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Assessing Information Systems Success Models: Empirical Comparison
(Research in Progress)

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Abstract

Information System (IS) success may be the most arguable and important dependent variable in the IS field. The purpose of the present study is to address IS success by empirically assess and compare DeLone and McLean's (1992) and Gable's et al. (2008) models of IS success in Australian Universities context. The two models have some commonalities and several important distinctions. Both models integrate and interrelate multiple dimensions of IS success. Hence, it would be useful to compare the models to see which is superior; as it is not clear how IS researchers should respond to this controversy.

Key words:

Enterprise Systems, Information Systems, IS-Impact, IS-Success, Australian Universities.

INTRODUCTION

Despite of the economical downturns, organisations across different sectors continue to increase spending on Information Technology (IT) (Kanaracus, 2008). However, globalisation, economical factors, and increasing competition influence organisations to cut down costs. On the other hand, this makes organisations keen to measure the success of the Information Systems (IS) and their impacts on both the organisation and the individuals to justify their value and contribution to the productivity, quality, and competitiveness of organisations (Gable, Sedera, and Chan, 2003). Evaluating the impacts of IT is one of the critical issues in IS literature (Kim and Kim, 1999), as the impacts of IT are often indirect and influenced by human, organisational, and environmental factors (Petter, DeLone, and McLean, 2008). Yet, it is argued *"if information systems research is to make a contribution to the world of practice, a well-defined outcome measure (or measures) is essential"* (DeLone and McLean, 1992: 61).

The IS success concept is broadly accepted in the IS literature as the main decisive factor for evaluating IS. Studies concerned with evaluating information systems success has started since the late 1970's (Delone and Mclean, 1992, 2003; Gable *et al.* 2003). However, academics as well as practitioners are still struggling with the question of which constructs best signify IS success. *"The problem lies in the ambiguity of the concept and the multiplicity of IS success constructs pervading the research"* (Rai *et al,* 2002: 50). In fact, measuring success in general is a very difficult process as there are no structured frameworks that guide such process Gable (1991), as IS researchers have addressed different aspects when evaluating information systems (Delone and Mclean, 1992). Seddon *et al.* (1999) supported Gable's view by stating that there few clear guidelines exist about how effectiveness should be measured, this can be attributed to the fact that there have been little attempts to measure IS success systematically (Shang and Seddon, 2000). Furthermore, Seddon *et al.* (1999) argue that previous literature does not indicate what measures are appropriate in a particular context, stating that the identification of the context at which the evaluation is conducted is vital to justify the measures used.

DeLone and McLean (1992) reviewed 180 studies, both empirical and conceptual, and identified over 100 measures used to evaluate IS success. The authors found that researchers have addressed different aspects of success; thus, making comparisons difficult. This means that before DeLone and McLean there were no certain criteria for success measures or any kind of categorisation that organises these measures and makes them as unique and parsimonious as possible. Based on the work of Shannon and Weaver (1963) and Mason (1978); DeLone and McLean (1992) proposed an IS-Success model that reflects previously reported measures. The IS-Success model consists of six major constructs or variables of IS success: System Quality, Information Quality, Use, User Satisfaction, Individual Impact, and Organisational Impact. The IS-Success model considered as one of the most widely cited model (Heo and Han, 2003).

A most recent model to measure IS success or impact is the IS-Impact measurement model introduced by a Gable, Sedera, and Chan (2008). Akin to analytic theory[13] (Gregor, 2006), the IS-Impact model is conceptualised as a formative, multidimensional index, wherein the constructs have a causal relationship with the overarching measure– IS-Impact. According to Gable *et al*. (2003), the driver for the study is the lack of reliable, standardized, and empirically validated measurement model for assessing the success or impact of contemporary information systems. The IS-Impact model consists of four constructs: Information Quality (IQ), System Quality (SQ), Individual Impact (II), and Organizational Impact (OI). It can be noted that the two models, DeLone and McLean and Gable *et al*, have some commonalities and several important distinctions. Both models integrate and interrelate multiple constructs of IS success.

