5 Data Analyses and Results

Chapter 4 was dedicated to the research methodology, and provided the methodological background to this research study. Chapter 4 also addressed the development of the survey instrument and the data collections. This chapter focuses on data analysis, including data descriptive statistics, constructs and sub-constructs validation and hypothesis testing. It is organized as follows: Section 5.1 articulates the data analysis strategy which guided the data analysis processes; Section 5.2 focuses on sample demographics and descriptive statistics; Section 5.3 provides an assessment of the measurement models, i.e., evaluation of constructs validity; Section 5.4 presents the assessment of the structural model and the hypothesis testing; Section 5.5 summarizes the Chapter.

5.1 Data Analysis Strategy

This section describes the data analysis objectives, discusses the appropriate procedures for the data analysis, and provides the criteria for justification of the data analysis.

Following Sekaran (1992), data analysis serves three objectives:

- Acquiring a feel for the sample data by using data descriptive statistics.
- Assessing the goodness of the data by assessing the measurement model, and
- Testing the hypotheses developed for this research by structural model testing.

An analysis strategy was used to guide the data analyses in this research. Three statistics analysis software packages, SPSS 11, LISREL8, and SmartPLS1.01, were chosen for the data analyses. Of these,

- SPSS 11 was used to investigate descriptive statistics of the sample data, and calculate alpha coefficients for scale reliabilities.
- The covariance-based SEM, LISREL, was used to examine the goodness of data by testing the measurement models, and assessing construct validity.
- SmartPLS was used to test the structural models and hypotheses.

The data analyses were conducted sequentially. Descriptive statistical analysis was carried out to investigate the characteristics of the sample data, and evaluate the statistical assumptions for applying a covariance-based SEM technique (LISREL) for further analyses.

The validation of survey scales followed the procedure employed in previous research by Salisbury, Chin et al. (2002). An assessment of convergent, discriminant, and nomological validity was conducted using the confirmatory factor analysis (CFA) technique (refer to Section 4.3.1), as a practical and systematic approach to establish each form of validity through a sequential step of tests. In this research context, the nomological validity was not assessed until the structural model testing was undertaken, because there was no available nomological network.

CFA for convergent validity works in the following way. The researcher specifies a factors model, including factors, measures (or items) to the factors and linkages among the factors, based on previous studies or on theory. CFA tests the fit of that model against the given data set, and determines how well the model explains the sample data (Chin, Gopal et al. 1997; Goodhue 1998; Gefen, Straub et al. 2000). The convergent validity of a tested construct is established if all the item loadings are above 0.60, and the overall model goodness of fit indices are adequate (Chin, Gopal et al. 1997).

Discriminant validity is tested using χ^2 difference, the result of comparing the χ^2 measures for two analyses. In the first analysis, the constructs of interest are assumed to be identical by fixing the correlation between the constructs at 1.00, and then a χ^2 measure is calculated for the model. In the second analysis, the correlation between the constructs is released, i.e., allowed to be freely estimated; a new χ^2 can then be generated for the same model against the same dataset. There are no other differences in the model specification for the two analyses except for the correlation change. As a result, discriminant validity is suggested if the ratio of difference of the χ^2 values for two analyses to the difference in the degrees of freedom between the two models is greater than 3.84 (1 d.f., $\alpha = 0.05$) (Chin, Gopal et al. 1997).

As mentioned in chapter 4, LISREL is recommended as the preferred technique for construct validation via CFA because it can provide a more rigorous assessment of the

fit between the sample data and the measurement model (or the theoretical factorial structure), and enables assessment of the measurement properties of convergent validity and discriminant validity.

With respect to the model fit indices, the ratio of χ^2/df gives a rough indication that the model might fit the dataset. However, other overall goodness of fit indices, such as GFI, AGFI, NFI, CFI, RMR are recommended as being more appropriate to determine the quality of overall model fit (Hinkin 1998; Gefen, Straub et al. 2000). For practical purposes and as a rule of thumb, the following threshold values are applicable for the selected model goodness-fit indices in the analyses.

