carefully at all stages to ensure methods and findings are reported accurately. Authors should carefully check calculations, data presentations, typescripts/ submissions and proofs.

2. Honesty

2.1 Researchers should present their results honestly and without fabrication, falsification or inappropriate data manipulation. Research images (e.g. micrographs, X-rays, pictures of electrophoresis gels) should not be modified in a misleading way.

2.2 Researchers should strive to describe their methods and to present their findings clearly and unambiguously. Researchers should follow applicable reporting guidelines. Publications should provide sufficient detail to permit experiments to be repeated by other researchers.

2.3 Reports of research should be complete. They should not omit inconvenient, inconsistent or inexplicable findings or results that do not support the authors' or sponsors' hypothesis or interpretation.

2.4 Research funders and sponsors should not be able to veto publication of findings that do not favour their product or position. Researchers should not enter agreements that permit the research sponsor to veto or control the publication of the findings (unless there are exceptional circumstances, such as research classified by governments because of security implications).

2.5 Authors should alert the editor promptly if they discover an error in any submitted, accepted or published work. Authors should cooperate with editors in issuing corrections or retractions when required.

2.6 Authors should represent the work of others accurately in citations and quotations.

2.7 Authors should not copy references from other publications if they have not read the cited work.

3. Balance

3.1 New findings should be presented in the context of previous research. The work of others should be fairly represented. Scholarly reviews and syntheses of existing research should be complete, balanced, and should include findings regardless of whether they support the hypothesis or interpretation being proposed. Editorials or opinion pieces presenting a single viewpoint or argument should be clearly distinguished from scholarly reviews.

3.2 Study limitations should be addressed in publications.

4. Originality

4.1 Authors should adhere to publication requirements that submitted work is original and has not been published elsewhere in any language. Work should not be submitted concurrently to more than one publication unless the editors have agreed to co-publication.

4.2 Applicable copyright laws and conventions should be followed. Copyright material (e.g. tables, figures or extensive quotations) should be reproduced only with appropriate permission and acknowledgement.

4.3 Relevant previous work and publications, both by other researchers and the authors' own, should be properly acknowledged and referenced.

4.4 Data, text, figures or ideas originated by other researchers should be properly acknowledged and should not be presented as if they were the authors' own.

4.5 Authors should inform editors if findings have been published previously or if multiple reports or multiple analyses of a single data set are under consideration for publication elsewhere.

4.6 Multiple publications arising from a single research project should be clearly identified as such and the primary publication should be referenced. Translations and adaptations for different audiences should be clearly identified as such, should acknowledge the original source, and should respect relevant copyright conventions and permission requirements.

5. Transparency

5.1 All sources of research funding, including direct and indirect financial support, supply of equipment or materials, and other support (such as specialist statistical or writing assistance) should be disclosed.

5.2 Authors should disclose the role of the research funder(s) or sponsor (if any) in the research design, execution, analysis, interpretation and reporting.

5.3 Authors should disclose relevant financial and non-financial interests and relationships that might be considered likely to affect the interpretation of their findings or which editors, reviewers or readers might reasonably wish to know.

6. Appropriate authorship and acknowledgement

6.1 The research literature serves as a record not only of what has been discovered but also of who made the discovery. The authorship of research publications should therefore accurately reflect individuals' contributions to the work and its reporting.

6.2 In cases where major contributors are listed as authors while those who made less substantial, or purely technical, contributions to the research or to the publication are listed in an acknowledgement section, the criteria for authorship and acknowledgement should be agreed at the start of the project. Ideally, authorship criteria within a particular field should be agreed, published and consistently applied by research institutions, professional and academic societies, and funders.

6.3 Researchers should ensure that only those individuals who meet authorship criteria (i.e. made a substantial contribution to the work) are rewarded with authorship and that deserving authors are not omitted.

6.4 All authors should agree to be listed and should approve the submitted and accepted versions of the publication. Any change to the author list should be approved by all authors including any who have been removed from the list. The corresponding author should act as a point of contact between the editor and the other authors and should keep co-authors informed and involve them in major decisions about the publication (e.g. responding to reviewers' comments).

6.5 Authors should not use acknowledgements misleadingly to imply a contribution or endorsement by individuals who have not, in fact, been involved with the work or given an endorsement.

7. Accountability and responsibility

7.1 All authors should have read and be familiar with the reported work and should ensure that publications follow the principles set out in these guidelines. In most cases, authors will be expected to take joint responsibility for the integrity of the research and its reporting. However, if authors take responsibility only for certain aspects of the research and its reporting, this should be specified in the publication.

7.2 Authors should work with the editor or publisher to correct their work promptly if errors or omissions are discovered after publication.

7.3 Authors should abide by relevant conventions, requirements, and regulations to make materials, reagents, software or datasets available to other researchers who request them. Researchers, institutions, and funders should have clear policies for handling such requests. Authors must also follow relevant journal standards. While proper acknowledgement is expected, researchers should not demand authorship as a condition for sharing materials.

7.4 Authors should respond appropriately to post-publication comments and published correspondence. They should attempt to answer correspondents' questions and supply clarification or additional details where needed.

8. Adherence to peer review and publication conventions

8.1 Authors should follow publishers' requirements that work is not submitted to more than one publication for consideration at the same time.

8.2 Authors should inform the editor if they withdraw their work from review, or choose not to respond to reviewer comments after receiving a conditional acceptance.

8.3 Authors should respond to reviewers' comments in a professional and timely manner.

8.4 Authors should respect publishers' requests for press embargos and should not generally allow their findings to be reported in the press if they have been accepted for publication (but not yet published) in a scholarly publication. Authors and their institutions should liaise and cooperate with publishers to coordinate media activity (e.g. press releases and press conferences) around publication. Press releases should accurately reflect the work and should not include statements that go further than the research findings.

9. Responsible reporting of research involving humans or animals

9.1 Appropriate approval, licensing or registration should be obtained before the research begins and details should be provided in the report (e.g. Institutional Review Board, Research Ethics Committee approval, national licensing authorities for the use of animals).

9.2 If requested by editors, authors should supply evidence that reported research received the appropriate approval and was carried out ethically (e.g. copies of approvals, licences, participant consent forms).

9.3 Researchers should not generally publish or share identifiable individual data collected in the course of research without specific consent from the individual (or their representative). Researchers should remember that many scholarly journals are now freely available on the internet, and should therefore be mindful of the risk of causing danger or upset to unintended readers (e.g. research participants or their families who recognise themselves from case studies, descriptions, images or pedigrees).

9.4 The appropriate statistical analyses should be determined at the start of the study and a data analysis plan for the prespecified outcomes should be prepared and followed. Secondary or post hoc analyses should be distinguished from primary analyses and those set out in the data analysis plan.

9.5 Researchers should publish all meaningful research results that might contribute to understanding. In particular, there is an ethical responsibility to publish the findings of all clinical trials. The publication of unsuccessful studies or experiments that reject a hypothesis may help prevent others from wasting time and resources on similar projects. If findings from small studies and those that fail to reach statistically significant results can be combined to produce more useful information (e.g. by meta-analysis) then such findings should be published.

9.6 Authors should supply research protocols to journal editors if requested (e.g. for clinical trials) so that reviewers and editors can compare the research report to the protocol to check that it was carried out as planned and that no relevant details have been omitted. Researchers should follow relevant requirements for clinical trial registration and should include the trial registration number in all publications arising from the trial.

Bagian Kedua

Membangun Metodologi
Research Methodology

Pada saat membahas terkait metodologi, ada hal-hal yang perlu diperhatikan. Biasanya bisa kita mulai dengan membahas terkait Philosophical…..
Hal tersebut bisa kita tulis seperti dibawah ini:

2. Research Methodology

The discussion begins with a broad philosophical discussion of the epistemological orientation of the study. Issues addressed are the alternative methods available, the rationale for choosing one, the paradigmatic stance that has been adopted, and the data analysis strategy that has been used. Subsequent sections of this chapter deal with practical issues relating to the design of the research study method. A staged method for developing the measurement instrument that responds to these issues is described. In terms of the domain, the respondents that were to be subjects of the research are described. Finally, specific details of the structural equation modelling data analysis that has been applied to test the theoretical models are described.

2.1 Epistemological orientation

It is necessary to describe the epistemological orientation of this study at the outset because several substantial alternatives exist that could have been adopted when researching the method design. Depending on the research method design that had been chosen, there would be a cascading effect on the practical nature of the study and how the relevant issues would be conducted (Singh, 2002).

2.1.1 Methodological alternatives

At the broadest level, research methods might be classed as either analytical (where formal, deductive methods are used) or empirical (where inductive methods are used) (Sax in Wacker 1998). Wacker (1998) divided each of these two traditional classifications into three further sub-categories. For the analytical research method, the sub-categories were analytical conceptual research, analytical mathematical research and analytical statistical research. Similarly, the sub-categories of the empirical research method were empirical experimental research, empirical statistical research and empirical case studies. Each of these six sub-categories represented a fundamentally different type of research methodology. In terms of a theory-building exercise, if a several different methods affirmed a theory (a procedure called triangulation (Meredith et al, 1998; Gable 1994; Denzin, 1978)) there would be greater confidence in the results. Although not usually practical, if all six research methods were applied and produced the same positive results there would be compelling evidence in support of the theory.

In practice, no single study is usually able to employ all six research methodologies to support a theory. Due to resource constraints and time lags involved in the conceptual development of theories, individual researchers have to pragmatically choose a limited number of methods to study a particular theory (Singh, 2002). This has been the case for the current study as well. The analytical conceptual research method and findings of preliminary fieldwork have been used to develop the underlying theoretical models of sustainable technology transfer. These models have been designed to be tested using the empirical statistical research method.

There are two main reasons why the empirical statistical research method has been chosen. Firstly, this method is able to empirically verify theoretical relationships using larger sample from organisations than the other available methods (Meredith et al, 1998). Secondly, the empirical statistical research method can handle rather complex issues (Wacker, 1990). Thus, it is suitable for addressing the compound relationships that have arisen from the theoretical models upon which the hypotheses are based.

There were many specific types of research that fall under the empirical statistical research sub-category. These included structured and unstructured interviews, surveys, historical/archival research, expert panels and Delphi techniques (Wacker, 1998; Flynn et al, 1990; Singh, 2002). Each of these methods is intended for the statistical analysis of data from relatively large samples.

In this research study, the survey research method was selected. This method was developed to deal with a fraction of the total population. The most common form of surveys is the self-administered mail questionnaire, although other methods such as telephone surveys and personal interviews also have been used (Miller, 1991).

For this research the personal interview survey method was applied. The advantages of this method are that it has the highest percentage of returns, high accuracy of information, large sample coverage, overall good reliability and validity, and most completeness of the returned questionnaires (Miller, 1991). However, this method also has disadvantages. The interview method is relatively expensive in money terms compared with mail surveys. The interview method is also significantly time-consuming. Because the advantages were substantial, the chosen method was appropriate to the requirements of this study. The author decided that the limitations could be managed through careful design and time management.