The study proceeds from a central interest in the importance of evaluating IS in organizations. Hence, study aims to make a contribution to the IS field by addressing known limitation of what may be the most important dependent variable; IS success. ***The present study aims to empirically apply, assess, and compare DeLone and McLean (1992) and Gable et al, (2008) models of IS success in Australian Universities context***, as it is not clear how IS researchers nor practitioners should respond to this controversy. It would be useful to compare the models to see which is superior. The main research questions of this study are: **(1) Are the two models, the IS-**Success and the IS-Impact valid, only one, or neither? **(2)** *Which model is more applicable in the Australian Universities context*?

This study will examine the validity of DeLone and McLean and Gable *et al*. models. So, this research is an applied analysis and comparison of the two models and not a theoretical model/instrument evaluation exercise. As this research is applied in nature, a brief literature review is discussed[14]. Then, the methodology followed by the progress to date and next steps are presented.

BRIEF LITERATURE REVIEW OF DELONE AND MCLEAN AND GABLE *ET AL,* MODELS

DeLone and McLean (IS-Success) Model

As illustrated in Figure 1, DeLone and McLean (1992) synthesized a six factor categories (constructs) of IS success from the diversity of IS success measures found in the literature they reviewed. The taxonomy of these constructs suggests that (1) the interdependence between these constructs; and (2) the time sequence or causal relationship between these constructs. The D&M model proposes that System Quality and Information Quality singularly and jointly affect both System Use and User Satisfaction. Moreover, the amount of System Use can affect the degree of User Satisfaction, positively or negatively, and the degree of User Satisfaction also, affects System Use. Additionally, System Use and User Satisfaction are direct antecedents of Individual Impact. Finally, the Individual Impact should eventually have some influence on the Organizational Impact (DeLone and McLean, 1992, pp. 82-87).

DeLone and McLean did not provide empirical validation of the model they proposed and, in fact, suggest further development and validation is needed for their taxonomy (DeLone and McLean, 1992). However; Seddon (1997) listed number of contributions associated with the IS-Success model, including: (1) it combines previous research, (2) it provides a scheme for classifying the different measures of IS success models that have been proposed in the literature into six constructs, (3) it suggests a model of temporal and causal interdependencies between the identified categories, (4) it has been considered an appropriate base for further empirical and theoretical research, and (5) it has gained wide acceptance among IS researchers, who attempt to test and validate the different parts of the model. At the same time, Seddon (1997) was among the first to test the model (DeLone and McLean, 2003). Seddon criticised the model in two main points: (1) the model combined both causal and process relationship explanations which is confusing; (2) the Use construct is ambiguous and is not appropriate for causal relationship explanations[15].

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[13] The first of Gregor's (2006) five types of theory in IS, analytic theories, *"analyse 'what is' as opposed to explaining causality or attempting predictive generalizations ... they describe or classify specific dimensions or characteristics of individuals, groups, situations or events by summarising the commonalities found in discrete observations"* (2006: 612).

[14] A detailed review of the literature on IS evaluation can be found in DeLone and McLean (1992).

[15] It should be noted that Seddon (1997) respecified the model to overcome the confusion, and proposed an alternative model that treats IS Use as behaviour, as opposed to a proxy for benefits or an event in a process leading to Individual or Organisational Impacts. His alternative model focuses on the variance (casual) aspects of the interrelationships among the taxonomic categories. His model considers three classes of variables, including: measures of information and system quality, general measures of net benefits of IS use, and behaviour with respect to IS use.

Despite of the criticism that the IS-Success model has received, several elements of DeLone and McLean's model have been tested previously. Some researchers changed the causal paths (Seddon and Kiew, 1994; Glorfeld, 1994), combined existing constructs (Glorfeld, 1994), or added new constructs (Seddon, 1997; Glorfeld, 1994). Also, some studies demonstrate conflicting results concerning the causal relationships between the six constructs of DeLone and McLean's model. For example, Glorfeld (1994) found a positive relationship between User Satisfaction and Individual Impact, while Teo and Wong (1998) did not a relationship between the same constructs.
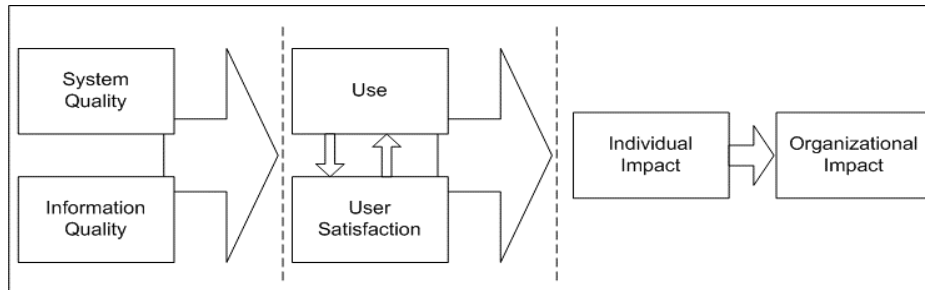