Statistic	Recommended Value	Abbreviation Expansion
χ^2		Smaller
χ^2 P-value	> 0.05 (Adams, Nelson et al. 1992)	Insignificance
DF		Degree of Freedom
χ^2/d.f.	< 5 (Salisbury, Chin et al. 2002)	
GFI	>0.90 (Gefen, Straub et al. 2000)	Goodness of Fit Index
AGFI	>0.80 (Gefen, Straub et al. 2000)	Adjusted Goodness of Fit Index
NFI	>0.90 (Tabachnick and Fidell 1996)	Normed Fix Index
CFI	>0.90 (Tabachnick and Fidell 1996)	Comparative Fit Index
RMR	< 0.10 (Salisbury, Chin et al. 2002)	Root Mean Residual

Table 5.1 Heuristics for Statistical Analyses

The PLS technique was chosen to test the structural model in this study for several reasons.

- Firstly, the nature of this study is primarily theory building and predictive rather than theory testing. Although this research is based on the previous studies of AST, the AST model has been extended to a new area, knowledge management.
- Secondly, PLS allows latent constructs to be modelled as either formative or reflective indicators.
- Thirdly, PLS requires fewer statistical assumptions of the data than does the covariance-based SEM technique, e.g., the assumption of multivariate normal distribution required by covariance-based SEM (see Section 4.3.4 for details).

Consequently, PLS was considered more appropriate for the structural model testing in this research, and was used to assess three structural models. In addition, the results

from model II testing were also used to examine the nomological validity of the constructs/sub-constructs, as a further confirmation of the validation conducted by CFA via LISREL. As PLS does not generate overall model fit statistics, the predictive validity is assured primarily by examining the R-square and the structural paths (Gefen, Straub et al. 2000).

As all the hypothesized relationships (i.e., between indicators and latent constructs and between latent constructs) to be tested in this study are directional, all probabilities of the hypotheses testing will be reported based on one-tailed t-tests (Tabachnick and Fidell 1996).The significance of hypotheses testing results is to be reported in four ways, based on p, the probability level (Perry 1998), namely:

Significant	$p \leq 0.05$.
Highly significant	$p \leq 0.01$.
Very highly significant	$p \leq 0.001$.

5.2 Sample Demographics and Descriptive Statistics

It is important to get a feel for the collected data and demographic characteristics of the respondents before formally conducting construct validation and hypothesis testing (Sekaran 1992). The demographic characteristics of the respondents for this study are addressed in detail in Section 5.2.1.

A feel for the data can be obtained by checking the central tendency and the dispersion, which may include statistics such as mean, mode, range, standard deviation and variance (Sekaran 1992; Zikmund 2000). The sample descriptive statistics are addressed in Section 5.2.2.

5.2.1 Demographic Characteristics

Sampling took advantage of the Internet and reached a large number of organizations in several countries including the USA, the UK, Canada, Australia, New Zealand, Germany, France, the Scandinavian countries and South Africa. The survey sample was cross-sectional, and spread across diverse industries as shown in Figure 5.1. The biggest industry sub-group was computer and telecommunications (23.2%), the second largest

was government departments (17.68%), followed by education/research (14.92%) and chemistry and pharmaceuticals (12.71%)