Bagian Ketiga

Paradigmatic Stance

3. Paradigmatic stance

Besides the need to select an appropriate research method design, it was required to clearly specify the paradigmatic stance adopted for the research. This would resolve some fundamental questions about the nature of the research in the field (Singh, 2002), e.g. what constituted relevant research questions, foundational assumptions, viable methodologies, compelling evidence, and the larger objectives for inquiry (Zald, 1993).

Positivism has been the dominant paradigm in organisational studies research for quite some time (Wicks and Freeman, 1998; Goles and Hirscheim, 2000). The underlying premise of positivism is that the task of researchers is to find 'reality' rather than create it. It assumes that there is an underlying objective reality that can be discovered. Positivism also involves descriptive instead of prescriptive work (Flew, 1979; Donaldson, 1992).

> Researchers stand as neutral observers, using scientific techniques that allow them to get beyond human biases so that they can make contact with reality and document facts. Another key distinguishing characteristic of positivism is its claim that scientifically grounded study is the only way to gain genuine knowledge. The scientific method allows researchers to test their hypothesis and rely on objective data to support their findings. Positivists regard concepts and terms as being value-neutral (i.e. stripped of moral content). Finally, under positivism, reality is construed as being unequivocal (Singh, 2002, p.128).

There is also an 'anti-positivist' school of thought (Astley, 1985; Martin, 1990; Morgan, 1983). Anti-positivists challenge the alleged objectivity of science and demonstrate instead the ultimate subjectivity of all forms of research, including the physical sciences. According to anti-positivism, the scientist is not a neutral observer but an active participant and creator in collecting data. By rejecting the epistemologically privileged position of science, the anti-positivist position has been claimed to hold great promise for introducing creativity and legitimising a broad array of approaches within organizational studies (Wicks and Freeman, 1998; Goles and Hirschheim, 2000).

Singh argues that the assumptions behind the positivist position -- which anti-positivists so strongly attack -- are unwittingly retained by them (Singh, 2002). Rather than moving beyond the basic distinctions outlined above on positivism, anti-positivists simply invert them. In other words, while positivists try to be ’finders’, ‘descriptive’ and ’scientific’, anti-positivists represent ’makers’, ‘prescriptive' and ’non-scientific’ (Wicks and Freeman, 1998; Goles and Hirschheim, 2000).

This suggests that while there are some arguments to indicate that positivism is not without its problems, the limitations of positivism are not completely overcome by the approach of its purported antagonists (anti-positivism) (Sing, 2002). On balance, it has been decided that positivism offers the strongest and best understood approach to be adopted for the research in this thesis.

Bagian Keempat

Teknik Analisa Data

4. Data Analysis Technique

The fieldwork research used surveys in Java, Indonesia. Survey research was applied because the survey method can deal with a proportion of the total population. Given the nature of the research problems and hypotheses identified for this study, the confirmatory approach was implemented. The confirmatory approach requires testing pre-specified relationships between variables (Gozaly, 2005; Hair et al, 1998; Singh, 2002) developed from theory-based expectations on how and why variables are related.

The hypotheses identified in chapter 3 are basic (i.e. they state that 'X' has a direct impact on 'Y'), but the result could be a positive or negative relationship. Outputs from the confirmatory tests needed to be interpreted in the light of the direction of the relationships, thus giving a contribution to the body of knowledge in this research area. For the purpose of this research, the multivariate data analysis technique called 'Structural Equation Modelling' (SEM) was applied. The form in which the hypotheses involving the underlying theoretical model of knowledge and technology transfer approach have been presented is ideally suited to be analysed using this technique (Singh, 2002).

SEM is a statistical methodology used for applying the hypothesis-testing approach through testing relations among variables (Hoile, R, 1995, Singh, 2002) by using t-test. This technique is capable of accommodating latent (unobservable) variables. A latent variable is a construct or abstract concept that can only be measured indirectly, through the effect of observed variables, which are termed indicators. For example, illness is a construct (latent variable) and indicators (observable variables) of illness are for example, the body temperature and reduce of appetite. Indicator and then represented by measurement item or also can be broken down into several measurement items (Sitinjak and Sugiarto, 2006).

In this thesis, latent variables or unobserved variables (constructs) are measured through indicators. When applied in practice, the indicators can be treated as measurement items or measurement instrument (Singh, 2002); this means that the indicators for one construct can be directly represented by measurement items. These measurement items are then modified to be user friendly and applied as survey instrument in questionnaires.

However, despite an indicator being identified as a measurement item to measure a construct, sometimes this one measurement item is not sufficient to measure the construct. Therefore to increase the reliability, sometimes there needs to be more than one measurement for representing one indicator. For example, if it is desired to know whether a person has a 'happy life' (construct/unobserved variable) or not, several indicators such as wealth, employment, health, family connections may be measured.

Sometimes it is not enough to just ask one question about 'wealth' (indicator/observe variable) for example "Are you wealthy?" to measure whether a people is rich or not. To improve the validity and reliability of the measurement, the interviewer might need to ask about his/her salary, "Do you earn money more than $5000 a month?", and "Do you have money to buy more than one property?", "Do you have more than one property in elite real estate?" etcetera. These questions that each represent the one indicator (wealth) to measure the construct 'happy life', are called measurement items or measurement instruments (Sitinjak and Sugiarto, 2006) .

SEM can be used in a confirmatory manner or an exploratory one. In particular, SEM can be applied to test a substantive theory (hypothesis testing) or to determine direct or indirect relations (mediation) of one variable to another or to compare group differences. The causal processes under study are represented by a series of structural (i.e. regression) equations. Due to the complexity of the interrelationships, these structural relations are often modelled pictorially for a clearer conceptualisation of the proposed model (Singh, 2002).

SEM has been claimed to be a comprehensive statistical method for testing hypotheses about relations among variables (Hoyle, 1995). It is also known as covariance structure analysis, latent variable analysis, confirmatory factor analysis, and LISREL® (name of the pioneering SEM software package). SEM is claimed to improve upon and supersede other tools such as factor analysis, multiple and multivariate regression, recursive path analysis, non-recursive economic modelling, ANOVA, analysis of covariance, principal component analysis, and classical test theory (Holmes-Smith, 2000). Technically, SEM estimates the unknown coefficients in a set of linear structural equations (MacLean and Gray, 1998; Singh 2002).

There are some characteristics of SEM that distinguish it from other univariate and multivariate techniques. First, SEM is *a priori* and requires researchers to think in terms of models that require confirmation; but, a priori does not mean exclusively confirmatory. Many applications in SEM are a blend of exploratory and confirmatory analysis (Kline, 1998). Second, SEM allows the explicit representation of a distinction between observed and latent variables, which makes it possible for researchers to test a wide variety of hypotheses (Holmes-Smith, 2000). Third, the basic statistic in SEM is the covariance between variables. The covariance matrix allows for the assessment of the degree of fit of the observed model (Hair et al, 2010). Covariance also helps to show linear correlations between independent and dependent variables. (It is possible, however, to analyse other types of data with SEM such as means (Kline, 1998)).

The next characteristic is that SEM is a large sample technique (Kline, 1998). Fifth, SEM provides a comprehensive mechanism to deal with measurement error terms. It provides the ability to incorporate measurement error in the estimation process

(Holmes-Smith, 2000); allows correlations among the measurement errors; and allows for the estimation of the reliability and construct validity of measures. Sixth, SEM provides a test of fits for systems of equations by simultaneously estimating several interrelated dependence relationships; this is particularly useful in testing theories that contain multiple equations involving dependent relationships (Hair et al., 2010; Gozali, 2005). SEM also permits relationships between dependent outcome variables. Finally, SEM allows for the estimation of higher-order factor analysis where no observed indicators of the higher-order factors are available (Holmes-Smith, 2000). Collectively, these features make SEM a very powerful tool (Singh, 2002).

Most authors describe a five- or six-step SEM application process (Kline, 1998). For example, the five-step process of Bollen and Long (1993) is

Step 1. Review the relevant research literature to specify a model;
Step 2. Identify a model and indicating measurement method;
Step 3. Estimate parameters in measurement and/or structural models;
Step 4. Assess model fit, parsimony or comparison of models; and
Step 5. Re-specify the model if meaningful.

The first step, model specification, refers to the initial model that a researcher formulates prior to estimation. The model may be formulated based on theory or on one's past research in the area. Identification determines whether it is possible to find unique values for the parameters of the specified model.

Once the model is identified, there are several estimation methods available. Selection of estimation techniques is often determined by the distributional properties of the variables being analysed. After the estimates are obtained, the researcher can test whether the model is consistent with the data. If it is, the process proceeds to the fourth step. The process may stop after the fourth step. More typically, the fit of the model can be improved through re-specification. Once re-specified, steps 2 through 5 might be repeated, often multiple times (Bollen and Long 1993). For this study, the SEM software package used is LISREL 8.3 (Joreskorg and Sorbom, 1999). Some pre-processing of data was done using PRELIS (which is part of LISREL). LISREL was the first general program for estimating structural equation models (Hayduk, 1996). Even though currently LISREL is not the only SEM program - some competitors are AMOS (Arbuckle, 1988) and EQS (Bentler, 1985) - LISREL is still the most widely used structural equation program (Hair, 2010). Another program, the well-known SPSS (Statistical Program for Social Science), is also used for preliminary processing and post-processing of data generated in this research.

Bagian Kelima

Evaluasi *Data Quality*

5. Evaluating Data Quality

The literature concerning research methods routinely points to two fundamental aspects of the quality of survey research instruments: reliability and validity (Hair et al. 2010). Since testing for reliability and validity is a significant part of the SEM process to be employed in this research, a brief review of the relevant literature is provided in the following section.

Reliability

Reliability refers to the ability of an instrument to produce consistent results (Sarantakos, 1998), and is sometimes simply referred to as consistency (Hair et al., 1998). This consistency can be assessed in two principle ways: when the same respondent is asked the same question on multiple occasions (called longitudinal reliability) (Krosnick et al., 1997), or, when the same respondent is asked a series of different questions intended to tap the same attitude on one occasion (called cross sectional reliability) (Krosnick et al, 1997).

A lack of correspondence in answers to an item over time can be observed for either of two reasons: the measure might be unreliable, or the attitude itself might have changed during the intervening time interval. The shorter the interval in time, the less likely that attitude change has occurred; on the other hand, the more likely it is that the respondent remembers their answer to the question during the first survey and simply repeats it, thus artificially inflating apparent reliability (Krosnick and Fabrigar 1997).

A series of questions aimed to assess the same attitude to a single event might be perceived by a respondent as just that, and respondents might attempt to provide responses that appear to be consistent with one another across the items. Alternatively, respondents might doubt that the researcher would intentionally ask a series of questions about exactly the same issue, so the respondents might attempt to infer fine distinctions between the questions and thus exaggerate differences between them (Krosnick and Fabrigar 1997).

