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The CIO Role Expectations Instrument: Validation and Model Testing

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Abstract

The validation of IS instruments has not been given the attention that it deserves. This study uses component-based structural equation modelling (PLS/SEM) to investigate the psychometric properties and possible modelling of the CIO role expectations instrument based on data obtained from 174 Australian CIOs. Results show that the CIO role expectation instrument exhibit solid validity and reliability indices despite some minor weaknesses. The results also demonstrate the possibility to model the constructs of this instrument in different null and hierarchical models, and the validity of this instrument to measure the CIO role in different types of industries not just the healthcare sector in which it was developed. The results provide support for CIO role theory on two central issues: CIOs are fulfilling a configuration of roles not just one specific role; and the CIO roles can be grouped into two major categories: supply side roles and demand side roles.

Keywords

Chief Information Officer role, Configuration of CIO Roles, Duality of CIO Roles, CIO Role Expectations instrument, Partial Least Squares (PLS), Psychometric Properties, Hierarchical Models.

INTRODUCTION

The arrival of the information age has made the role of the chief information office (CIO) more vital than other C-suite managers (Peppard, Edwards & Lambert 2011). Since the emergence of the CIO role in early 1980s , much has been written about it, however this role remains ambiguous (Peppard et al. 2011). This ambiguity indicates a lack of theory building regarding the CIO role in an organisation. Consequently, the lack of theory leads to a lack of rigorous measurements. A review of the literature revealed a handful of instruments that have been used to measure the role of the CIO (e.g.,Arthur Andersen & Co 1988; Gottschalk 2000; Karimi, Gupta & Somers 1996; McCall & Segrist 1980; Smaltz, Sambamurthy & Agarwal 2006; Wu, Chen & Sambamurthy 2008). Information Systems (IS) management has been identified as one of the most researched topic in IS (Palvia, Pinjani & Sibley 2007), however the vast majority of literature is substantive rather than measurement oriented. Many scholars acknowledge that there is a lack of attention given to measurement validation in the IS field (Doll & Xia 1997; Gefen & Straub 2005; Klenke 1992) and Chau (1997) pointed out that calls for methodological rigour and model testing in management information systems research are increasing and there is growing use of the structural equation modelling (SEM) approaches in management science. However, recent IS literature acknowledged the absence of applied examples on how to apply SEM techniques to assess IS multidimensional or hierarchical constructs (Wright, Campbell, Thatcher, and Roberts 2012; Wetzels, Odekerken-Schröder, and Oppen 2009). The last two decades have provided many attempts by IS scholars to validate previously developed measures (e.g.,Chau 1997; Chin & Todd 1995; Doll & Xia 1997; Klenke 1992;

Segars & Grover 1993; Stewart & Segars 2002; Burton-Jones & Straub 2006). Other studies have provided guidelines for best checking of instrument validation (_ENREF_3Gefen & Straub 2005; Straub, Boudreau & Gefen 2004). Further examination of IS measurement is considered central to both theoretical and operational perspectives (Stewart & Segars 2002).

As far as the CIO role expectations instrument is concerned from a theoretical perspective, the results of re-examination will assess the rigor and the extent of confidence in CIO role theory. Additional investigation from the operational point of view facilitates generalizability and consistency of measurements over time and context, and may avoid erroneous conclusions being drawn regarding the existence, magnitude, and direction of association between constructs (Stewart & Segars 2002). Smaltz et al. (2006) encouraged IS researchers to validate the generalizability of the configuration of CIO roles in different industries beyond the healthcare sector in which it was developed.

In order to address this gap and respond to these calls for increased theoretical and methodological rigor, the purpose of this study is twofold. First, we will critically examine the psychometric properties of the CIO role expectations instrument (Smaltz et al. 2006) using component-based structural equation modelling (PLS/SEM). Then, different types of null and hierarchical models using the constructs of the CIO role expectations instrument are assessed and compared for best modelling. The two research questions investigated in this study are:

- Is the CIO role expectations instrument valid and reliable?
- How can the constructs of the CIO role expectations instrument be modelled to gain best validity, reliability and model fit?

This paper has been divided into five sections: first the background section discusses CIO role measurement in general and specifically the CIO role expectations instrument. Next, the research methodology used in this study is described and justified. After that, the results of the analysis of the survey data are presented. Then, a discussion regarding the key results of this study is provided. Finally, conclusions, implications of the key findings for existing theory and practice are discussed and some suggestions for future research are provided.