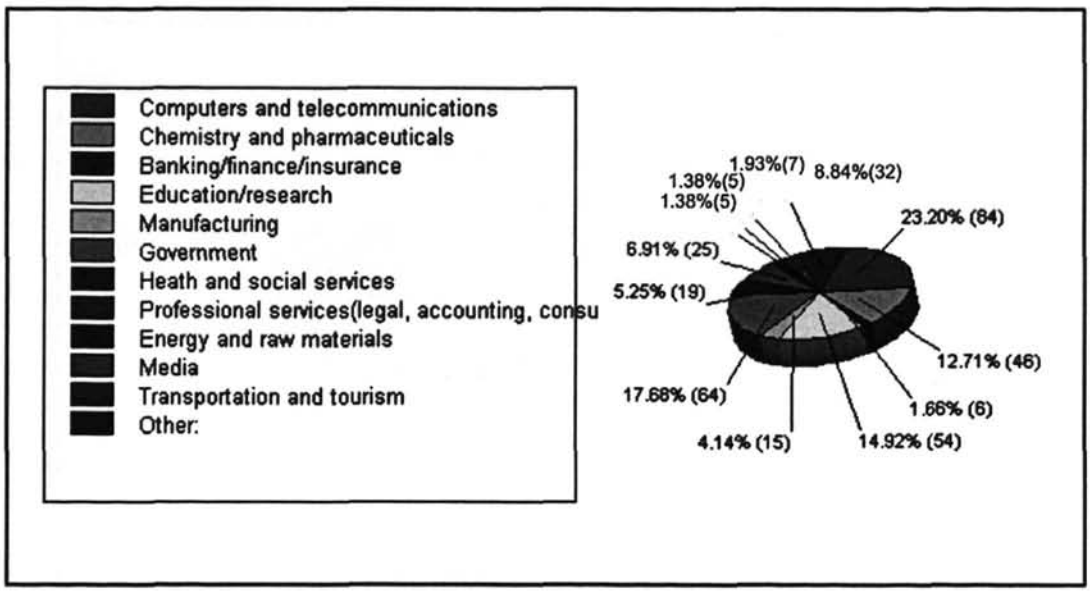


Figure 5.1 Sample by Industry

Whilst over 50% of the respondents came from multinational and global organizations, 47.49% of these respondents came from the organizations operated within one country. The size of respondents' organizations is shown in Figure 5.2. It will be seen that over 75% of the respondents came from organizations with over 100 employees.

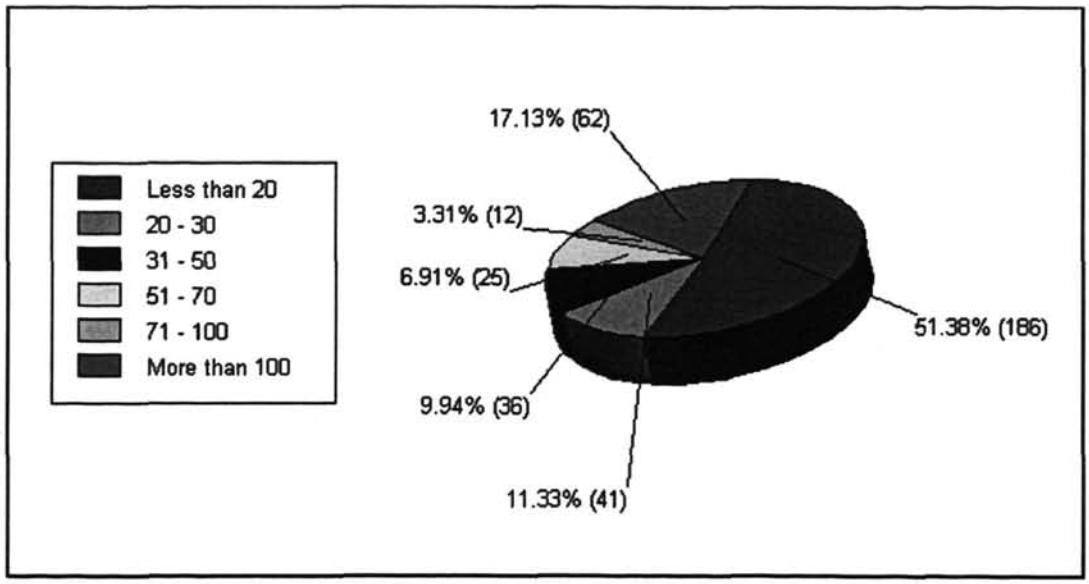


Figure 5.2 Size of Respondents' Organizations

Figure 5.3 shows that the sample group is highly educated, with over 62% of the respondents having postgraduate qualifications, and over 90% with a first degree or

better. The characteristics of the sample are typical of knowledge workers (Drucker, 1999).