For this study, assessment of longitudinal reliability was not possible, due to time limitations restricting the survey to only one cycle. Only cross-sectional reliability, assessed using internal consistency measures, was possible.

Examining internal consistency requires comparing results across and among items within a single instrument. The most common technique for determining the internal consistency of survey measurements is through Cronbach's coefficient alpha (Hair et al, 1998). The assumption behind internal consistency is that items assigned to constructs are all different measures of the same concept Hair, et al., 2006); therefore, the correlation between items should be high when they are measuring different aspects of the same notion. The values of Cronbach's coefficient alpha must be greater than the acceptable value of 0.6 for internal consistency to be established (Hair et al., 2006).

Validity

Validity is generally defined in terms of the type of evidence used to determine that a measuring instrument is indeed measuring what it purports to measure (Heath and Martin, 1997; Hair 2010; Singh 2002). It refers to the accuracy of a measure (Krosnick and Fabrigar, 1997) and involves demonstrating that the questions truly measure what they are supposed to measure, and does not measure anything else (Flynn et al, 1990).

The literature on research methods normally distinguishes several different forms of validity. The common forms of validity are 'content', and 'construct' validity (Flynn et al., 1990).

Content Validity

A measure is said to have content validity if it covers all possible aspects of the research topic (Sarantakos, 1998). Content validity is a judgment of the degree to which instruments truly measure the concept that they are intentioned to measure. It can only to be determined by experts and reference to the literature and cannot to be determined statistically (Flynn et al., 1990; Singh, 2002).

Construct Validity

A measure can claim construct validity if its theoretical construct is valid. For this reason, validation concentrates on the validity of the theoretical construct (Sarantakos, 1998). Construct validity measures whether a set of items is a suitable operational definition of a construct. Establishing construct validity is a difficult process. This is because the construct cannot be directly measured empirically and compared with the set of items being tested for. If it could be directly measured then there would not be the need for the observed variable(s) to describe it. Investigation into construct validity is only through indirect inference, which can be made by empirical investigations, such as by measuring the observed variable rather than the construct itself (Flynn et al 1990; Singh 2002).

Reliability and Validity Inter-Relationship

An instrument that is reliable is not necessarily valid, and vice versa. An analogous example may make the distinction clearer. This concept perhaps can be explained with the oft quoted example from Flynn et al (Singh, 2002). If length is measured with an elastic tape measure, the measurements will all be different. One of these may be the correct length, but it is impossible to determine which. Inconsistent measures lead to poor reliability. In the same vein, using an invalid scale is like trying to measure inches with a metric tape measure; precise quantitative data can be collected to establishing validity. If a measure yields inconsistent results, even very highly valid results are meaningless (Flynn et al, 2001). Given the different but complementary nature of the two measures, it is necessary to test for both reliability and validity when assessing the value of results from survey instruments. In this context, a rigorous method for conducting empirical statistical research work and validating a measurement instrument is described in section 4.5.

Bagian Keenam

Mengurangi Peluang Kesalahan Riset Survey

6. Reducing Errors In Survey Research

The previous section has shown the necessity of demonstrating the reliability and validity of measuring instruments to ensure high quality survey research. Malhotra and Grover (1998) have extended the scope of testing of the reasonableness of a survey. They produced a list of 16 questions that need to be sufficiently addressed in order to confirm that errors were minimised. These are summarised in Table 6.1 along with a brief discussion of what is required in order to achieve a positive response.

Table 6.1 List of Questions to Minimise Errors (after Malhotra and Grover, 1998)

Questions	What to look for
1. Is the unit of analysis clearly defined for the study?	A formal statement defining the unit of analysis is needed for a positive assessment of this attribute. Justification of why the unit of analysis has been selected is desirable, though not considered critical
2. Does the instrumentation consistently reflect the unit of analysis?	The items in the questionnaire need to be at the same level of aggregation as the unit of analysis. For example, to ensure consistency, a question pertaining to overall business strategy must have a strategic business unit as the unit of analysis. In contrast, a manufacturing strategy related study could have plant as the unit of analysis
3. Is the respondent(s) chosen appropriate for the research question?	The person who is most knowledgeable in the selected unit must be the preferred respondent. It would be inappropriate, for instance, to survey plant employees on an organisational construct within a multi-plant organisation
4. Are multi-item variables used?	Multiple items or questions have to be used as opposed to a single item/question to define a construct of interest.

5. Is content validity assessed?	Content validity would need to be assessed through prior literature, or opinion of experts who are familiar with the given construct.
6. Is field-based pre-testing of measures performed?	A positive assessment will be made only if the study formally states the inclusion of field-based pre-testing in refining the survey instrument and establishing its relevance.
7. Is reliability assessed?	Cronbach's Alpha analysis or test-retest analysis would be needed for positive assessment.
8. Is construct validity assessed?	Construct validity (discriminant/convergent) analysis, items construct correlation would be needed for positive assessment.
9. Is pilot data used for clarifying measures or are existing measures adopted?	A positive assessment is made if constructs and their associated items are to be evaluated on the basis of pre-testing before the collection of actual data. Alternatively, a construct which has been defined and tested in a prior study could be used.
10. Are confirmatory methods used?	Confirmatory factor analysis results would need to be reported to establish construct validity.
11. Is the sample frame defined and justified?	A sound discussion of the sample frame is needed for a positive assessment.
12. Is sampling random from the sample frame?	Sampling procedures (random or stratified random) need to be used for a positive assessment unless there are particular justifiable reasons for using some other sampling method.
13. Is the response rate over 20%?	A formal reporting or response rate over 20% is needed for a positive assessment.

14. Is no-response bias estimated?	A formal reporting of non-response bias testing is needed for a positive assessment.
15. Are attempts made to establish internal validity of the findings?	At the very minimum, a discussion of results with the objective of establishing cause and effect in relationships, elimination of alternatives explanations, etc., is needed for a positive assessment. Statistical analysis for establishing internal validity (like Structural Equation Modelling) is considered desirable, but not critical.
16. Is there sufficient statistical power to reduce statistical conclusion error?	At least a sample size of 100 and an item to sample size ratio of more than 5 is needed for a positive assessment.

Bagian Ketujuh

Mekanisme Membangun dan Memvalidasi *Measurement Instrument*

7. Mechanics of Developing and Validating a Measurement Instrument

The development and validation process of the measurement instrument used in this thesis that systematically addresses each of the 16 questions recommended by Malhotra and Grover is described in this section. The instrument was derived from available underlying theories in knowledge and technology transfer areas.

7.1 Develop Items For Each Construct (Step I)

The primary assignment was reviewing the available literature to develop measurement items for each construct. The literature review has concentrated on areas which associate with sustainable technology transfer. This approach followed the primary 'rule' in establishing the instruments for confirmatory analysis; it was essential for the instrument to get strong theoretical support (Singh, 2002).

Transferors

The construct, indicators and measurement items to measure the transferor dimension (latent variable) were adopted and modified from previous studies of Kremic (2003) and Bozeman and Lee (1997). These items reflect the motive and method of the transferor in transferring technology. Five indicators were identified and broken down into eight measurement items as shown in Table 7.1. The measurement items are grouped based on their matching indicator.

Table 7.1 List of Items to Measure the Transferor Construct

Constructs	Indicators	Measurement Items	Sources
Transferor (motives and methods)	1. Responsibility/ control	1. Responsibility/ control of the transferors	Kremic, 2003; Bozeman, 1997; and Lee, 1997.
	2. Project terms	2. Project terms of technology transfer programs	

	3.Communication	3. Communication built by transferor 4. Conference, meeting 5. Technology transfer through industry visit	
	4. Program	6. Workshop program 7. Personnel exchange	
	5. Feedback process	8. Sufficient feedback process	

Knowledge

As discussed in chapter 2, knowledge may be classified as tacit or explicit. Construct, indicators and measurement items of this dimension were adapted and modified from the studies of Takeuchi (1995), Gorman (2002), Fernandez et al (2004) and Marcote and Niosi (2000). Three indicators of tacit knowledge are broken down into six measurement items and three indicators of explicit knowledge are broken down into five measurement items to measure the knowledge construct as shown in Table 7.2.

Table 7.2 List of Items to Measure the Knowledge Construct

Constructs	Indicators	Measurement Items	Sources
Tacit	1. Technical aspect	1. The expertise is provided 2. The technical exchange 3. Transferring expertise's skill transfer	Takeuchi, 1995; Gorman, 2002; Marcotte and Niosi, 2000.
	2. Cognitive aspect	4. Stimulating transferor skill on new technology 5. Transferring expertise' experience	
	3. Communication	6. Communication between transferee and transferor	
Explicit	1. Manuals	1. Introduction on technology/ product specification	Takeuchi, 1995;

		2. Blueprint of the new technology	Gorman, 2002; Marcotte and Niosi, 2000.
	2. Product specification	3. Managing product standardisation	
	3. Form of data	4. Statistical data 5. Words and numbers in scientific formulas	

7.2 Content Validity of the Constructs (Step II)

Having constructed lists of items, it was then required to review these to ensure that they were comprehensive and reflected the area of sustainable technology transfer. This process, forming part of the content validity analysis, was largely achieved by reviewing the available literature (as summarised in chapter two), and comparing the items/constructs to the contents of the existing instruments developed by others such as Koufteros et al (2002), Schlie (1995), Porter (2000), Kremic (2003), Bozeman (1997), Lee, (1997) and Davenport, (1993). This review process provided evidence to conclude that the constructs and their associated items had sufficient basis in literature and therefore had content validity.

7.3 Assembly of The Draft Instrument (Step III)

Resolving some logical issues was necessary in assembling the draft instrument. In order to reduce complexity, items needed to be organised in generic categories. Fuller descriptions of the constructs and measurement items are shown in Table 7.4. As can be seen, the original measurement items shown in Tables 7.1 to 7.3 have been expanded from simple phrases to full statements which assist in understanding the meaning of the items. Also codes were assigned to each item to facilitate and simplify statistical analysis of the responses.

