

A STRUCTURAL MODEL OF THE INFORMATION SYSTEMS PROFESSIONAL

Comparing practitioners, employers, students, and academics

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Abstract: This paper reports the identification and modelling of four latent variables in the makeup of the professional repertoire of information systems professionals. The relative importance of work experience, soft skills, IS education, and non-IS education to four stakeholder groups, IS employers, professionals, students, and academics, is graphically and quantitatively represented through a second-order structural equation model. The model is simultaneously tested against the four stakeholder groups, the fit measures are the same for each of them, providing a commensurate basis for comparison. The fit measure values indicate an excellent fit, within accepted limits. The model provides a quantitative basis for identification of the relative importance of the respective variables to the education and career development of IS professionals. The model also includes features of the working environment which may influence the career choices and progress of IS graduates. Analysis of the shifts in importance attached to latent variables between groups may provide improved understanding of changing values and perceptions of IS professionals as careers develop and as individuals change stakeholder group membership.

Key words: Information Systems, IS professional, IS graduates, technical skills, soft skills, hard skills, structural model.

1 INTRODUCTION

The preparation, quality, and expectations of new information systems (IS) graduates continues to be the focus of many discussions, conferences, workshops, and publications by IS practitioners, employers, students, and academics.

Employers and experienced practitioners are often critical of a lack of practical experience or unrealistic views and expectations perceived to be held by some new graduates. Students and new graduates necessarily lack real world work experience, yet they sometimes have unrealistically high expectations about their immediate value. Academics continually revise curricula to accommodate change and growth in the body of knowledge and the skills that they believe are needed by students preparing for entry into professional IS roles.

How do the perceptions and needs of stakeholders change as careers develop and mature? What are the “essential” bodies of knowledge, skills, and personal characteristics that are essential for successful IS professional work? How do the relative importance of *work experience*, *soft skills*, *IS education*, and *non-IS education* differ across different groups.

2 PREVIOUS STUDIES

Numerous studies of the skill requirements of IS graduates, including soft skills, hard skills, and job features that help motivate IS professionals are available. (Van Slyke, Kittner *et al*, 1997; Young (1996).

Some compare various stakeholders such as academics and industry, or student perceptions. In the main, these studies are descriptive in nature covering curriculum emphasis, importance of skills rated in order of importance (Williams, 1998; Wong, 1996; Orr, 2000; Lee & Koh, 2002; Goles, 2001; Farwell, Lee *et al*, 1993, 1995).

Interpersonal skills and technical skills are recognised as possessing equal importance for IS professionals. (Young & Keen, 1997) IS students must develop “soft” skills and abilities in various areas including teamwork, creativity and communication.

Determining those skills employers of new IS graduates seek is important for educators in designing curricula and advising students. Van Slyke (1997) found that specific technical skills were less important than basic technical skills and non-academic skills.

Doke and Williams (1999), in a study across various IS job classifications, found that systems development skills and interpersonal

skills were common across classifications but programming skills were more important for entry level IS positions.

Core curriculum requirements have been set in association with professional bodies in Australia (Underwood, 1997) and the USA (Gorgone, Feinstein *et al.*, 1997). However, it has been suggested that course requirements surrounding the IS 2002 model curriculum (ACM-AIS, 2002) as it stands probably contains more technical material than can be covered in an undergraduate degree program (Beachboard & Parker, 2003).

Yet as Ross & Ruhleder (1993) note IS education often is seen as concentrating too much on a narrow set of technical skills and suggest that the IS curriculum should concentrate on developing technical & business skills. Others (Ashley & Padgett, 1997; Turner & Lowry, 2001) have shown that despite the call from IS employers for more business orientated skills in graduating IS students, core business subjects do not rate highly.

Technical skills are not the total answer in preparing IS professional (Ross & Ruhleder, 1993). They suggest that programs aimed at developing IS professionals of the future must cover a wide range of skills and assist the integration of these skills in complex environments. Little, Granger *et al.*, (1999) suggest that it is not sufficient for IS graduates to just possess technical capabilities but should be aware of the need for professionals to take responsibility for their work and the importance of appropriate ethical behaviours. They further suggest a need to include these aspects in the curriculum of current IS programmes. They identify an “industry-academic gap” that leads to dissatisfaction amongst employer groups with IS graduates (Little, Granger *et al.*, 1999).