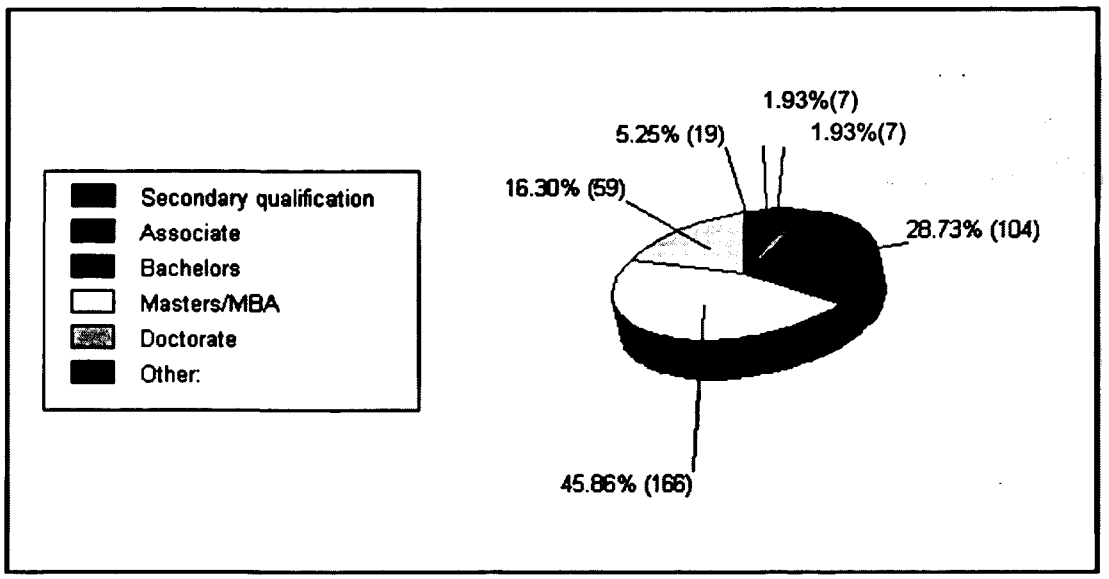


Figure 5.3 Respondents' Highest Education Level

The positions held by the respondents were professionals (54.7%) as the major sub-sample, followed by managerial staff (20.72%) and academics (10.22%). More details of the positions held by respondents are presented in Figure 5.4.

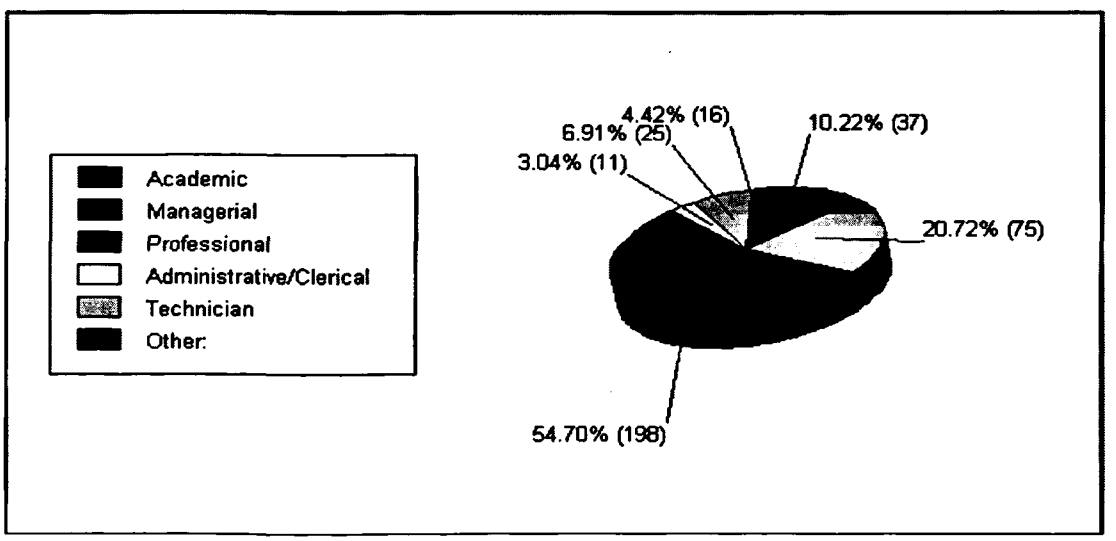


Figure 5.4 Positions of Respondents

In terms of job titles, 17.68% of the respondents reported their jobs as managers, 12.34% as directors, 12.15% as project managers and 11.05% as group leaders. More details of respondents' job titles are shown in Figure 5.5.