Table 7.3 Expanded Construct and Measurement Items

The Role of Government in Technology Transfer	x1
1. Responsibilities and controls of government agency for technology transfer (TT) were appropriate for company's need.	x1.1
2. Sufficient workshop programs were provided by government agency.	x1.2
3. Project terms of the technology transfer programs were suitable for company.	x1.3

4. There has been effective communication built by government agency associated with the technology transfer program.	x1.4
5. Sufficient personnel exchange programs have been provided by government associated with technology transfer program.	x1.5
6. Conferences or meeting programs by government agency were suitable for company's need.	x1.6
7. There have been sufficient industry visits associated with the technology transfer program provided by government.	x1.7
8. The government agency encouraged sufficient feedback .	x1.8
Tacit Knowledge in Technology Transfer	x5
1. Sufficient expertise was provided in technology transfer program.	x5.1
2. Appropriate technical exchange was included in technology transfer program.	x5.2
3. Communication between transferee and transferor have been built in technology transfer programs.	x5.3
4. Transferring expertise's skills transfer was part of technology transfer programs.	x5.4
5. Transferring expertise' experiences on the new knowledge/technology was part of technology transfer program.	x5.5
6. Stimulating transferor skills on new technology was part of technology transfer programs.	x5.6
Explicit/Codified Knowledge in Technology Transfer	x6
1. There were sufficient statistical data in technology transfer programs .	x6.1
2. Codified knowledge such as "Drawing" CAD model of the new technology was part of technology transfer programs.	x6.2
3. There were sufficient introductions on technology/ product specification .	x6.3
4. Managing product standardisation was an important component of technology transfer programs .	x6.4
5. Programs through words and numbers in scientific formulas were provided in technology transfer programs.	x6.5
6. Understanding codification interpretation between transferors and transferees was included in technology transfer programs.	x6.6

Selection of Measuring Scale

Sarantakos (1998) described scales as techniques that are employed by social scientists in the area of attitude measurement (The term ‘attitude’ is used widely when discussing survey instruments even though psychologists and others would use the word ‘opinion’. Attitude has a particular and different meaning in psychology. The term attitude is used in this thesis consistent with Sarantakos’ usage.) . Scales place responses on a continuum between a very low (or negative), through a neutral, to a very high (or positive) position.

The most popular scales applied by researchers are the Likert, Guttman and Thurstone scales (Sarantakos 1998). In this research, the Likert scale was chosen to measure all items, ahead of other alternative scale measurement techniques such as the Thurstone scale or the Guttman scale. The reason for preferring the Likert scale in this research is that (1) the Likert scale has the capability of dealing with the highly complex, abstract and conceptual nature of the subject in related management and organisational studies areas; and (2) the Likert scale is capable of dealing with measuring direction of attitude (e.g. ‘agree/disagree’), intensity of attitude (e.g.’ strongly’ or not). Other reasons were: (3) large numbers of items were involved, and the simplicity of the Likert scale may overcome the potential problem of respondent fatigue (Albaum, 1997, Singh, 2002); (4) the Likert scale has a high degree of validity, even if the scale contains only a few items; (5) the Likert scale has a very high reliability and (6) the Likert scale is relatively easy to assemble (Sarantakos, 1998).

Whilst overall the research method literature is insistent that the Likert scale involves ordinal data (Krosnick and Fabrigar, 1997), some applied researchers (e.g. Flynn et al, 1990) have argued that the Likert scale produces metric interval type data. Ordinal type means that the objects of a set are rank ordered on an operationally defined attribute. There is no fixed, measurable interval between one number and another number on the scale (e.g. 1 = Strongly disagree; 2 = Disagree; 3 = Neutral; 4 = Agree; 5 = Strongly agree), whereas, interval type have numerically equal distances, or interval scales representing equal distances among attributes (e.g. height in feet and inches) (Colton and Covert, 2007).

Careful past assessments of the Likert scale recommend there is significant support for the resulting data being considered of the ordinal type (Singh, 2002). “This is because the distance between intervals is not likely to be equal (e.g. [strongly agree-agree] ≠ [agree-neutral]), therefore violating a key property of interval data type” (Singh, 2002 p.153). In this thesis, data obtained using Likert scales were treated as being of the ordinal type.

Labelling of Scale Points

When making an instrument, an important decision in the construction of scales is whether to label all or some scale points with words, or to label all or some points with numbers, or a combination of both words and numbers. Obviously, in order for any rating scale to have a meaning, it is necessary to at least label the endpoints of the scale. Studies had shown that fully labelled scales were more reliable and valid than partially labelled scales (Krosnick and Fabrigar 1997; Singh, 2002).

For verbal labels to be most useful, they need to have reasonably precise meanings for respondents (Singh, 2002). For the purposes of the measurement instrument of this research, both verbal and numerical labels were assigned to all the items. As an example, the scale offered to the respondents might have the points strongly disagree (1), disagree (2), neutral (3), agree (4), and strongly agree (5).

Scale Properties

There was also an issue relating to whether to choose a bipolar or unipolar scale. It is important to distinguish between bipolar scales (i.e. scales reflecting two opposing alternatives with a clear conceptual midpoint) and unipolar scales (i.e. reflecting varying levels of items with no conceptual midpoint and with a zero point at one end) (Krosnick and Fabrigar 1997).

Attitudes can be thought of as bipolar, because they range from extremely positive to extremely negative, with neutral as a specific midpoint, representing neither positive nor negative (Krosnick and Fabrigar 1997, Singh 2002). The amount of importance a person attaches to a particular attitude he or she holds is an example of a unipolar response. It ranges from a minimum to some maximum level, and there is no precise midpoint (Krosnick and Fabrigar 1997, Singh 2002). Because attitudes were to be measured, bipolar agreement scales were used in this research.

Scale's Reliability and Validity

Much of the empirical research exploring the effect of the scale point number on measurement quality investigates its influence on reliability. Investigations of cross-sectional reliability with unipolar scales suggest that the optimum number of scale points is between 5 and 7 points (Krosnick and Fabrigar, 1997). Other studies found that cross sectional reliability is greater for 5-point than for 7- point scales (Mckelvie1978).

A substantial amount of research has also examined the effect of the scale point number on the validity measurement. Much of this research used computer simulations to examine how transforming data from continuous representations of relations to representations with discrete scale points distorts known patterns of data. With a few exceptions (Martin 1973), it has been suggested that distortion in data decreases as the number of scale points increases, but that this improvement is relatively modest beyond 5 to 7 points (Green and Rao, 1970; Lehman and Hulbert, 1972; Ramsay, 1973). Rosenstones et al (1986) found that 5-point predicted conceptually related variables better than 3-point bipolar scales.

Assessing 'No-Opinion' Responses

Sing (2002) mentions that from a statistical analysis viewpoint, the presence of no opinion data in the form of 'not sure', 'not applicable' or similar, is irksome because these cases have to be eliminated, hence reducing the effective sample size. This can be substantial in some cases. To overcome this problem, researchers have developed no-response filters that force respondents to evaluate the extent to which they have considered the topic previously and how genuine the respondent's no opinion is (Krosnick and Fabrigar 1997; Singh, 2002). This is premised on the notion that respondents choose the 'not applicable' response category because they want to minimize the cognitive effort involved expressing an opinion on issues (Krosnick and Fabrigar 1997; Singh, 2002). This assumption is not reasonable for situations in which a respondent must hold "no opinion" due to the statement/question not being applicable to the company's circumstances (Singh, 2002). Forcing respondents to express an opinion in this case risks increasing measurement error. Based on this latter point, a 'not applicable' response option was included in the survey instrument for this thesis.

Taken as a whole it was decided that a five point scale will be used in this measurement instrument. Verbal and numeric labels will be assigned to and explained for all the items; and a not applicable no-opinion response option was included. Having decided on the technical contents and the suitable scale, the questionnaires were assembled.

Write Stems Unidimensionally

Colton and Covert (2007) state that for clarity and reliability, only one attribute should be described in the stem of each question. That is, the stems are said to be unidimensional. Consider the following example of a double-barrelled item, which is unlikely to be correctly answered as a respondent's answer to the two-part stem might not match any of the paired alternatives shown in the response set.

Original: Identify your position and salary:

a. Administrator ($23,000-$35,000 annually)
b. Teacher ($30,000-$60,000 annually)
c. Teacher's aide ($20,000-$25,000 annually)

The way to create the correct this is by rewriting the question as separate items as below:

1. Indicate your current position with this school system:
    a. School administrator
    b. Classroom teacher
    c. Teaching assistant
    d. Other
2. Indicate your current annual salary from employment with this school system:
    a. Less than $20,000
    b. $20,001-$30,000
    c. $30,001-$40,001
    d. $40,001 or more

In writing of the individual instruments care was taken to ensure unidimensionality.

7.4 Pretest of the Draft Instrument (Step IV)

A panel of experts that consisted of the research supervisors and the research committee were asked to assist in the task of pre-testing the survey instrument. Advice was received concerning logical and grammatical problems, which were then addressed. The processes involving expertise took more than two months in time. The panels supervised and assessed the draft instrument. And the layout of the questionnaire was assessed so as to make it easily readable.

7.5 Translation of the Draft Instrument (Step V)

As the fieldwork research was to be held in Java in Indonesia, the draft instrument was translated into the Indonesian language (*Bahasa Indonesia*) by the author. In order to obtain the best translation of the survey instrument, the *Bahasa Indonesia* version of the draft instrument was sent to a professional translation service (the Indonesia Australia Language Foundation) in Bali, Indonesia to be translated back into English. The resulting translation was compared to the original English version of the draft instrument and both were assessed with regards to differences. This approach was applied to ensure that the *Bahasa Indonesia* version of the draft instrument matched with the original English version without any missing ideas and messages, and so it should avoid bias (Appendix B).

7.6 Pilot Testing the Draft Instrument (Step VI)

The pilot project was conducted on SMEs with a sample size of about 30 in Java. The purpose of this pilot project was to provide feedback about how easy the questionnaire was to complete and whether the questionnaire contained any unclear concepts or questions outside the respondent's knowledge and responsibility. Then the result was tested statistically to ensure that the items were correctly assigned to constructs and reliable and valid as measures of those constructs.

7.7 Assessment of the Reliability and Validity of the Draft Instrument (Step VII)

Statistical measurement was conducted to test the reliability and validity of the measurement instrument. Pearson correlation and Cronbach's alpha coefficient were used to measure the validity and reliability of the instrument (Appendix C). This approach was taken to ensure that the measurement instrument was capable of measuring what was intended to be measured. For all items, Cronbach's alpha coefficient values were greater than the acceptable value of 0.6 (Hair, 2006), indicating that the items assigned to the constructs were reliable.

7.8 Compilation the Final Instrument (Step VIII)

The tests on item performance of the constructs found that the instrument of sustainable technology transfer was reliable. The final set of survey instruments is shown in Table 7.4. A set of codes was attached to the items to enable statistical analysis. The full version of the survey instrument was written in *Bahasa Indonesia* (Appendix D).