BACKGROUND

An extensive review of the CIO roles literature suggested that there are at least six survey instruments that have been used to identify the CIO roles to date e.g., Arthur Andersen & Co (1988); Gottschalk (2000); Karimi et al. (1996); McCall and Segrist (1980); Smaltz et al. (2006); and Wu et al. (2008). These measures are all developed specifically for the CIO except the instrument developed by McCall and Segrist (1980) which is based on Mintzberg's ten general managerial roles . The CIO role expectations instrument was developed by Smaltz et al. (2006) within the USA healthcare sector based on a wide base of knowledge regarding the CIO role integrated with a comprehensive CIO role inventory derived from the literature along with rich data obtained from CIOs and Top Management Team members interviewed.

This instrument was used to identify the perceived importance of six key CIO roles proposed as Strategist (the organisational desire for the CIO to be an effective business partner and help their organisation leverage valuable opportunities for IT-based innovation and business process redesign), Integrator (the desirability of the CIO providing leadership in enterprise-wide integration of processes, information, and decision-support as digital options for the business), Relationship Architect (the desirability of a CIO to build relationships both across the enterprise as well as outside the enterprise with key IT service provide), Educator (the role of the CIO as an IT missionary, who provides insight and understanding about key information technologies to raise top management savviness, awareness, and appreciation of IT and help them to make appropriate judgments about the business value of IT and wise IT investment decisions), Utility Provider (the role of the CIO as a builder of sustaining, solid, dependable, and responsive IT infrastructure services), and Information Steward (the desirability of the CIO to be an organisational steward for high quality data and operationally reliable systems). It is worth noting that these six roles have been classified by Smaltz et al. (2006) into two groups as follows : (1) Supply side roles: include the roles that are best described as operational or technical for the CIO as utility provider, information steward, and educator, and (2) Demand side roles: include the roles that are best described as strategic or business for the CIO as integrator, relationship architect, and strategist.

The final CIO role expectations instrument by Smaltz et al. (2006) included 25 items identified to measure the CIO role. They operationalized this instrument using exploratory factor analysis/ principal component extraction in order to examine the dimensionality of its indicators. From the results, six-dimensional factors reflecting six roles for the CIOs emerged as follows: Strategist (5 items); Relationship Architect (4 items); Integrator (4 items); Educator (3 items); Information Steward (4 items); and Utility Provider (3 items). They found that the factor loadings for 23 out of 25 items analysed were acceptable in the range from 0.4 to 0.82. Two items were

omitted due to lower factor loadings (Stra1 and UtPr4). To our knowledge, this instrument has not been validated before, hence, this study aims to use a confirmatory approach to validate this instrument and test the categorization of its constructs based on previous literature.

METHODOLOGY

Data Collection

Data for this research were collected through a large scale cross-sectional survey carried out in Australia in early to mid-2012. Prior to data collection, the instrument used by Smaltz et al. (2006) was slightly modified because it was developed within one specific sector (healthcare) and we intended to collect data from CIOs across a wide range of industries. Accordingly, the wording of eight of the 25 items was modified to be more generic than the initial ones. These items are UtPr2, UtPr3, Edu1, Edu2, Edu3, Integ3, Integ4, and Stra1. Also, we expanded the Likert scale used in this instrument from 5 to 7 points to increase the instrument reliability. Then, an initial draft of the instrument was pre-tested. Some minor changes were made to some items in terms of the wording in the light of the expert panel's valuable feedback. Next, one former healthcare CIO and the CTO of USQ were asked to complete the pilot survey and comment on any issues that might impair completion of the questionnaire or generate a poor response rate. The experts' comments were very helpful and a number of minor changes were incorporated to finalize the research questionnaire for data collection. Table 1 includes the statements used in the questionnaire.

The survey was administered in three waves, two postal mail outs followed by an online email survey. The target population for this research was Australian private sector IT executives. A list of postal addresses for senior IT executives in Australian private sector firms purchased from Dun & Bradstreet Australia (2011) provided the sampling frame. A cover letter along with a copy of the questionnaire and pre-paid reply envelope was sent to all of the 954 Australian senior IT executives listed in the sampling frame in early 2012. To increase the response rate, follow-up phone calls were conducted in early July 2012 to motivate more responses after the second mail out.