It is indicated above that there is an interaction between the competing aspects in the development and education of IS graduates. How can these interactions be measured? The purpose of this paper is to present the results of a study utilising structural equation modelling methods to develop and validate a model that illustrates the possible relationships between these areas and the emphasis that students and IS decision makers place on them.

3 METHOD

A multipart questionnaire was developed to solicit the views of four different groups of stakeholders regarding the importance of academic and useful adjunct skills and abilities areas included in information systems degree programs. Drawing on previous surveys (Cheney, 1988; Cappel, 2001/2002; Farwell, Lee *et al.*, 1995; Leitheiser, 1992; Leonard, 1999; Snoke & Underwood, 1998a, 1998b; Tang, Lee *et al.*, 2001; Van Slyke, Kittner *et*

al, 1997; Trauth, Farwell *et al*, 1993) the instrument developed for this study included some additional items in the area of job features and conditions. Items were organised into several sections: demographic data, IS and business computing related skills, non-IS academic subjects, soft skills and personal characteristics, and workplace conditions and incentives.

Four variations of the instrument were developed and administered to the four stakeholder groups as follows:

1. Students were senior undergraduate information systems students in three universities in Victoria, Australia. Of a total of 300 surveys distributed to students during regular classes, 254 usable responses were received, a response rate of 84.6 percent.
2. Academics were those teaching IS subjects at Australasian universities were invited to participate by email containing a hotlink to the on-line form. A total of 396 emails were sent and 195 responded with usable replies, a response rate of 49.2 percent.
3. IS Practitioners were employed in an IS/IT capacity in Australia. One thousand two hundred questionnaires were delivered by email. A total of 136 usable responses were returned, a response rate of 11.3 percent.
4. IS managers and decision makers were those in a supervisory or managerial role responsible. One thousand seven hundred and eighty questionnaires were distributed by email. The response for this survey resulted in 153 returns with 138 usable, a 7.7 percent response rate.

4 ANALYSIS

4.1 Factor Analysis

Nine different factors were identified through exploratory factor analysis using PCA analysis with Varimax rotation. Two items were concerned with the IS job and its features, two were concerned with soft skills and personal qualities and five were concerned with educational matters from IS technical areas (three items) and non-IS academic areas (two items).

Questions that did not clearly load onto a single factor or did not have a value of at least 0.5 were excised from analysis. Item reliability was tested using Cronbach's α . Item reliability was good with the overall value for each subscale exceeding recognised benchmark value of 0.7 (Cronbach, 1951).

Summated scales were computed using a weighted mean approach (Holmes-Smith & Rowe, 1994; Hair, Anderson *et al*, 1998) where the mean scores are multiplied by their respective factor loadings, summed, and divided by the sum of the factor loadings. This procedure ensures that the

factor loadings are properly and fully taken into account when computing the summated scales.

As a result, nine separate factors in four separate areas of interest were identified. Two factors SF1W and SF2W were identified as soft skills and these were measured by eight questions. Two factors WF1W and WF2W concerned work related incentives and these were measured by seven questions. Two factors OAF1W and OAF2W measured by eight questions were identified as non-IS academic subject areas and three factors F1W, F2W and F3W were identified as IS academic subjects, measured by eight questions. An interpretation of these factors is given in Table 1 below.

Factor	Interpretation	Emphasis
F1W	IS academic subjects	High level applications
F2W	IS academic subjects	Design and development
F3W	IS academic subjects	Web related applications
OAF1W	Non-IS academic subjects	Inwardly focussed core non-IS business subjects
OAF2W	Non-IS academic subjects	Outwardly orientated non-IS subjects
SF1W	Soft skills	Get on with people, communicate or stand-out
SF2W	Soft skills	Skills acquisition and able to do job
WF1W	Work related incentive	Environmental and comfort
WF2W	Work related incentive	Reward related (hygiene) factors

Table 1: Factor Interpretations

4.2 Structural Modelling

The model was developed using AMOS R5. The structural model has four latent variables. These are *soft skills* referring to soft skills such as interpersonal skills and team work; *IS ed* referring to the IS education skills outcomes and technical skills such as web development, analysis and design; *non-IS ed* referring to non-academic subjects such as accounting, economics and commercial law, and finally *work aspects* referring to aspects of the IS/IT work environment that may influence the professional. The dependent variable, *IS Professional*, is the combination of soft skills, education and work environment.