Figure 1: Delone and McLean IS-Success Model. From Delone and McLean (1992)

DeLone and McLean (1992) recommend the use of tested and proven measures, of IS success, from existing research. As such, existing measures that have adequate and acceptable qualities will be used to operationalise the IS-Success model. The following is a brief description of the selection of items that will be used in the measurement instrument from tested instruments found in the IS literature[16].

Organizational Impact (OI) assesses the influence of the IS on overall organizational performance. As a result, the five items measuring instrument in Sabherwal (1999) and the three items measuring instrument in Mahmood and Soon (1986) will be used in this study. Sabherwal (1999) items were chosen because they measure the impact of IS in areas that are highly important to all types of organizations, including: reduction of administrative costs, improvement of organization image, customer satisfaction, and enhancement of internal operations. The reliability score (Cronbach's alpha) reported for this measure was (0.84). Mahmood and Soon (1986) items were chosen because they measure the impact of IS on coordination with other organization, communication with other organizations, and improvement in decision making.

Individual Impact (II) examine the impact of IS on the users' performance. Doll and Torkzadeh (1988a) will be the basis to operationalise the Individual Impact construct in this study. This instrument measures the effect of four aspects, including: task productivity, task innovation, customer satisfaction, and management control. The overall reliability reported for the instrument was (0.92).

System Use (SU) was studied by Doll and Torkzadeh (1988b) and it examines the actual use of IS, the extent of use of IS in the users' work, and the number of system applications used in the users' work. Igbaria *et al* (1989) developed a 4-item instrument to measure this construct. Later, the instrument was proven reliable and valid by Anakwe *et al* (1998).

User Satisfaction (US) is concerned of examining the successful interaction between the IS and its users. The User Satisfaction construct, in this study, will be operationalized using Seddon and Yip (1992) instrument. The instrument consists of four questions and later was tested by Seddon and Kiew (1994) for reliability. The Cronbach's alpha score reported for this measure was (0.91).

System Quality (SQ) is *"concern with whether or not there are bugs in the systems, the consistency of the user interface, ease of use, response rate in interactive systems, documentation, and, sometimes quality and maintainability of the of the program code"* (Seddon and Kiew, 1994: 101).

Information Quality (IQ) is *"concern with such issue as timeliness, accuracy, relevance, and format of information generated by an information system"* (Seddon and Kiew, 1994: 101). Bailey and Pearson's (1983) instrument will be used to operationalize the Information Quality construct in this study. The instrument was used previously (e.g. Mahmood and Becker (1986); Li (1997); and Khalil and Elkordy (1999)). Bailey and Pearson's instrument consists of nine items, and is widely accepted and considered as the standard instrument in the IS field to assess Information Quality.

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[16] The instrument is available on request by the author

Gable et al's (IS-Impact) Model

A recent model to measure IS success or impact is the IS-Impact Measurement Model introduced by Gable *et al.* (2008) (see also Gable *et al.* (2003) and Sedera and Gable (2004)). Gable *et al.* (2008) define the IS-impact of an Information System (IS) as *"a measure at a point in time, of the stream of net benefits from the IS, to date and anticipated, as perceived by all key-user groups"*. According to Gable *et al.* (2003), the driver for the study is the lack of reliable standardized and empirically validated measurement model for IS success. Figure 2 depicts the IS-Impact Measurement Model.
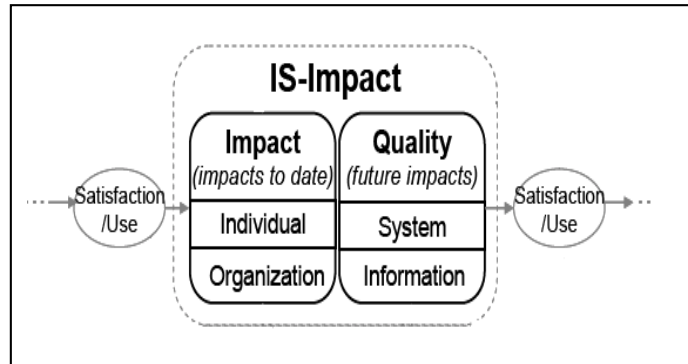