A total of 113 questionnaires were returned as undeliverable due to invalid addresses, and emails were received from 19 firms who indicated that they were not willing to participate in this survey for different reasons. With 174 complete and usable responses (161 hardcopy and 13 online), the response rate was calculated at 20.68 per cent (174/ (954 -113) = 20.68 %) which is considered to be reasonable for survey research compared to similar studies involving CIOs reported by Preston, Karahanna, & Rowe (2006) where response rates have ranged from 7 to 20 per cent. It is recognised that the targeted respondents were senior IT executives who are busy people and tend to be over-surveyed.

Data Analysis

The preliminary analysis included data screening and data cleaning for data entry errors, outliers, normality, multicollinarity and non-responses bias test. The main data analysis was conducted using Partial Least Square Structural Equation Modelling (PLS / SEM). PLS Graph Alpha (Version 03.12 build 01) software was used to analyse the data. The results of the PLS analysis were used to assess the validity of the CIO role expectations instrument. PLS/SEM is variance based, prediction oriented, distributional free, and able to treat reflective and formative constructs within highly complex structural models (Chin & Newsted 1999).

RESEARCH RESULTS

The survey data were prepared for data analysis by correcting errors, checking and treating outliers, checking for normal distribution, and multicollinarity based on the guidelines provided by Tabachnick and Fidell (2007). Next, an assessment of non-response bias was carried out. A comparison was conducted between the early respondents (N=21) and late respondents (N=13) in terms of the six CIO roles included in this instrument. The results of the Mann-Whitney U test conducted on the 25 items of this instrument found statistically significant differences in only one item (ReAr1). This means that there are no major differences between early and late respondent CIOs, and that non-response bias does not appear to be an issue in this research.

Psychometric Properties of the CIO Role Expectations Instrument

The six CIO roles included in this instrument were modelled by Smaltz et al. (2006) as reflective constructs, hence five major areas should be tested to ensure measurement validity (Henseler, Ringle & Sinkovics 2009): reliability at the construct level; reliability at the indicators level; convergent validity; discriminant validity at the construct level; and discriminant validity at the indicators level.

Following common criteria suggested by Chin (2010) and Henseler et al. (2009) we examine the inter-construct correlations, composite reliabilities, average variance extracted for each construct, item loadings on their

constructs and item cross loadings on other constructs to ensure this instrument's reliability and its discriminant and convergent validity. These statistics are presented in Table 1 and Table 2.

Reliability at the indicators level is checked by examining the item loadings on their respective constructs (see Table 1). Henseler et al. (2009) suggest 0.7 as a rule of thumb as a standardized outer loading to ensure that the indicator has captured at least half of the variance. Item loadings and cross loadings presented in Table 1 provide evidence of discriminant validity at the indicators level as all items except four are strongly related (load) to the constructs they were intended to measure and they do not have a stronger connection with another construct (cross load). The four weak items (ReAr4 - *Interact often with non-IT managers throughout the organization*, Info.S1 - *Keep key systems operational*, Integ2 - *Migrate organization from legacy, department applications to cross-department, integrated applications*, and UtPr1 - *Establish and maintain an IT department that is responsive to user requests/problems*) were eliminated and excluded from further statistical analysis.

As can be seen from Table 2, the composite reliability (CR) for all constructs exceeds the satisfactory level of 0.7 which supports internal consistency reliability (Werts, Linn & Jöreskog 1974). Discriminant validity at the construct level is confirmed, as the square roots of the average variances extracted (AVE) values of all constructs (shown in the diagonal in Table 2) are larger than the inter-correlation of the constructs in the model which means that all constructs shared more variance with their own measures than with others. Sufficient convergent validity is indicated as the average variances extracted (AVE) for all research constructs exceed the acceptable cut off of 0.5 proposed by Fornell and Larcker (1981).

Overall, these results indicate two important facts: (1) the psychometric properties of the CIO role expectations instrument exhibit adequate reliability and validity which increases confidence in this instrument and CIO role theory; and (2) this instrument is valid for a range of industries other than solely the healthcare sector as the data for this research were collected from senior IT leaders from a range of different Australian industries.