Appropriateness of the model structure has been discussed elsewhere (Turner, Fisher & Lowry, 2004) and validated against independent groups. A group model was tested against sets of independent data from four stakeholder groups: students, academics IS decision makers and IS

managers. The values of the relative importance between latent variables expressed by the four stakeholder groups are shown below.

The fit parameters for the model in Figure 1 indicate an excellent fit and are within the acceptable levels (Schumaker 2004). As the model is being simultaneously tested against four groups, the fit measures are the same. The model fit values for the four stakeholder groups are: GFI=0.964, AGFI=0.934, TLI=0.974, RMSEA=0.018 (range LO90=0.00, HI90=0.028), RMR=0.027, $p=0.051$ and CMIN (discrep) =1.24. These values all indicate the model fit is sound. Standardized residual covariance values between indicators are each below the critical value suggest by Hair, Anderson *et al*, (1998) of 2.58 supporting the fit of the model to the data.

With the exception of the path WF1W<---work_aspects which is not significant, each of the regression weights is significant at $p<0.001$. Table 2 shows the standardised regression coefficients determined for the model. These standardized regression coefficients are significant at $p<0.001$ with critical ratios great than 2.

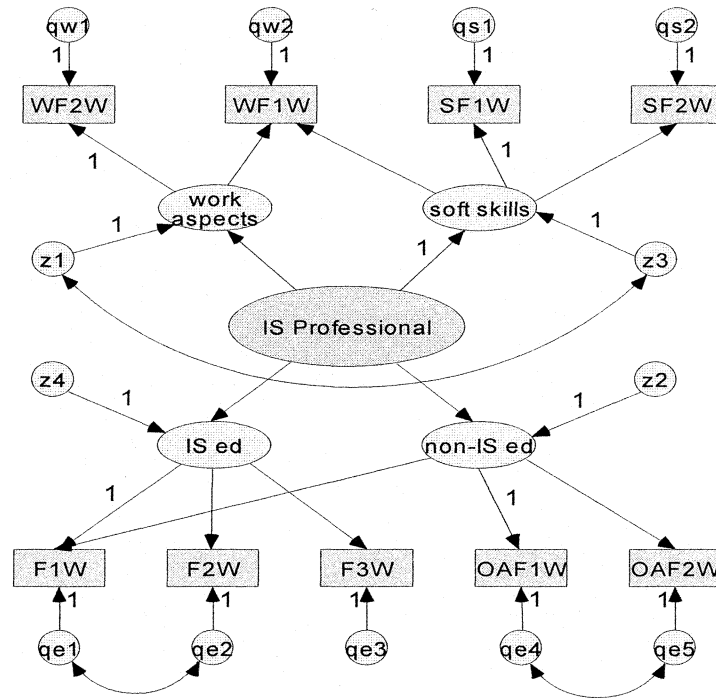


Figure 1: Model Path Diagram

Standardized Regression Weights

Path			Students	Academics	IS Practitioner	IS Decision Makers
non-IS ed	<---	IS Professional	0.96	0.76	0.96	0.72
IS ed	<---	IS Professional	0.85	0.82	0.32	0.70
soft skills	<---	IS Professional	0.88	0.82	0.85	0.76
work_aspects	<---	IS Professional	0.87	0.57	0.42	0.61
SF2W	<---	soft skills	0.63	0.55	0.61	0.54
F1W	<---	IS ed	0.32	0.38	0.48	0.43
F3W	<---	IS ed	0.56	0.67	0.70	0.73
OAF2W	<---	non-IS ed	0.63	0.60	0.57	0.78
SF1W	<---	soft skills	0.72	0.65	0.76	0.62
F2W	<---	IS ed	0.53	0.54	0.66	0.64
OAF1W	<---	non-IS ed	0.46	0.48	0.42	0.62
WF1W	<---	work_aspects	0.02	0.08	0.08	0.10
WF2W	<---	work_aspects	0.61	0.84	0.75	0.98
F1W	<---	non-IS ed	0.33	0.33	0.32	0.38
WF1W	<---	soft skills	0.57	0.40	0.49	0.43

Table 2: Standardized Regression Weights

Regression weight values below 0.3 are weak, between 0.3 and 0.5 as mild and above these values as strong (Holmes-Smith, 2000). From Table 2 below it can be seen that most regression weights are mild to strong and above 0.3. Those below 0.3 include the path WF1W←work_aspects which suggests that this is not regarded as a work related feature but as a soft skill. Squared multiple correlations presented in Table 3 are generally above the recommended minimum value of 0.3 suggested for good item reliability (Holmes-Smith, 2000).