Table 7.4 Final Survey Instrument

Individual Instruments	**Code**
The Role of Government in Technology Transfer	x1
1. Responsibilities and controls of government agency for technology transfer (TT) were appropriate for company's need	x1.1
2. Sufficient workshop programs were provided by government agency	x1.2
3. Project terms of the technology transfer programs were suitable for company's need	x1.3
4. There has been effective communication built by government agency associated with the technology transfer program	x1.4
5. Sufficient personnel exchange programs have been provided by government associated with technology transfer program	x1.5
6. Conferences or meeting programs by government agency were suitable for company's need	x1.6
7. There have been sufficient industry visits associated with the technology transfer program provided by government	x1.7
8. The government agency encouraged sufficient feedback	x1.8
Scale: 1 = Strongly disagree; 2 = Disagree; 3 = Neutral; 4 = Agree; 5 = Strongly agree	

Table 7.4 Final Survey Instrument (Continued)

Tacit Knowledge in Technology Transfer	x5
1. Sufficient expertise was provided in technology transfer program	x5.1
2. Appropriate technical exchange was included in technology transfer program	x5.2
3. Communication between transferee and transferor have been built in technology transfer programs	x5.3
4. Transferring expertise's skills transfer was part of technology transfer programs	x5.4
5. Transferring expertise' experiences on the new knowledge/technology was part of technology transfer program	x5.5
6. Stimulating transferor skills on new technology was part of technology transfer programs	x5.6
Scale: 1 = Strongly disagree; 2 = Disagree; 3 = Neutral; 4 = Agree; 5 = Strongly agree	

Table 7.4 Final Survey Instrument (Continued)

Explicit/Codified Knowledge in Technology Transfer	x6
1. There were sufficient statistical data in technology transfer programs	x6.1
2. Codified knowledge such as "Drawing" CAD model of the new technology was part of technology transfer programs	x6.2
3. There were sufficient introductions on technology/ product specification	x6.3
4. Managing product standardisation was an important component of technology transfer programs	x6.4
5. Programs through words and numbers in scientific formulas were provided in technology transfer programs	x6.5
6. Understanding codification interpretation between transferors and transferees was included in technology transfer programs	x6.6
Scale: 1 = Strongly disagree; 2 = Disagree; 3 = Neutral; 4 = Agree; 5 = Strongly agree	

7.9 Conduct of the Full-Scale Survey (Step IX)

In conducting the full-scale survey, it was necessary to resolve several issues that had the potential to affect the result of the research. These included: deciding on the research domain and level of analysis, selecting a suitable sample, maximising the response rate and minimising the non-response bias.

Research Domain

The subjects of the research were SMEs involved in metal-based manufacturing in Java, Indonesia. This domain was chosen because of its pioneering role in knowledge and technology transfer (KTT) practices. This industry was significant in terms of knowledge and technology transfer (see section 3.1). As part of the long history of experiences in knowledge and technology transfer, and consequently, accumulated knowledge, the metal-based manufacturing industry was deemed appropriate as the subject of the survey of this research.

Level of Analysis

Although this research was applied to SMEs, the structure of the sector in Java meant that it was possible that one person (or closely related persons) could answer for more than one company. (For example, one family had five different SMEs, each managed by a different son). To avoid there being the same respondent in two SMEs, the samples were revised to ensure that only one site per respondent was chosen as a sample.

Besides choosing the level of the organisation, another issue related to the level of analysis was the person in the organisation who was directly selected to complete the questionnaires. Ideally, the questionnaires should be completed by a number of people in each part of an organisation. This is so that an aggregate measure for the organisations could be obtained, and individual response bias could be minimized (Flynn et all., 1994; Singh, 2002). However, this research was conducted in SMEs which were simple in nature due to the plain structure of organisation hierarchy, the alternatives were whether to select the top manager or the owner or the person who had responsibility for KTT programs. In this survey, the person who was preferred to be chosen to answer the questionnaires was the person responsible for the KTT program of the organisation.

Sample Selection

The reason for drawing most of the respondents from the Central Java and East Java areas is provided in section 3.1 of this thesis. the database developed from the preliminary fieldwork research was utilised to determine the potential respondents. From those about 800 prospective respondents' areas, 300 were randomly selected. The respondents were checked to ensure that respondents only belonged to one SME included in the sample.

Response Rate

The survey was conducted between May and September 2008. The questionnaires were delivered to the potential respondents in person. An intensive explanation was provided before the respondents gave their responses. Follow up by telephone communication was conducted for respondents who did not give their feedback on site and those who did not answer by the due date. Several local strategies were applied to encourage the participation of organisations in order to boost the response rate; for example, personal approaches and maintaining communication, support letters from local universities, local government and in addition, information from the central Department of Technology, and also support from a senior person in the community.

The final response rate was 88.3% and the total number of cases responding was 250. Literature suggested that a minimum acceptable response rate was 20% (Malhotra, Grover 1998), and the preferred response rate was above 50% (Flynn et al., 1990; Singh, 2002). It was deemed that 88.3% response rate was an excellent achievement, for the seven-page survey instrument used.

The number of respondents also met the needs of the structural equation modelling technique adopted: for the computer data processing using LISREL sofware, the minimum requirement for data processing was at least 200 cases (Hair, Anderson 1998; Sing 2002). Other sources (Slovin in Umar, 1999) said there was a need for at least 100 cases required in SEM.

Non-Response Bias

In practice, non-response means a loss of a valuable source of information and affects the degree of representativeness of the research (Sarantakos, 1998). The response rate of 88.3% for this research means that there is a smaller affect of non-responses than for some other surveys. However, to increase the certainty of representativeness of the research, in dealing with non-response bias, the particular approach that was used to assess the potential level of non-response bias was by making telephone calls to the non-responding organisations and finding out their reasons for not responding to the survey. The major reasons for the non-response respondents were ‘having no time’ and ‘too late to give the feedback’. These answers do not indicate that the non-respondents would have answered the survey any differently from those who did, and so the level of non-response bias appeared to be low (Singh, 2002).

Missing Data Analysis

In terms of missing data analysis, 95% of the respondents to the questionnaires had a maximum of 5% missing data. In assessing missing data, there was no specific guideline about how many missing data was too many. 5% or even 10% missing data on particular variables may be considered as not large (Cohen, 2007). As such the level of missing data in this research was considered acceptable.

Examination of the complete data set showed that the missing data was about 5%. There are numerous ways for taking care of missing data. According to Hair and Anderson (1998), these are based on either elimination or substitution techniques. Elimination can be either list-wise, where all cases that have missing data are dropped, or pair-wise, where only cases with a missing data for variables that have been analysed were dropped.

For this research, the elimination techniques would have been inefficient or caused other difficulties. For instance, if list-wise elimination were applied, only about 60% of the data would have remained to be processed. Also, pair-wise elimination would have resulted in different numbers of cases per variable available for analysis, and this is problematic for structural equation modelling analysis.

The more efficient strategy to be applied for handling missing data in this case was substitution (Singh, 2002). The most well-known technique involves substitution with either the mean or the median in place of the missing data. In this research the substitution applied the mean to replace missing data. Simulation studies have shown that replacing missing data using this method produced good representations of the original data when both the number of respondents with missing data and the number of items missing were 20% or less (Downey and King, 1998). This technique, incorporated in statistical packages such as SPSS, was used in this study.

'No Opinion' Response Analysis

'No Opinion' data analysis determined the amount of no opinion (expressed as "not applicable") data. Examination of the data showed that less than 5% of responses as 'not applicable'. This shows that no opinion data was small relative to valid responses. However, the SEM technique, does not handle no opinion data very well. Therefore, these responses needed to be treated, and not simply ignored. In many research cases, a simple solution would be to eliminate cases that had such responses (Singh, 2002). But, as mentioned previously, the elimination-based techniques are inefficient. It was decided that the same substitution technique as used for handling missing data would also be applied for treating no opinion data. Since the total number of no opinion cases was small, it is expected that the potential bias would be limited.

7.10 Is the Final Instrument Acceptable? (Step X)

Having treated the raw data to reduce problems for the SEM technique, statistical tests could be conducted to determine the quality of the data. This requires several different tests to assess different aspects of the data.

Test for Multicollinearity

Multicollinearity occurs when the correlation between items measuring the same construct is very high (i.e. greater than 0.9) leading to linear dependencies between items (Wothke 1993); essentially this means that they are practically identical (Ahire, 1996). When multicollinearity occurs, one of the items measured should be eliminated to reduce weighting bias. There are several types of correlation coefficients that could be calculated to assess the extent of multicollinearity between items for each construct. The most recognised one is Pearson's correlation (Hair, 2010).

In this case several items measuring the same construct have correlation coefficients higher than 0.9 (items in constructs x1, x2, x3, x4, x7, x8, x9, x10). It shows that those items were identical; therefore, a modification is carried out. The items which have a correlation coefficient greater than 0.9 are deleted leaving only one item to measure the construct. In deleting the items which had multicollinearity, besides considering the logical and conceptual approach, the statistical reason should also be considered, regarding the reliability of the measurement. For example in construct x1, there were identical items (x1.3 and x1.4) which have correlation coefficients higher than 0.9. In this case after testing to determine which item would yield the greater reliability, it was found that both have a similar reliability coefficient value. The second approach was to take a logical and conceptual approach. It was decided to eliminate x1.4 and leave x1.3, because items x1.3 (communication between transferor and transferee) represents a critical aspect of the model and could not be excluded without seriously impairing the theoretical basis of the model, and was capable of covering instrument x1.4. After eliminating any identical items (correlation higher than 0.9), leaving one for each construct, multicollinearity was no longer a significant issue (Appendix E1 and E2).

Test for Unidimensionality

Unidimensional items collectively estimate one single construct (Ahire et al 1996, Hair 1998, Singh 2002). To check for unidimensionality of the pre-specified items, a confirmatory method that involves the specification of one-factor cogeneric measurement models has been developed for all the constructs. A one-factor confirmatory measurement model is the most general form of the confirmatory factor analysis model (Jorenkog, 1971), and the generalized form of this model is shown in Figure 7.1 where four items are being used to measure a construct.

Figure 7.1 Generalised One-Factor Measurement Model

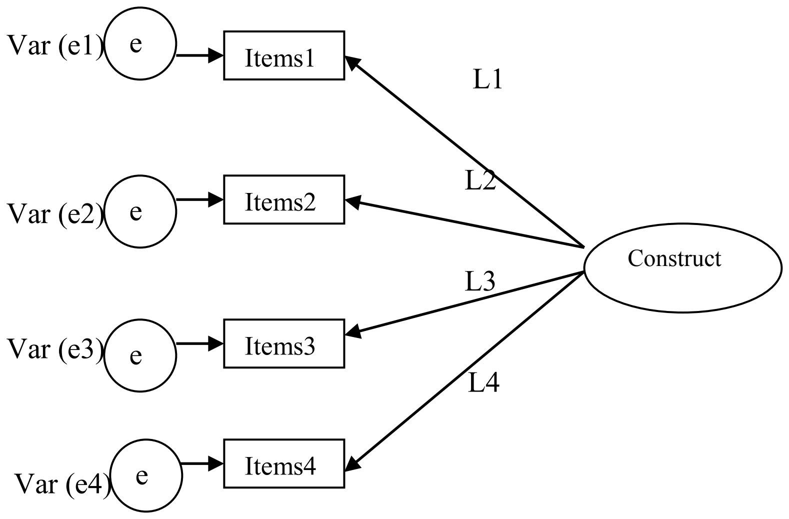

Figure 7.1 shows a one-factor measurement model consisting of a 'construct' that is an abstract concept that was not directly measurable (Jorekog, 1971) and is also known as a latent variable (Jorekog, 1971). It is estimated by a number of measurable variables called 'items' (Jorekog, 1971; Singh 2002) or observed variables (Ghozaly, 2005). Each of the items has an associated error labelled 'e'. The factor loadings (Li) bind the construct to the items, and the quantitative variable linked with the error terms is the variance, labelled 'var (ei)'. The directions of the arrows show that the variances of the individual items are explained by the construct. The balance of the variance of the items is attributable to their associated error terms (Singh, 2002).