Figure 2: The IS-Impact Measurement. From Gable et al., (2008)

The IS-Impact model, which is based in DeLone and McLean's work, overcomes many concerns with past IS Success models. Gable *et al.*(2003) pointed out that the IS-Impact Model deviates from the traditional DeLone and McLean model in the following ways: (1) it depicts a measurement model and does not purport a causal/process model of success, (2) it omits the use construct, (3) satisfaction is treated as an overall measure of success, rather than as a construct of success, (4) new measures were added to reflect the contemporary IS context and organisational characteristics, and (5) it includes additional measures to probe a more holistic organisational impacts construct.

The IS-Impact model has been extensively validated statistically and uses mainly perceptual measures. According to Gable *et al.* (2008), the model was developed in two phases: the exploratory phase and the confirmatory phase. Two surveys were conducted in the exploratory phase where the purpose of the first one is identify success measures and the purpose of the second is to test what is called a priory model. In the confirmatory phase, the model was tested for reliability and validity using different data set.

Firstly, in the exploratory phase, the model was empirically tested using survey data gathered from 456 respondents representing twenty-seven Queensland public sector organizations that implemented SAP R/3 in the late 1990s. The a priori model was initially based on the DeLone and McLean's model with exclusion of the "Use" construct. After testing the priory model for construct validity, user satisfaction construct were taken out because it loaded along with the System Quality. As a result, the model consists of four constructs: Information Quality (IQ), System Quality (SQ), Individual Impact (II), and Organisational Impact (OI). The model was next tested at Queensland University of Technology (QUT) through confirmatory factor analysis of 157 survey responses regarding their ORACLE Financials systems. Analysis of the second-round, confirmatory, 'weights' survey data (model testing), demonstrated the discriminate validity of the four constructs, as well as their convergence on the single higher-order phenomenon – IS success. Criterion validity testing further demonstrated the additivity of the four constructs of success, and the completeness of the resultant over-arching, second-order measure of IS success. Figure 3 demonstrates the 37 measures of the IS-Impact measurement model.
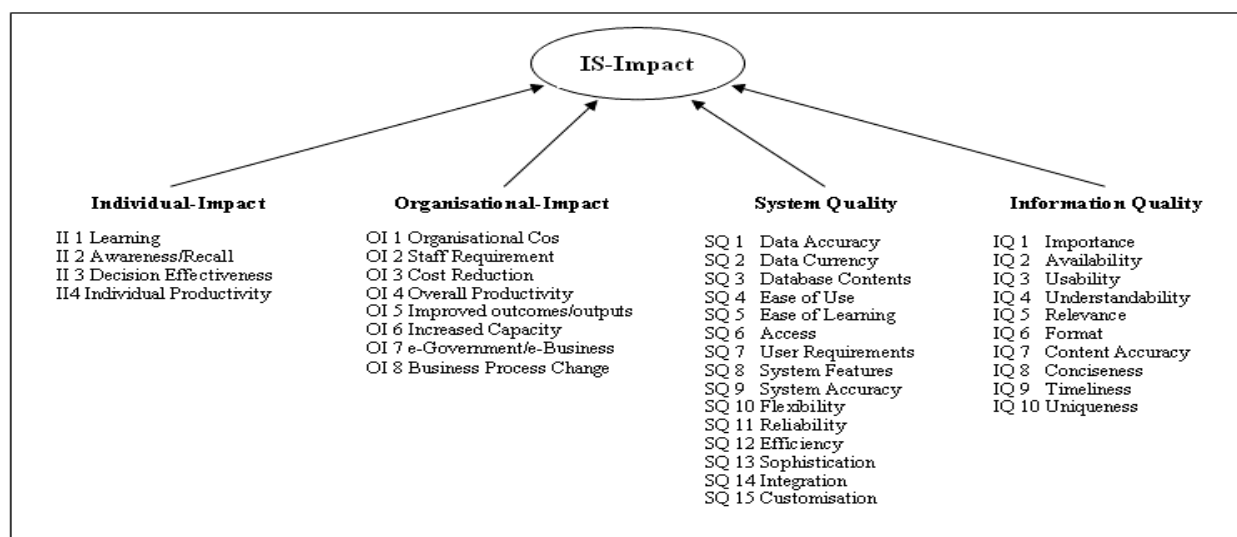
Figure 3: The 37 Measures of the IS-Impact Model. (Adapted from Gable *et al,* (2008, p. 390))