Squared Multiple Correlations

Variable	Students	Academics	IS Practitioner	IS Decision Makers
work_aspects	0.41	0.32	0.17	0.37
non-IS ed	0.87	0.57	0.93	0.51
IS ed	0.71	0.67	0.10	0.50
soft skills	0.80	0.67	0.73	0.58
OAF1W	0.24	0.23	0.18	0.39
F1W	0.41	0.41	0.42	0.49
F2W	0.28	0.29	0.44	0.41
F3W	0.31	0.45	0.49	0.53
OAF2W	0.40	0.36	0.32	0.60
SF2W	0.38	0.31	0.37	0.29
SF1W	0.51	0.43	0.58	0.39
WF1W	0.38	0.19	0.30	0.24
WF2W	0.70	0.71	0.56	0.96

Table 3: Squared Multiple Correlation Values (R²)

As a further indicator of model acceptability, standardized residual covariance values between indicators are each below the critical value of 2.58 as suggested by Hair, Anderson *et al*, (1998) and are significant at the 0.05 level.

IS practitioners appear to place a low emphasis on the value of IS education with the regression weight IS Professional->IS Ed being quite low and the R^2 value indicating a very low explained variance.

Most of the R^2 values were similar for most groups, with some interesting exceptions. The work_aspects factor is of similar importance to all groups except IS Professionals. Similarly, all groups except IS Professionals place similar value on non-IS education. All groups except IS Decision Makers place a relatively low value on OAF1W, non-IS academic subjects. IS Decision Makers place a much higher value on OAF2W, outwardly focused non-IS subjects which are those most directly connected with soft skills development.

Not surprisingly, all groups place a high value on F1W, high level application IS Academic Subjects. Students and academics place a somewhat lower value on F2W, design and development IS Academic Subjects. Web related subjects, F3W, are also highly rated by all groups.

All groups place high value on work related factors, WF2W, resulting in the highest R^2 values across the table. The high value ($R^2 = 0.96$) from the IS Decision Makers group suggests that they view components such as salary, company shares, company cars, and other hygiene factors as of paramount importance to a greater degree than do the other groups of stakeholders.

5 DISCUSSION

Most research published in the area of skills is based on one view of the IS professional. A number of studies have been published on technical skills required as perceived by the various stakeholders or comparing the perceptions of stakeholders. There is also a body of work illustrating the growing importance of soft skills, again from the perspective of various stakeholders. A number of studies have also been published concerning the effects of the working environment on IS professional perceptions of their work situation. Another body of work has been presented illustrating the importance placed on business related skills acquired as part of the IS graduate's preparation.

To the authors' knowledge, no research has appeared which links these areas together in a dynamic structural model. The research reported in this paper addresses this issue. The findings suggest that there is a stable and interactive relationship between these four factors. The model shows the

relative importance and strength of the factors. Development of a structural model advances our knowledge of the constellation of skills, knowledge, and values held by IS stakeholders beyond conventional factor analysis which does not allow for comparison of the significance of these factors. For the first time it is possible to show the interacting relationships of the four factors along with measures that suggest their relative importance to each of the stakeholder groups.

The model shows a good fit for all four sets stakeholder data. An important requirement for any model is that it is able to fit to independent sets of data, a requirement satisfied in this case.

The results presented here indicate that the perceptions of four stakeholder groups can be described by a second order, four latent factor model described in terms of hard IS skills, non-IS educational skills, personal attributes and soft skills and the job conditions.

It should be stressed that the model is not necessarily the only one that can fit the data. It does however show that it is possible to develop a comprehensive model to explain the various attributes of the IS professional. Ultimately it is hoped that such a model can be useful in improving the career prospects of new graduates and as providing indicators of shifting emphasis and value of these factors as individuals change stakeholder groups as their careers develop.

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