In congeneric models, both factor loadings and error variances are unconstrained and are expected to be estimated by the structural equation modelling technique (i.e.$L1 \neq L2 \neq L3 \neq L4$, in figure 7.1) (Jorenkog, 1971; Singh 2002). SEM analysis of one-factor congeneric measurement models is only possible for models that have three or more items (Hair et al, 1998).

Models that have one or two items are unidentified (i.e. there is an insufficient number of equations to 'solve for' (Hair et al, 1998) each of the unknown coefficients to be estimated). In this research, because none of the items of the constructs had less than three items, all constructs could be analysed using the confirmatory factor analysis method. Numerous measures of goodness of fit (GoF) will be analysed. When the GoF indices suggest a good fit, for the form in which the initial models were presented, it is implied that the items were unidimensional.

Development of the Composite Reliability

As indicated earlier, Cronbach's coefficient alpha (α) is a widely used measure of construct cross-sectional reliability. However, this measure of reliability can be biased under particular conditions (Singh, 2002). The magnitude of Cronbach's coefficient alpha increases as the number of indicators belonging to the construct increases (Ahire et al, 1996). In order to overcome these difficulties with Cronbach's coefficient alpha, the composite reliability was calculated for all the constructs. The composite measure is believed to be superior when compared to Cronbach's coefficient alpha (α), since it utilises the item loadings obtained within the causal model, and it is not influenced by the number of indicators within the construct (Barclay et al, 1995; Hulland, 1999). The formula for calculating composite reliability is as follows (Hair 2010):

$$\rho_c = \frac{(\sum \lambda)^2}{|(\sum \lambda)^2 + (\sum \theta)|} \qquad (1)$$

where:

ρc = composite reliability
λ = standardised loading factor
θ = error variance

According to Igbaria et al (1997) the composite reliability should be accepted if ≥ 0.50.

Variance Extracted Estimates

Another measure of construct reliability is the variance extracted estimate. This reflects the overall amount of variance in the indicators accounted for by the latent construct. The standardised factor loadings and errors variance as a result of the SEM analysis outputs were used to calculate the maximal reliabilities. The scores for the composite measures were calculated from the value of standardised factor loadings from observed variables to latent variables. Fornell and Larcker (1981) developed the formula for assessing this estimate as follows:

$$\rho_{vc\eta} = \frac{(\sum \lambda)^2}{|(\sum \lambda^2)+(\sum \theta)|} \qquad (2)$$

where:

$\rho_{vc\eta}$ = variance extracted estimate
λ = standardised loading factor
θ = error variance

Higher variance extracted values occur when the indicators are truly representative of the latent construct. The variance extracted measure is a complementary measure to the construct reliability. Guidelines suggest that the variance extracted value should exceed 0.50 for a construct (Hair et al. 2006; Holmes-Smith 2001).

Test for Construct Validity

Construct validity is the degree to which variance in a measure is attributed to variations in the variable and not some other factor (e.g., method variance) (Kelly and Vokurka, 1998). Establishing construct validity involves convergent validity (Campbell and Fiske, 1959).

Convergent Validity Test

Convergent validity relates to the degree to which varying approaches of measuring a variable provide the same result. For example, if we measure manufacturing flexibility using different methods, to what degree does the data from the two methods converge? The assumption is that if a measure is valid, it should yield the same result when utilized across different methods (Kelly and Vokurka, 1998). On one level, completely different methods of administering the instrument (e.g. mail surveys and interviews) can be used to demonstrate convergent validity (Ahire, 1996). On another level, individual items assigned to constructs are treated as different approaches to measuring the common constructs (Singh, 2002). This is the level of analysis that is used to assess the level convergent validity of all the constructs of the technology transfer model presented in this thesis.

The result of the SEM analysis of one-factor congeneric measurement models was used to examine the convergent validity of all the constructs. As suggested by Ahire et al. (1996), a SEM analysis test output was used; namely, the Normed Fit Index (NFI). The value of NFI indicates the proportion in improvement of the overall fit of the researcher's model relative to a null model (Singh, 2002). NFI should be greater than 0.95 for a good fit, although values between 0.9 and 0.95 indicate reasonable fits according to Ahire et al. (2006), while other researchers have claimed that values as low as 0.7 demonstrate an acceptable fit (Tamini, 1998).The results of these analyses will be reported in Chapter Six.

7.11 Analysis of Relationships Between Constructs (Step XI)

The results of the series of tests described above confirm that the constructs of the sustainability technology transfer model have been well measured. These show that the instrument had collected good quality data, and the level of reliability and validity was higher than conventionally acceptable in most cases satisfactory to assess the proposed sustainable technology transfer model..

Bagian Kedelapan

Structural Equation Modelling Analysis Process

The structural equation modelling analysis that was applied for the purpose of testing the hypotheses was synthesised from procedures presented by several authors including Hair et al. (2010), Holmes-Smith (2000), Singh, (2002). Important aspects of this process include: (1) a review of theoretical models that were to be tested; (2) details of the two-step analysis procedure where the structural and measurement models were analysed separately; (3) the method that was applied to assess the identification status of the model; (4) the parameter estimation technique that was used; (5) a description of the goodness-of-fit and of how well the model fits the data; (6) modifications to the models; and, (7) interpretation of the final models. These aspects are described in the following section.

8.1 Description of Theoretical Models

The model representing sustainable knowledge and technology transfer is to be tested. It was considered that the model's contents reflected the current state of ideas. Therefore, it was felt that the model could be justified as representing a good theoretical model of sustainable knowledge and technology transfer. The theoretical model, consisting of constructs and interrelationships between these constructs, was described verbally as well as diagrammatically. The diagrammatic form of the model will be used to develop path diagrams in the form needed for the purpose of SEM analysis.

8.2 The Two-Step SEM Analysis Procedure

Conventional SEM analysis involves a single-step procedure where there is simultaneous estimation of both structural and measurement models. This is the best approach when the model possesses strong theoretical rationale and highly reliable measures, resulting in more accurate relationships and decreasing the possibility of interactions between structural and measurement models (Hair, 2010;

Singh, 2002). However, some researchers have proposed a two-stage procedure to maximize the interpretability of both measurement and structural models (Schumacher, et al, 1996; Hair, 1996; Singh, 2002).

The two-stage procedure has been proposed to avoid the condition where the researcher estimates both structural and measurement models simultaneously, but the result of the overall fit is not acceptable. In such circumstances, the one step approach has difficulties in determining the sources which have caused unacceptable overall fit measurements (Kline, 1998). Anderson and Gerbing (1988) suggested a two-step approach that analyses the measurement model and structural model separately. In order to maximize the interpretability of both measurement and structural models, in this research a two-step procedure was applied.

8.3 Assessing the Identification Status of Structural Equation Models

It is possible for simple confirmatory factor analysis to analytically determine the identification status (i.e. whether it is theoretically possible to calculate a unique estimate of all the parameters). However, for more complex models that contain many latent variables, two methods are suggested to assess identification. These are the calculation of the degrees of freedom of the model, and an empirical identification assessment provided as part of the SEM analysis output (Singh, 2002). For the purpose of determining identification, the number of degrees of freedom for any given structural equation model can be calculated using the formula:

$$df = \frac{1}{2}[(p+q)(p+r+1)] - t \qquad (3)$$

where:

df = the degrees of freedom of the model
p = the number of endogenous indicators
q = the number of exogenous indicators
t = the number of estimated coefficients in the proposed model

A just-identified model has exactly zero degrees of freedom. Although this provides a perfect fit of the model, this solution is “uninteresting” because it has no generalisability (Singh, 2002). In this research, achieving over-identification in a structural equation model was the goal since it has more information in the data matrix than the number of parameters to be estimated, meaning that there were positive degrees of freedom. The rationale was to achieve acceptable fit with the largest number of degrees of freedom possible. This ensures that the model was generalisable (Singh, 2002). However, under particular circumstances, the just-identified model in some cases is inevitable (for example, when some items must be dropped because of a multicollinearity problem, the number of the information is the same as the number of a parameters to be estimated that cause the just identified model).

The degrees of freedom were calculated for each model. Once the degrees of freedom of the model are shown to be positive, the model should be run in a suitable SEM software package to obtain the empirical identification assessment matrix. Most SEM software packages assess the identification status of models using a combination of the tests developed by Wiley (1973), and Joreskog (1988).

8.4 Estimation Technique

For models that are over-identified, parameters of the structural model need to be estimated. Since an over-identified model has more information available than required for parameter estimation, several probabilistic techniques for estimation of parameters are available. The commonly used estimation techniques include the Maximum Likelihood (ML), the Generalized Least Square (GLS), and the Weighted Least Squares (WLS) and Asymptotically Distribution Free (ADF) procedures (Hair et al., 2010).

All these techniques involve complex probability-based heuristics to estimate parameters by minimizing discrepancy between the empirical variance-covariance matrix and the variance-covariance matrix implied by the model (Singh, 2002). A review of the estimation methods suggested that the ML procedure is the most popular. It is efficient and unbiased when the assumption of normality is met. Also, ML has been found to be sensitive to the sample size (when the sample size exceeds 400 goodness-of-fit measures indicate poor fit), however ML is most suitable for sample sizes around 200 (Hair et al., 2010). As the sample size in this research was about 250, the Maximum Likelihood method is considered a suitable choice for estimation.

8.5 Evaluating the Level of Fit Between Model and Data

Once a model has been specified, the following phase is to ensure whether or not the model 'fits' the data. This begins with an examination for offending estimates (Hair et al., 2010). After the model is confirmed as providing acceptable estimates of parameters, the goodness-of-fit of the model with the data is then assessed for the overall and structural models.

Offending Estimates

The model first has to be examined for offending estimates (Hair et al, 1996). These are estimated parameters that exceed acceptable limits. The most common offending estimates are negative error variances or non-significant error variances for any construct. A specific approach can be applied to deal with these offending estimate problems. In the case of negatives error variances, also referred to as Heywood cases, the error variances can be fixed to a very small positive value, usually 0.005 (Bentler et al 1987; Dillon et al., 1987).

Overall Model Fit

The overall fit of the model with the data is usually assessed with one or more goodness-of-fit measures. These measures assess the correspondence of the actual or input covariance/correlation matrix with that predicted by the proposed model. Goodness-of-fit measures are of three types: (1) absolute fit measure; (2)

incremental fit measure: and (3) parsimonious fit measure (Hair, 2010; Singh 2002).