In attention to proliferation of overlapping measures, (Gable *et al.* 2008) comprehensively evaluated existing items, resolving redundancy and identifying new measures for contemporary IS. Their model reconciles persistent confusion regarding the role of the DeLone and McLean constructs as measures versus explanandum, conceptually demonstrating their value as both. Gable *et al.* (2008) analysis represents the first test of the sufficiency and necessity (or not) of the six DeLone and McLean constructs; they ultimately evidence the sufficiency and necessity of the four IS-Impact constructs. They argue the redundancy of Use, and consistent with contemporary views in Information Systems, they also present a strong rationale for conceiving User Satisfaction[17] as a consequence of success (and antecedent) rather than a construct (see Figure 2).

The complex, multi-dimensional nature of IS success is represented by four constructs. The four-dimensional IS-Impact measurement model consists of two halves; the "impact" half includes Organizational-Impact and Individual-Impact constructs, this half measures the up to date impact and benefits that have been realized from the evaluated system; the quality half includes System-Quality and Information-Quality constructs, this half forecasts the potential impact of the system in the future (Gable *et al.*, 2008).

The IS-Impact model, by design, is intended to be robust, simple and generalisable, to yield results that are comparable across time, stakeholders, different systems and system contexts (Gable *et al.* 2008). The model and measurement approach employ perceptual measures and offer an instrument that is relevant to all key stakeholder groups, thereby enabling the combination or comparison of stakeholder perceptions. The IS-Impact model does not represent process or causal relationships. The model also can be used as benchmark tool to compare different ES products, versions, and upgrades or to compare different organisations and departments within an organisation

In this research, all constructs in the IS-Impact model will be operationalised. According to Gable *et al.* (2008, pp. 389-390), *"Individual Impact is a measure of the extent to which (the IS) has influenced the capabilities and effectiveness, on behalf of the organization, of key-users, Organizational Impact is a measure of the extent to which (the IS) has promoted improvement in organizational results and capabilities, Information Quality is a measure of the quality of (the IS) outputs: namely, the quality of the information the system produces in reports and on-screen, and System Quality is a measure of the performance of (the IS) from a technical and design perspective".* This study will use the IS-Impact instrument used in Gable *et al.* (2008)[18].

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[17] Gable *et al.* (2008) argue that User satisfaction has been possibly the most extensively employed single measure for IS evaluation [as cited in Gable *et al.,* (2008): DeLone and McLean, 1992, Doll and Torkzadeh, 1988a, Etezadi-Amoli and Farhoomand, 1991, Gatian, 1994, Igbaria and Tan, 1997, Lucas, 1975]. Several widely cited studies developed standard instruments that measure satisfaction [Bailey and Pearson, 1983, Baroudi and Orlikowski, 1988, Doll and Torkzadeh, 1988a]. Early satisfaction constructs in IS success evaluation (e.g., user information satisfaction—Bailey and Pearson 1983) have been found to mix measures of multiple success constructs (e.g. quality and impact) rather than measuring a distinct satisfaction construct [Gable, 1996]. Rai *et al* (2002), state that user satisfaction has been measured indirectly through Information-Quality, System-Quality and other variables in prior studies. Additionally, [Sedera and Tan, 2005] demonstrated – through content analysis of 192 satisfaction-related items from 16 Satisfaction instruments – that 98% (189) of the measures readily map into existing measures pertaining to: System-Quality, Information-Quality, Individual-Impact and Organizational-Impact; with only 2% of the items (3 items) appearing to measure Satisfaction explicitly.

[18] The instrument is available on request by the author.

METHODOLOGY

Population and Sample

The unit of analysis for this study is the Financials and the Human Resource (HR) applications in Australian Universities. By 2001 86% of the Australian higher education institutions were using, implementing or intended to implement at least one Enterprise System application. In 2002, 86% of Australian universities adopted at least one module of an ES (Beekhuyzen *et al.*, 2001) with the aim of improving and integrating the management and administrative processes in student registration, HR systems and financial processing (Frantz, 2001). Nielson (2005) reported that 38% of Australian institutions had adopted ES applications from a single vendor and 48% had adopted a 'best of breed' approach deploying a range of applications from several vendors, while only 14% had not implemented any ES.