This section critically examines the alternative null and hierarchical models for the CIO role expectations instrument. First, the factorial nature of this instrument is assessed using three possible null (also known as measurement) models supported by existing CIO literature. These three null models, in which no structural relationships are specified, represent three different factorial structures based on the CIO role expectations instrument. Estimation of the possible null models allows researchers a formal assessment of convergent validity and the factorial-structure or the dimensionality of the construct. An examination of the second-order hierarchical structure which deals with the CIO role as a multidimensional construct involving more than one dimension will then be tested. Edwards (2001) argued that the examination of the hierarchical models might allow: (1) more theoretical parsimony; (2) reduce model complexity; (3) matching the level of abstraction for predictor and criterion variables; and (4) assessment of the reliability and the validity of measures of multidimensional constructs. Furthermore, Stewart and Segars (2002) emphasize the importance of testing higher order models rather than only examining a set of correlated first-order factors:

"The theoretical implication of higher-order models is that each first-order factor and the implied second-order factor is important in capturing the domain of the construct. Further, the second order factor may be a more important mediator between a consequent and predictor variable than the first order construct" (p. 37).

Underlying factorial-structure of CIO role expectations instrument. In operationalizing the CIO role expectations instrument, Smaltz et al. (2006) used the 25 items in two ways. The first approach modelled them as one first-order reflective factor *CIO effectiveness* to assess the CIO effectiveness from the perspective of the top management team. The second approach modelled them as six first-order reflective factors (Strategist role; Relationship Architect role; Integrator role; Educator role; Information Steward role; and Utility Provider role) to assess the dimensionality of role expectations from the CIO's point of view. Smaltz et al. (2006) also theoretically classified the six factors (roles) into two groups (supply side and demand side) on the basis of existing CIO literature (e.g. Broadbent & Kitzis 2005; Mark & Monnoyer 2004). In this section , an assessment of the factorial-structure and psychometric properties of three null models specified based on the theory with no structural relationships was conducted. Table 3 presents a comparison of the psychometric properties for the suggested three null models. The results presented in Table 3 confirm the uni-factorial (one first-order factor) , the bi-factorial (two first-order factors), and the multi-factorial (six first-order factors) of the CIO role expectations instrument, yet the quality of these three models varies. In this respect, the properties of the models could be ordered in sequence of decreasing quality: multi-factorial, bi-factorial and finally uni-factorial model.

Table 1 CIO Role Expectations Item Loadings and Cross Loadings

Item*	Item Statements**	Strategist	Relationship Architect	Integrator	Educator	Information Steward	Utility Provider
Stra1	Develop and implement a strategic IT plan that aligns with the organization's strategic business plan	**0.71**	0.27	0.32	0.32	0.11	0.35
Stra2	Develop/maintain metrics that measure the value of IT to the organization	**0.75**	0.26	0.53	0.39	0.25	0.35
Stra3	Direct IT-enabled business process restructuring reengineering	**0.76**	0.25	0.48	0.38	0.25	0.29
Stra4	Provide expertise on multidisciplinary business process improvement teams	**0.76**	0.36	0.54	0.54	0.24	0.41
Stra5	Be initially involved in shaping the mission/vision of the organization	**0.80**	0.23	0.26	0.43	0.05	0.35
Stra6	Be initially involved in business strategic planning and decisions	**0.76**	0.17	0.20	0.40	0.30	0.29
ReAr1	Provide executive oversight for all IT contracts with external vendors	0.25	**0.79**	0.26	0.13	0.20	0.28
ReAr2	Negotiate with vendor IT organizations on new external contract proposals	0.33	**0.89**	0.32	0.30	0.30	0.37
ReAr3	Ensure IT contracts with external vendors remain within scope and budget	0.29	**0.83**	0.26	0.22	0.30	0.45
ReAr4	Interact often with non-IT managers throughout the organization	0.49	**0.35**	0.11	0.22	0.19	0.09
Integ1	Direct efforts to build an integrated delivery system.	0.45	0.21	**0.78**	0.25	0.49	0.42
Integ2	Migrate organization from legacy, department applications to cross-department, integrated applications	0.37	0.25	**0.65**	0.46	0.24	0.26
Integ3	Develop/acquire an electronic document management capability throughout the organization	0.27	0.22	**0.78**	0.33	0.31	0.26
Integ4	Develop an understanding of the industry delivery process	0.46	0.31	**0.85**	0.42	0.28	0.24
Edu1	Champion digital literacy throughout the organization	0.41	0.21	0.48	**0.83**	0.28	0.43
Edu2	Provide insight to the top management team /executives staff on new emerging technologies	0.55	0.24	0.4	**0.88**	0.10	0.35
Edu3	Assist top management team/executives staff in improving their digital literacy	0.48	0.23	0.36	**0.90**	0.18	0.37
Info.S1	Keep key systems operational	0.15	0.10	0.05	0.11	**0.37**	0.43
Info.S2	Build and maintain an IT staff with skill sets that match your current and planned technology base	0.36	0.41	0.41	0.30	**0.71**	0.40
Info.S3	Provide oversight for quality assurance of organizational data	0.44	0.36	0.33	0.43	**0.79**	0.29
Info.S4	Ensure confidentiality and security of organizational data	0.26	0.24	0.19	0.28	**0.85**	0.31
UtPr1	Establish and maintain an IT department that is responsive to user requests/problems	0.11	0.25	0.23	0.11	0.29	**0.67**
UtPr2	Establish electronic linkages throughout the organization	0.17	0.21	0.37	0.22	0.33	**0.85**
UtPr3	Ensure the organization's users have adequate workstations (PCs/Laptops/Tablets) to accomplish their jobs	0.08	0.24	0.31	0.13	0.34	**0.76**
UtPr4	Establish electronic linkages to external entities (customers, suppliers, partners, etc.)	0.33	0.27	0.45	0.19	0.35	**0.76**