Absolute Fit Measure

This measure assesses only the overall model fit (both structural and measurement model collectively) with no adjustment for the degree of over-fitting that might occur. The measures applied in this study are discussed as follows.

Chi-square (χ^2) statistic provides a statistical test of the resulting difference with its associated degrees of freedom (*df*) and probability of significant difference (p). The chi-square is a measure of the absolute discrepancy between the implied variance/covariance matrices obtained from the empirical data.

The difference in the covariance matrices (S – Σλ) is the key value in assessing the goodness-of-fit of any SEM model. SEM estimation procedures such as maximum likelihood produce parameter estimates that mathematically minimize this difference for a specified model. It is represented mathematically by the following equation:

$$\chi^2 = (N - 1)(S - \Sigma\lambda) \quad (4)$$

N is the overall sample size. It should be noted that even if the differences in covariance matrices remained constant, the value increases as sample size increases. Likewise, the SEM estimated covariance matrix is influenced by how many parameters are free to be estimated (the λ in Σλ), so the model's degrees of freedom also influence χ^2 (Hair et.al 2006). The acceptable level for this test is when the p-value is greater than 0.05 (i.e. at the α=0.05 level of significance) (Hair et al., 2006).

Goodness of Fit Index (GFI), is the most widely used goodness-of-fit measure in many studies of SEM (Hair, 2010), ranging in value from 0 (poor fit) to 1.0 (perfect fit). It represents the overall degree of fit (the squared residuals from prediction compared with the actual data).

If F_k is the minimum fit function after an SEM model has been estimated using k degrees of freedom (S - Σλ), and F_0 is the fit function that would result if all parameters were zero (everything is unrelated to each other; no theoretical relationship), then GFI is simply defined as:

$$GFI = 1 - \frac{F_k}{F_0} \qquad (5)$$

A model that fits well produces a ratio of F_k / F_0 that is quite small. Conversely, a model that does not fit well produces F_k / F_0 that is relatively large because F_k would not differ much from F_0. In the extreme, if a model failed to explain any true covariance between measured variables, F_k / F_0 would be 1, meaning the GFI would be 0 (Hair et.al 2006). GFI should be greater than 0.90 for the model to be considered a good fit (Holmes-Smith 2001; Hair et al., 2006), although values between 0.8 and 0.90 indicate a reasonable fit (Yamin and Kurniawan, 2009).

Root Mean Square Error of Approximation (RMSEA) is a measure that attempts to correct for the tendency of the chi-square statistic to reject any specified model with a sufficiently large sample size. Computation of RMSEA is rather straightforward and provided here to demonstrate how statistics try to correct for the problems of using the statistic alone.

$$RMSEA = \sqrt{\left(\frac{\chi^2 - df_k}{N-1}\right)} \qquad (6)$$

The *df* are subtracted from the numerator in an effort to capture model complexity. The sample size is used in the denominator to take it into account. To avoid negative RMSEA values, the numerator is set to 0 if *dfk* exceeds χ^2 (Hair et al., 2006). RMSEA values between 0.0 and 0.05 indicate good fit, while values ranging from 0.05 to 0.08 indicate acceptable fit (Ahire et al., 1998).

Incremental Fit Measures

These measures compare the proposed model to some baseline model, often a null model in which no causal relationships between the variables are proposed. The incremental fit measures calculated for the research were:

Normed Fit Index (NFI)

This is a relative comparison between the proposed model and the null model. It is calculated as:

$$NFI = \frac{\chi^2 null - \chi^2 proposed}{\chi^2 null} \qquad (7)$$

The recommended value of NFI for a good fit is 0.90 or greater (Hair et al., 2006), and values between 0.80 and 0.90 are marginal fit (Yamin and Kurniawan, 2009).

The Comparative Fit Index (CFI).

This is suggested by Bentler (1990) with the purpose of overcoming the deficiencies in the normed fit index (NFI) for a nested model. The NFI has the tendency to underestimate fit in small sized samples (Byrne 2006). Here, the comparative fit index compares whether the model under consideration is better than some baseline model, which in most cases is the null or independence model. The general computational form of the CFI is:

$$\text{CFI} = 1 - \frac{(\chi^2 - dfk)}{(\chi^2 - dfN)} \qquad (8)$$

Here, the represents values associated with the researcher's specified model of theory k, that is, the resulting fit with k degrees of freedom. *N* denotes values associated with the statistical null model. The CFI value should fall between 0 and 1, with values exceeding .90 indicating a good fit to the data (Kelloway 1998). In cases where the value of CFI is above 1, there is an indication that the model is an 'overfit' as too many parameters have been freed to be estimated (Holmes-Smith 2001).

Tucker Lewis Index (TLI), is also known as the non-normed fit index (NNFI), it combines a measure of parsimony into a comparative index between the proposed and null models, resulting in values ranging from 0 to 1.0 (although, sometimes values could exceed 1.0).

$$TLI = \frac{\left(\frac{\chi^2 null}{df null}\right) - \left(\frac{\chi^2 proposed}{df proposed}\right)}{\left(\frac{\chi^2 null}{df null}\right) - 1} \quad (9)$$

The recommended acceptable values of TLI are 0.90 or greater (Hair et al., 2006).

Parsimonious Fit Measures

This final type of measure provides a basis for comparison between models of differing complexity and objectives. In this research, the parsimonious fit measures calculated were:

Normed chi-square, which is obtained by dividing the chi-square (χ^2) value by the degrees of freedom (*df*) of the model. Because the normed chi-square statistic takes the model complexity into account, it is referred to as an index of model parsimony. In this sense, values of the normed chi-square that are very small suggest that the model probably contained too many parameters. Generally, χ^2: *df* ratios on order of 3:1 or less are associated with better-fitting models (Hair et al, 2010)

The Akaike Information Criterion (AIC),

AIC is a comparative measure between models with differing numbers of constructs. The model that fits with the smallest value of AIC is the most parsimonious model (Ahire et al., 2006).

Table 8.1 Goodness of Fit Indices

Goodness-of –Fit Index	Good Fit	Marginal Fit
Absolute Fit Indices		
Chi-square (χ^2, df, p-value)	p-value>0.05	-
Goodness-of –Fit Index (GFI)	0.90<GFI<1.00	0.80<GFI<0.90
Root Mean Square Error of Approximation (RMSEA)	RMSEA<0.05	0.05<RMSEA<0.08
Incremental Fit Indices		
Comparative Fit Index (CFI)	0.90<CFI<1.00	0.80<CFI<0.90
Tucker-Lewis Index (TLI)	TLI>0.95	0.90<TLI<0.95
Normed Fit Index (NFI)	0.95<NFI<1.00	0.90<NFI<0.95
Model Parsimony Indices		
Normal Chi-square (χ^2, df)	1.0<(χ^2/df)<2.0	2.0<(χ^2/df)<3.0
Akaike Information Criteria (AIC)	Model with smallest AIC is most parsimonious	

A summary of the goodness of fit indices is provided in Table 8.1 Currently there is no clear consensus as to which measure is the best (Hair et al, 2006). In most sighted studies that have used SEM analysis, multiple goodness of fit measures were reported. In the absence of clear consensus on the most suitable goodness of fit measure, this study applied the measures discussed.

8.6 Model Modification and Re-Specification

If the level of goodness of fit is poor, models can be improved by adding or deleting estimated parameters to/from the original model (Jorekog, 1993). In this research, modification indices between the constructs were applied for making modifications to the model.

Hipothesis Tests

For the hypothesis tests, the level of statistical support for the principal relationships in the theory and the directions of these relationships were examined. All relationships between variables involved a single dependent variable. Therefore, the relationships are tested using t-tests (Hair et al., 2010; Sarantakos, 1998). SEM methods provide standard errors and t-values for each coefficient that is estimated (Singh, 2002). At the conventionally accepted significance level of 0.05, the critical value for the t-test is 1.96 (Wijanto, 2008; Gozali, 2011). If the t-value obtained for a parameter is larger than this threshold value, the hypothesis is accepted.

Modification Indices

Modification indices (MI) were calculated for each non-estimated relationship as part of the SEM analysis output (Singh, 2002). The MI value corresponds to reduction in the chi-square estimate of the model that occurs if the suggested coefficient(s) are estimated. Conventionally, an MI value of 4 or greater suggests that a statistically significant reduction in the chi-square statistic would be obtained when the coefficient is estimated (Schumacker and Lomax, 1996; Hair et al, 1998; Holmes-Smith, 2000; Kline, 1998).

Concluding Remarks

This chapter has described in detail the design and conduct of an empirical study that obtained data in order to test the positions and hypotheses presented in the previous chapter. In essence, a survey research technique was used in the data collection process. At the outset, it was decided that wherever possible, the confirmatory approach to data analysis would be used. The development process of the measurement instrument started with derivation of the constructs of technology transfer. The areas relevant to support the key factor of technology transfer program were also included. Using the psychometric approach, measurement items that encapsulated the core ideas of the constructs were developed. All constructs had multiple items, usually about three or four.

The draft instruments were pretested with experts and then subjected to pilot testing with a sample of metal-based SMEs organisations. Since the pilot study involved a rather small sample size (n=30), tests such as those for reliability and validity were conducted. Eventually, the final measurement instrument was developed.

In sum, the rigorous scientific process that was used to collect data provides sufficient confidence that the quality of the data is high and has been measured well (e.g. reliability and validity). This therefore provides confidence that the propositions and hypotheses of this thesis can be tested thoroughly and with accuracy.

Bagian Kesembilan

Penutup

Buku ini pada bagian-bagian yang telah dibahas diatas memberikan panduan kepada penulis yang ingin melakukan publikasi internasional terkait bahasan Manajemen Teknologi dan Teknologi Transfer dengan pendekatan Structural Equation Modeling……..

Daftar Pustaka

Ahire, S. L. (1996), TQM Age Versus Quality: Empirical investigation, Production and Inventory Management Journal.

Anderson, James, C. & Gerbing, David, W.(1998), Structural Equation Modeling in Practice: A Review and Recommended Two-Step Approach, Psychological Bulletin 1998, Vol 103, No.3 411-423.

Amirth, Pal Singh.(2002), A Trestie on Phytochemistry, Emedia Sience Ltd.

Arbuckle, J.L., (1997), AMOS Version 3.6, Chicago, Illinois: Small Water Corporation.

Arbuckle, J. L., and Wothke, W., (1999), Amos 4.0 User's Guide: SPSS, Smallwaters Corporation.

Astley, W. Graham and Andrew H. Van de Ven.(1983), "Central Perspectives and Debates in Organization Theory", Administrative Science Quarterly 28, no. 2:245-273.

Atherton J.C, Green R., and Thomas S., (1970), Effects of 0,9% Saline Infusion on Urinary and Renal Tissue Composition in The Hydropaenic , Normal and Hydrated Conscious Rat, J. Physiol, 210, pp.45-71.