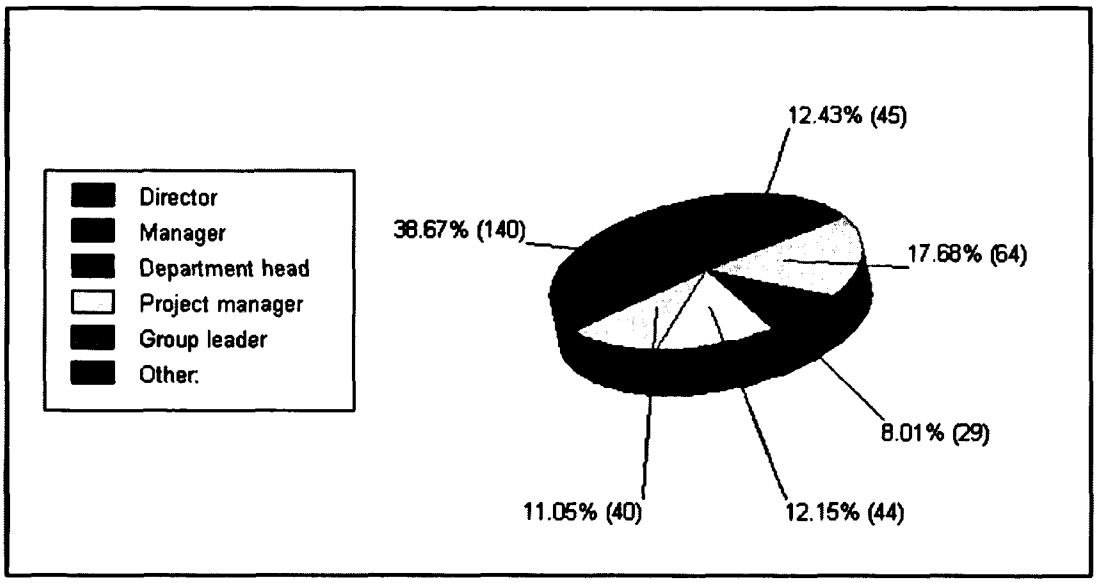


Figure 5.5 Job Titles of Respondents

Sveiby and Simons (2002) suggest that the age of knowledge workers is a significant factor in affecting collaboration and knowledge sharing. The age distribution of respondents is shown in Figure 5.6. The distribution of ages of respondents shows a balance across three age groups, i.e., 30 – 39 years, 40 – 49 years, and 50 – 59 years, with only 11.88% of the respondents being less than 30 years old.

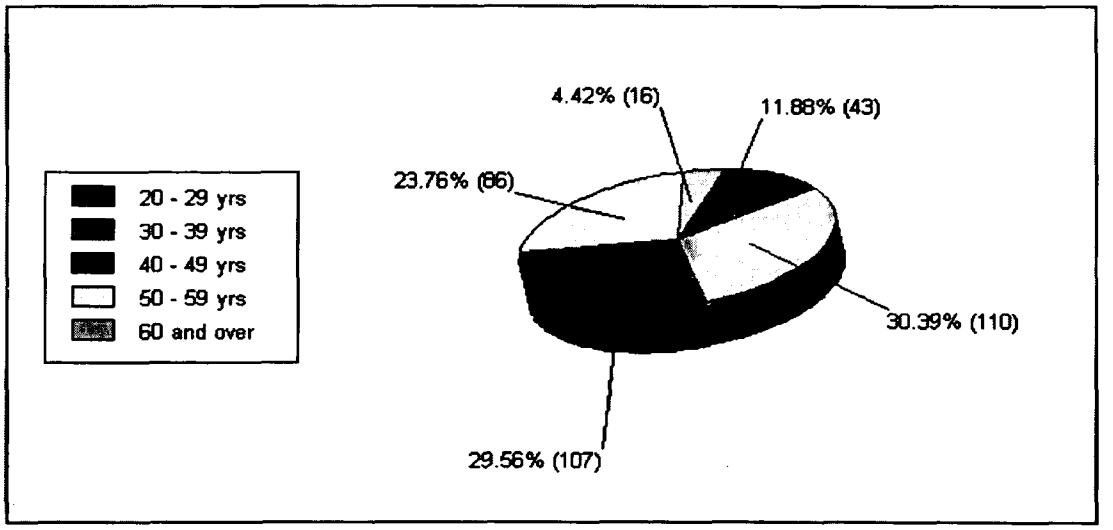


Figure 5.6 Age Distributions of Respondents

The investigation results also show that 28.73% of the respondents are female, while 71.27% of the respondents are male (see Figure 5.7). In terms of the length of time respondents had been with their current organization, 78% had been there over two years and approximately 50% of the respondents had been there for more than five years.

More details are shown in Figure 5.8. The sample shows stable employment status.