**Measured with 7 point Likert scale*

*** Adopted from Smaltz et al. (2006) with minor changes made to the wording of some items based on the outcome of the pre-test step.*

Table 2 Inter-construct Correlation and Reliability Measures

Construct*	CR	AVE	Strategist	Relationship Architect	Integrator	Educator	Information Steward	Utility Provider
Strategist	0.89	0.57	**0.75****					
Relationship Architect	0.88	0.70	0.35	**0.83**				
Integrator	0.84	0.64	0.49	0.29	**0.80**			
Educator	0.90	0.76	0.54	0.26	0.40	**0.87**		
Information Steward	0.83	0.62	0.46	0.42	0.37	0.47	**0.78**	
Utility Provider	0.84	0.63	0.22	0.26	0.42	0.20	0.39	**0.79**
* 7 point Likert scale **square root of AVE in diagonal								

Alternative Models for the CIO Role Expectations Instrument Based on Theory

Assessment of the hierarchical model. By applying the repeated indicators approach suggested by Lohmöller (1989) and following the guidelines provided by Wetzels et al. (2009) and Wright et al. (2012), we now examine the hierarchical model which is also supported by CIO role theory in terms of the psychometric properties and model goodness of fit (GoF) as proposed by Tenenhaus, Vinzi, Chatelin and Lauro (2005). In the hierarchical approach, the manifest variables are used twice: for the first-order latent variables (i.e. six CIO roles), and for the second-order latent variables (i.e. supply side and demand side CIO roles). As a result, the CIO demand side role is modelled as a function of three roles (Strategist, Relationship Architect, and Integrator) and the CIO supply side role is modelled as a function of the other three roles (Educator, Information Steward, and Utility Provider). The CIO role according to this view is considered as multidimensional construct type superordinate as the relationships flow from the construct to its dimensions (Wright et al. 2012).