Barclay, Michael J., Smith, Clifford W., & Watts, Ross L. (1995), The Determinant of Corporate Leverage and Dividend Policies, Journal of Applied Corporate Finance, Vol. 7 (4), 4-19

Bentler & Chou, (1987), Pratical Issue in Structural Modeling, Sociological Methods and research, pp. 78-117

Bentler, Peter.M.,and Douglas G. Bonnet (1980),―Significant Test and Goodness of Fit in the Analysis of Covariance Structures‖, Psychological Bulletin, 88, 588-606.

Bentler PM, (1995), EQS Structural Equations Program Manual, Encino, Multivariate Software, CA.

Bobbi de Porter (2000), Quantum Teaching/Learning, Kaifa, Bandung.

Bollen, K.A. & Long, J. Scott (1993), Testing Structural Equation Models. Sage, Thousand Oaks : CA.

Bozeman, Dennis P., & Pamela L Perrewe, (2001), "The Effect of Item Content Overlap on Organizational Commitment Questionnaire-Turnover Cognitions Relationships", Journal of Applied Psychology. 86(1) : 161-173

Campbell D. T., & Fiske, D. W. (1959), Convergent and discriminant validation by the multitrait-multimethod matrix, Psychological Bulletin, 56, 81-105.

Cohen, L., Manion, L., & Morrison, K. (2007), Research Methods in Education (6th ed.), London, New York: Routllege Falmer.

Colton, David dan Robert W. Covert, (2007), Designing and Constructing Instruments for Social Research and Evaluation. San Francisco: Jossey-Basse.

Davenport, T. H. (1993), Process Innovation: Reengineering work through information technology, Boston: Harvard Business School Press.

Denzin, NK. (1978), The Research Act: A Theoritical Introduction in Sociological Methods, New York: McGraw-Hills.

Dillon, William R and Matthew Goldstein,(1984), "Multivariate Analysis Method and Application", John Willey & Sons, Inc.
Donaldson, L dan J.H. Davis. (1994), Boards and Company Performance: Research Challenges the Conventional Wisdom, Washington DC.
Fabrigar LR, Smith SM, Petty RE, Crites Jr. SL. (2006), Understanding knowledge effects on attitude-behavior consistency: the role of relevance, complexity, and amount of knowledge, Journal of Personality and Social Psychology, 90(4):556-577.doi: 10.1037/0022- 3514.90.4.556.
Fernandez, C dan Yoshida, M. (2004), Lesson Study: A Japanese Approach to Improving Mathematics Teaching and Learning, New Jersey: Lawrence Erlbaum Assiciate, Inc.
Flew, Antony, (1979), A Dictionary of Philosophy, Cos and Wyman Ltd., Reading Great Britain.
Flynn N, (1990), Public Sector Management, Brighton, Wheatsheaf.
Fornell, C and Larcker, D. F. (1981), Evaluating Structural Equatuion Models with Unobservable Variables and Measurement Error, Journal Of Marketing Research, 18 (1): 39-50.
Freeman, R. E., J. S. Harrison, dan A. C. Wicks. (2007), Managing for Stakeholders: Survival, Reputation, and Success, New Haven, CT: Yale Univ Press.
Freeman, R., Harrison, J., Wicks, A., Parmar, B., & De Colle, S. (2010), Stakeholder Theory: The State of Art, Cambridge: Cambridge University Press.
Gable, M., and F. Dangello. (1994), "Locus of Control, Machiavellianism, and Managerial Job Performance." Journal of Psychology 128.
Goles, T. and R. Hirschheim. (2000), The paradigm is dead, the paradigm is dead…long live the paradigm: the legacy of Burrell and Morgan, Omega 28: 249-68.
Ghozali, Imam. (2005), Aplikasi Analisis Multivariate dengan SPSS, Semarang: Badan Penerbit UNDIP.
Ghozali, Imam. 2011. "Aplikasi Analisis Multivariate Dengan Program SPSS". Semarang: Badan Penerbit Universitas Diponegoro.
Gorman , S L et al., (2014), Realibility of the Function In Sitting Test (FIST), Journal of Rehabilitation and Practice, Vol: 2014.
Hair et al., (1998), Multivariate Data Analysis, Fifth Edition, Prentice Hall, Upper Saddle River : New Jersey.
Hair, Jr et.al. (2010), Multivariate Data Analysis (7th ed), United States : Pearson.
Hayduk, L. A. (1987), Structural Equation Modeling with LISREL, Baltimor and London, John Hopkins University Press.
Husein, Umar, (1999), Riset Sumber Daya Manusia Dalam Organisasi, Jakarta: PT Gramedia Pustaka Utama.
Hulland, J. (1999), Use of partial least squares (PLS) in strategic management research: A review of four recent, Strategic Management Journal, 20(2): 195.

Holmes-Smith, P. (2001), Introduction to Structural Equation Modeling Using LISREL, Perth: ACSPRI-Winter Training Program.
Hoyle, R.H. (1995), Structuring Equation Modeling: Concepts, Issues and Applications, Sage Publications, London.
Igbaria, M., Zinatelli, N., Cragg, P. & Cavaye, L.M. (1997), "Personal Computing Acceptance Factors in Small Firms: A Structural Equation Model", MIS Quarterly 21(3): 279-302.
J.A, Krosnick, A.L, Holbrook, and P.S, Visser.(2000), 'The impact of the fall 1997 debate about global warming on American public opinion", Public Understanding of Science, Vol.9, No.3.
Joreskog, K.G. 1971. Statistical Analysis of Sets of Congeneric Tests. Prentice Hall. New Jersey.
Joreskog, K.G. & Sorbom, D. (1989), LISREL 7: A guide to the program an SPSS, Inc.
Joreskog, Karl G. dan Sorborn, Dag. (1993), LISREL 8 : A Guide To The Program And Applications, Chicago.
Joreskog, K.G. and Sorbom, D., (1996), "Recent Developments in Structural EquationModeling," Journal of Marketing Research, 19.
Kelloway, E.K., (1998), Using LISREL for Structural Equation Modeling, London, Sage.
Kline, R. B. (1998), Principles and Practice of Structural Equation Modeling, The Guilford Press, New York, NY.
Koufteros, X. A. (1995), Time-Based Manufacturing: Developing a Nomological Network of Constructs and Instrument Development, Doctoral Dissertation, University of Toledo, Toledo, OH.
Lehmann, D. R., and J. Hulbert (1972), Are Three-point Scales Always Good Enough? Journal of Marketing Research, 9(4), 44-46.
MacLean, S. dan Gray, K. (1998), "Sructural Equation Modeling in Market Research" , Journal of The Australia Market Research.
Malhotra, Naresh, K., (1999), Marketing Research An Applied Orientation, Prentice Hall Inc., Upper Saddle River, New Yersey.
Malhotra R, Kapoor A, Grover V, and Kaushal S. Nicotine and periodontal tissues. (2010), J Indian Soc Periodontal 14(1): 72-9.
Martin, A., Swarbick, J., dan Cammarata, A., (1990), Farmasi Fisik Dasar dan Kimia Fisik diterjemahkan oleh Yoshita, Edisi Ketiga, Hal 141-142, Universitas Indonesia Press, Jakarta.
Marcotte, C., and Niosi, J. (2000), Technology Transfer to China: The issues of knowledge and learning, Journal of Technology Transfer, 25(1): 43-57.
Miller, J. C. dan J. N. Miller. (1991), Statistika Untuk Kimia Analitik Diterjemahkan Suroso, ITB, Bandung.
Morgan, David L. (1988), Focus Groups as Qualitative Research, London: Sage Publications.
Morgan, C.T. (1987), Psikologi Sebuah Pengantar, Jakarta : Pradnya Paramita.
Nonaka, Takeuchi. (1995), The Knowledge-Creating Company, New York: Oxford University press.

Sarantakos B & Allyn MA, (1998), Social Research, 2nd Ed, Macmillan Education, South Melbourne.

Schlie, E., Rheinboldt, J., & Waesche, N. M. (2011), Simply seven: Seven ways to create to sustainable internet business, IE business publishing, Houndmills, Basingstoke: Palgrave Macmillan.

Schumacker, R. E., Lomax R. G. (2010), A Beginner's Guide to Structural Equation Modeling Third Edition, Taylor and Francis Group LLC, 510 hal.

Sitinjak J.R.T dan Sugiarto, (2006), LISREL, Graha Ilmu, Yogyakarta.

Wacker, J.G. (1998), A Definition of Theory: Research Guidelines for Different Theory-Building Research Methods in Operations Management, Journal of Operations Management, 16, 361-385.

Wijanto, S. (2008), Structural Equation Modelling dengan Lisrel 8.8, Graha Ilmu, Yogyakarta.

Yamin Sofyan, Kurniawan Heri. (2009), SPSS COMPLETE: Tekhnik Analisis Statistik Terlengkap dengan software SPSS, Jakarta: Salemba Infotek.

https://publicationethics.org/files/International%20standards_authors_for%20website_11_Nov_2011.pdf

INDEKS

Tentang Penulis

Lahir di Bhumi Arema tahun 1972, Fourry Handoko, PhD, menamatkan S-1 Teknik Industri di Institut Teknologi Nasional (ITN) Malang tahun 1997 dan S-1 Bahasa Inggris-Jepang di Sekolah Tinggi Bahasa Asing (STIBA) Malang pada 1999. Di antara menyelesaikan studi di STIBA Malang, penulis melanjutkan Studi pada bidang Teknik Manufaktur di Universitas Indonesia (UI), Jakarta dengan tesis tentang Teknologi di bidang Manufaktur dan lulus pada tahun 2000. Pada Tahun 2008, penulis menyelesaikan program *Master of Engineering di The University of Melbourne* (Unimelb) Australia dan *leading to* program PhD, serta menyelesaikan pendidikan Strata 3 tersebut pada *Mechanical and Manufacturing Department*, Unimelb Australia dengan Studi tentang Transfer Teknologi.

Di bidang profesional, selain memiliki pengalaman di bidang *Marketin*g dan *Warehousing* di perusahaan di Indonesia dan Australia antara 1997 dan rentang 2005-2010, penulis sejak tahun 2013 memiliki pengalaman pula dibidang pelatihan-pelatihan untuk level operasional hingga manajer serta organisasi dan konsultan di Perusahaan Nasional atau BUMN dan FDI. Selain itu, di bidang usaha pendidikan, penulis pada periode 2015 hingga sekarang juga memiliki pengalaman pada level *Middle Management* maupun *Top Management.*

Di bidang akademik, penulis adalah dosen di Program *Undergraduate* dan *Post Graduate* jurusan Teknik Industri ITN Malang. Beberapa kali menjadi pemateri atau *Keynote Speaker* di Seminar Nasional, serta pemateri pada seminar internasional di beberapa Universitas di 4 Benua dan menulis puluhan paper yang diterbitkan di jurnal Nasional maupun Internasional untuk bidang Teknik Industri, terkait Manajemen Teknologi, Transfer Teknologi berkelanjutan dan Teknologi berbasis *Green.*