Due to a large number of Universities in Australia, the researcher chose a sample of three Universities located in South East Queensland. After identifying the three Universities, the researcher obtained the necessary approvals to conduct the study. Next, the researcher met with each of the financials and the human resource directors of the three Universities on May, 2009 and explained the importance and the implications of this study. All three Universities agreed to participate in the study.

Data Collection

The study will use two surveys to collect data; (i.e. one for the IS-Success model, and one for the IS-Impact model). The survey method was sought to be the most appropriate method for this study, as surveys are recommended when investigating the relationships between various factors across large population and suggested to be used in verification and validation purpose (Gable, 1994). On the other hand, Gable (1994) argues that the survey approach seeks to identify common patterns and relationships in organisations, identify *outliers*, and provide greater confidence in the generalisability of the results, hence, the main reasons of choosing the survey method are: (1) it provides high generalisability of the findings, which is the main aim of the study, (2) it usually consumes relatively less resources (in terms of time and money), and (3) one of the most appealing strength for this study is the fact that survey methods can be administered remotely.

The IS-Success model instrument is divided into two surveys- the management survey and the end user survey. The management survey will collect data about the Organizational Impact construct, and will be distributed to general managers, department heads, and supervisors. The end user survey will collect data about the Individual Impact, System Use, User Satisfaction, System Quality, and Information Quality constructs. The reason behind dividing the IS-Success model instrument into two surveys is that management should have the knowledge about the overall performance of the organization and should be able to evaluate the Organizational Impact. Where the end users, on the other hand, interact more with the financials and the HR applications in daily basis and they should have the required knowledge to evaluate the other five constructs.

On the other hand, the IS-Impact model instrument will be distributed to all respondent cohorts (i.e. strategic, managerial, operational, and technical) with no need to divide the instrument into different parts as Gable *et al.* (2008, p. 390) claimed that the *"survey instrument was designed to operationalize the 37 measures of the four constructs, and the wording of each item was carefully designed to insure all items were answerable by all respondent cohorts"*.

Data Analysis

Different data analysis techniques will be used to validate the IS-Success model. For example, the reliability of all instruments will be measured using Cronbach's alpha coefficient. Additionally, Person's correlation coefficients will be used to assess whether or not there are significant direct associations between the constructs of the model. Finally, regression analysis will be used to further validate the relationships between the model's construct.

With respect to the IS-Impact model, Gable *et al,* (2008) argued that the IS-Impact model is a formative not a reflective model. Hence, formative construct validity techniques will be used to validate the model; including, testing the model for multi-collinearity among the measures following the recommendations of Diamantopoulos and Siguaw (2006), this will be done by calculating the Variance Inflation Factors (VIF), employing a global item and examine the extent to which the items associated with the index correlate with this global item, further validate the indicators taking into account their interrelationship following the recommendations of Joreskog and Goldberger (1975), this will be done through a Multiple Indicator Multiple Causes (MIMIC) model, evaluating the Absolute Fit Indicators using the standardized RMR, looking at comparative fit measures by using the Normed Fit Index (NFI), Non Normed Fit Index (NNFI), Incremental Fit Index (IFI) and Comparative Fit Index

(CFI), and assessing the formative variables, focusing on the nomological aspects, by linking the index to other constructs with which it would be expected to be linked. Detailed discussion on Formative Construct Validity can be found in Gable *et al*, (2008).

PROGRESS TO DATE AND NEXT STEPS

All the required approvals, to conduct the study, were granted by Queensland University of Technology (QUT). An evaluation has been made of current challenges in relation to construct measurement and validation in research. This has incorporated a literature review supported by a conceptual analysis.

The instruments are completed. The data collection will be administered in August, 2009. At the beginning of each survey administration session, the researcher is planning to briefly introduce the aim and the importance of the research, acknowledge the importance of the participants' involvement and cooperation in this study, emphasize that the participation in this study is completely voluntary, and address the confidentially of responses. The participants will be instructed that there are no right or wrong answers, must compete all the questions, and they need only to record their first perceptions after reading each question. Finally, the researcher will make sure to give all the time required to complete the instruments.

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