Table 3 Null Models Psychometric Properties

Uni-Factor Null Model One First-order Factor			Bi-Factor Null Model Two First-order Factors		Multi-Factor Null Model Six First-order Factors	
Items	**Factor**	**Loadings**	**Factors**	**Loadings**	**Factors**	**Loadings**
Stra1	CIO Role Effectiveness CR= 0.91 AVE= 0.32	0.59	Demand Side Roles CR= 0.88 AVE= 0.39	0.67	Strategist Role CR= 0.84 AVE= 0.63	0.71
Stra2		0.68		0.74		0.75
Stra3		0.66		0.74		0.76
Stra4		0.76		0.78		0.76
Stra5		0.62		0.65		0.80
Stra6		0.54		0.58		0.76
ReAr1		0.40		0.46	Relationship Architect Role CR= 0.83 AVE= 0.62	0.79
ReAr2		0.53		0.53		0.89
ReAr3		0.51		0.50		0.83
Integ1		0.60		0.61	Integrator Role CR= 0.90 AVE= 0.76	0.78
Integ3		0.49		0.47		0.78
Integ4		0.61		0.65		0.85
Edu1		0.63	Supply Side Roles CR= 0.85 AVE= 0.39	0.73	Educator Role CR= 0.84 AVE= 0.64	0.83
Edu2		0.65		0.65		0.88
Edu3		0.62		0.71		0.90
Info.S2		0.58		0.58	Information Steward Role CR= 0.88 AVE= 0.70	0.71
Info.S3		0.61		0.70		0.79
Info.S4		0.50		0.65		0.85
UtPr2		0.40		0.55	Utility Provider Role CR=0.89 AVE= 0.57	0.85
UtPr3		0.31		0.44		0.78
UtPr4		0.49		0.50		0.76

Table 4 presents the path estimates, predictive power (R^2), and model goodness of fit (GoF) for the second-order, reflective, hierarchical CIO role model. The second-order hierarchical model shows acceptable properties in terms of reliability (CR), convergent validity (AVE), path coefficients (β), substantial explained variance (R^2), and a strong model fitting (GoF).

Figure 1 depicts the structure and estimated parameters of the CIO role expectations as a second-order hierarchical model.

Table 4 PLS Results for Hierarchical Model

First Order					Second Order		
Construct	**Item**	**Loadings**	**β**	**R^2**	**Construct**	**Item**	**Loadings**
Strategist Role CR= 0.84 AVE= 0.80	Stra1	0.71	0.90*	0.89	Demand Side CIO Roles CR= 0.88 AVE= 0.62	Stra1	0.65
	Stra2	0.76				Stra2	0.73
	Stra3	0.78				Stra3	0.72
	Stra4	0.77				Stra4	0.77
	Stra5	0.76				Stra5	0.62
	Stra6	0.72				Stra6	0.54
Relationship Architect Role CR= 0.87 AVE= 0.84	ReAr1	0.78	0.62*	0.38		ReAr1	0.48
	ReAr2	0.89				ReAr2	0.55
	ReAr3	0.82				ReAr3	0.51
Integrator Role CR= 0.89 AVE= 0.76	Integ1	0.79	0.75*	0.55		Integ1	0.61
	Integ3	0.75				Integ3	0.49
	Integ4	0.85				Integ4	0.66
Educator Role CR= 0.90 AVE= 0.87	Edu1	0.85	0.79*	0.64	Supply Side CIO Roles CR= 0.84 AVE= 0.62	Edu1	0.72
	Edu2	0.86				Edu2	0.63
	Edu3	0.89				Edu3	0.69
Information Steward Role CR= 0.83 AVE= 0.79	Info.S2	0.71	0.83*	0.68		Info.S2	0.59
	Info.S3	0.80				Info.S3	0.70
	Info.S4	0.83				Info.S4	0.65
Utility Provider Role CR= 0.84 AVE=0.80	UtPr2	0.85	0.65*	0.41		UtPr2	0.56
	UtPr3	0.75				UtPr3	0.46
	UtPr4	0.76				UtPr4	0.51
Model Goodness of Fit (GoF)=0.67			*Significant at $P > 0.01$				

DISCUSSION

To answer the research questions, our results indicate that the CIO role expectations instrument is valid and reliable, and the constructs can be structured in null and hierarchical models.

The results of this study demonstrate several important points. First, overall, the CIO role expectations instrument has exhibited solid psychometric properties and therefore researchers can use this instrument with confidence in future research. Second, four weak items have been identified in this instrument (ReAr4 - *Interact often with non-IT managers throughout the organization*, Info.S1 - *Keep key systems operational*, Integ2 - *Migrate organization from legacy, department applications to cross-department, integrated applications*, and UtPr1 - *Establish and maintain an IT department that is responsive to user requests/problems*). That indicates the need to pay more attention to verifying the Relationship Architect, Information Steward, Integrator, and Utility Provider roles and suggesting some other relevant items that can measure them precisely or consider revising the wording of these four items. Recall that the exploratory factorial validity for this instrument conducted by the developers (Smaltz et al. 2006) has led to omitting two different items (Stra1 - *Develop and implement a strategic IT plan that aligns with the organization's strategic business plan* and UtPr4 - *Establish electronic linkages to external entities (customers, suppliers, partners, etc*.).

Furthermore, there is a possibility to model the constructs of this instrument in three different factorial structures: multi-factorial with six factors; bi-factorial with two factors; and uni-factorial with one factor, as the CIO role theory suggested, yet the three null models have exhibited different psychometric properties. The factor loadings for some items and consequently the AVEs of the constructs of the two- and one-factor null models have decreased to below the acceptable cut off (0.50). This indicates questionable convergent validity and gives preference to the six factors null model against the two and one- factor null models. One can order these three null models according to their quality as follows: six-factors then two-factors and then one-factor. This result supports the views of previous studies that found the CIO performs a configuration of roles (e.g. Smaltz et al. 2006; Peppard et al. 2011). In practice senior management could effectively measure the performance of a CIO by assessing their competency across these six roles.

Moreover, the results of the hierarchical modelling support the CIO role instrument as a valid and reliable second-order model. What is more, the results confirm the validity of this instrument (after minor changes were made to the wording of some of its items) to measure the CIO role in different types of industries such as finance, mining and manufacturing, rather than solely the healthcare sector in which it was developed. That finding is consistent with the results of Seddon, Walker, Reynolds and Willcocks (2008).

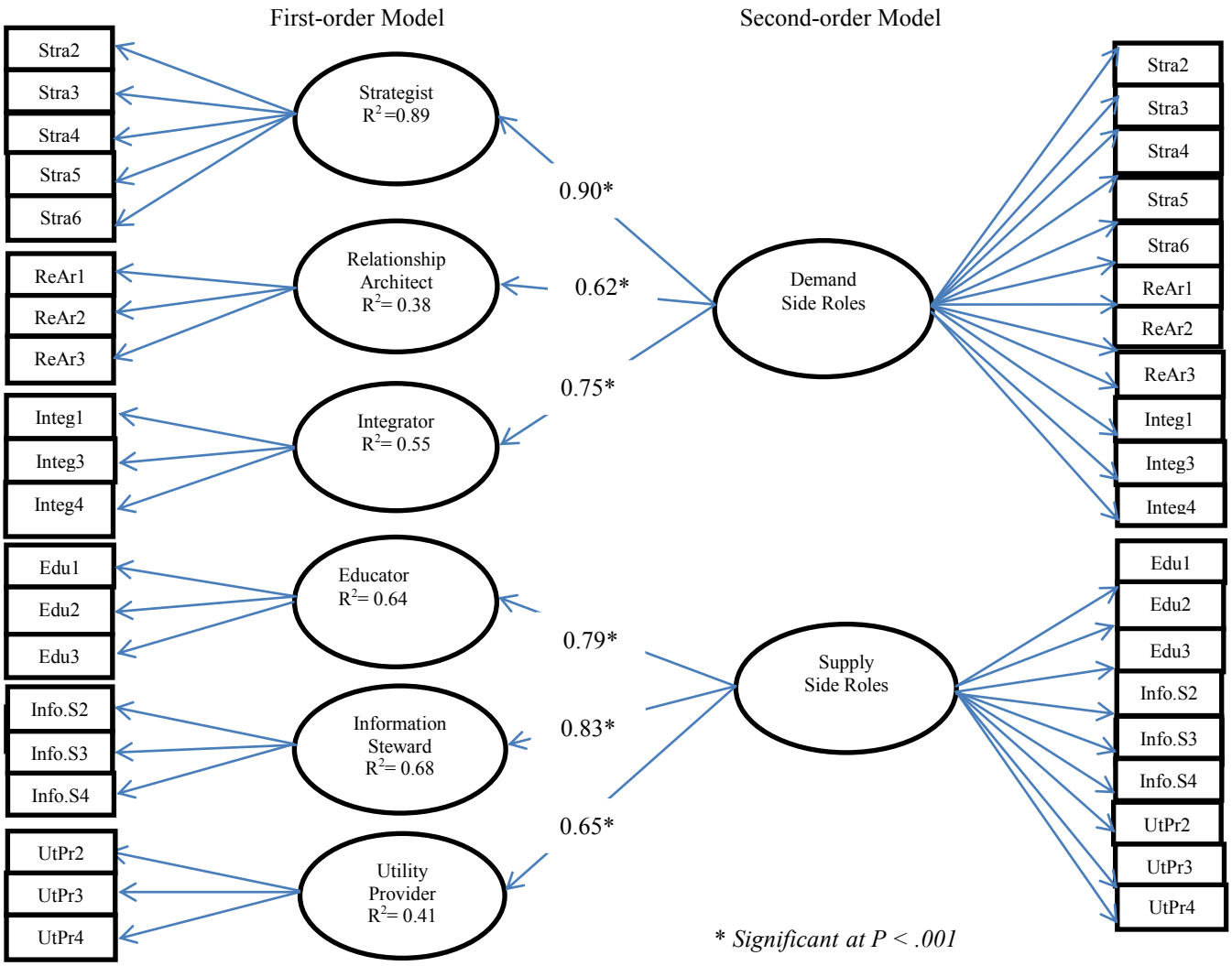

Figure 1 Hierarchical Model of CIO Role Expectations Instrument

The broad range of industries represented by the respondents enhances the generalizability of the CIO role instrument. Establishing that the CIO roles can be modelled as six distinct first-order factors and two distinct second-order factors provides greater clarity on how the CIO might perform their duties. This research provides support for the notion that the CIO role is actually configurations of distinct roles (or multidimensional construct) that are split between the operational and strategic IT needs of an organisation. This research supports the concept of a duality of high level roles, categorised as supply and demand side roles (Broadbent & Kitzis 2005; Mark & Monnoyer 2004).

The implication of this finding is that in terms of recruitment of CIOs and professional development, organisations need to balance the focus on operational vs. strategic roles. When CIOs are appointed, they need to establish their credibility and 'keep the lights on' but when trust is secured, they can drive strategic objectives for IT to add value to the organisation. This finding may support the proposal by Beatty et al. (2005) to split the IT leadership into two positions, with the CIO looking after the strategic aspects while the Chief Technology Officer (CTO) manages the operational side of IT. Furthermore, providers of professional development for CIOs need to incorporate both technical/operational and strategic/business knowledge and skills in their programs.

This study has contributed empirical evidence to CIO role theory and practice. From the theoretical perspective, this study has validated a recent CIO role measure, so that IS researchers can use this instrument in different contexts with confidence. This study has also added another example of how to use SEM as a contemporary method to validate and test the hierarchical models of IS instruments. In addition, the results of this study provide evidence on the configuration of roles that the CIO performs and the nature of these roles (technical vs. strategic) which contributes to clarifying the ambiguity surrounding this central role. Some gaps in the literature have been identified by this study in terms of clarifying the Information Steward and the Relationship Architect roles of the CIO.

CONCLUSION, LIMITATIONS AND FUTURE RESEARCH

To summarise, the analysis proves that the CIO role expectation instrument has exhibited solid validity and reliability despite some minor weaknesses. The results also demonstrate the possibility to model the constructs of this instrument in different null and hierarchical models, and the validity of this instrument to measure the CIO role in different types of industries not just the healthcare sector in which it was developed.

Some study limitations should be acknowledged. The findings representing the perceptions of Australian CIOs might not match the perceptions of CIOs in other countries. Although this study considered internal validity and reliability, construct validity was not addressed. For example, Cronbach and Meehl (1956) suggest nomological validity. This requires linking the constructs of this instrument with an exogenous construct in a nomological network and then assessing its construct validity within a structural model. Nomological validity was not assessed due to the lack of data measuring a suitable endogenous variable which could be used to test the relationship between the two constructs. The nomological network could comprise other personal and/or organisational factors such as the CIO's capability, productivity, firm performance, and firm profitability.

This study has identified some gaps that warrant further research. More studies are required to re-examine the four roles of the CIO as Relationship Architect, Integrator, Information Steward and Utility Provider as that could help to improve the CIO role measurement in regard to those four specific CIO roles. Further research is also required to explore whether a new role expectations for the CIO may have become relevant after 2006 when the original instrument was developed.

To conclude, we achieved the aim of this study to critically examine the psychometric properties of the CIO role expectations instrument, and to assess and compare different types of null and hierarchical models. We hope that our operationalisation of a configuration of CIO roles and our findings will encourage other researchers to pay more attention to the vital roles of the CIO, and that practitioners find the results relevant.

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