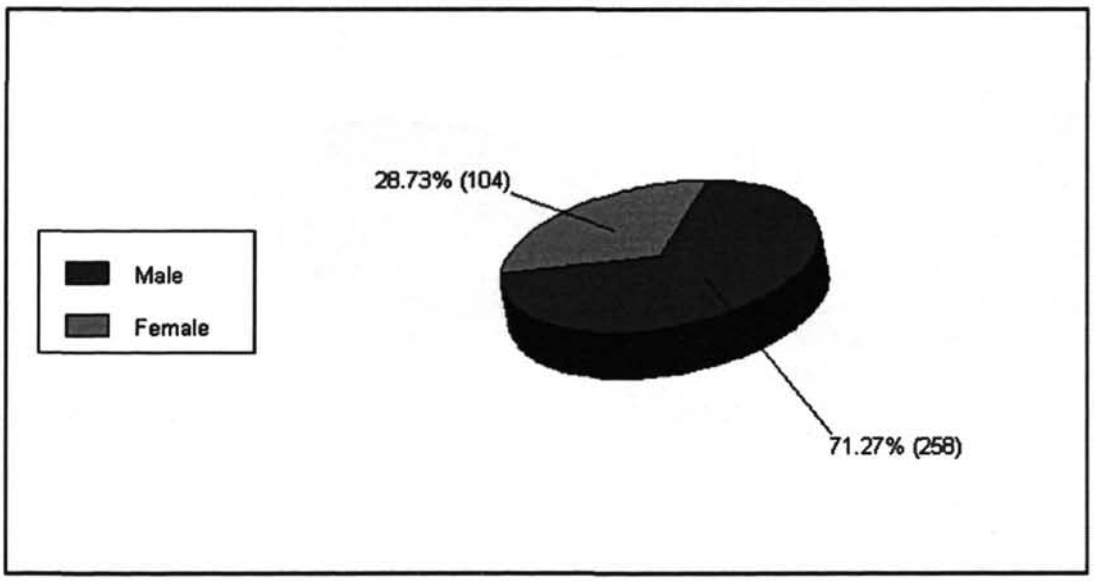


Figure 5.7 Gender Statistics

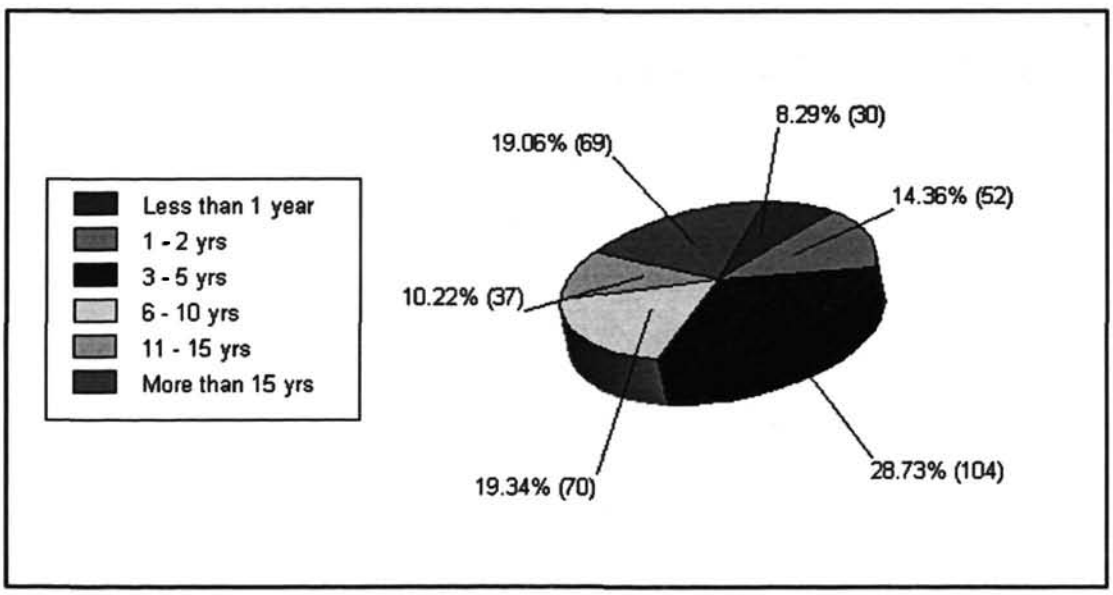


Figure 5.8 Number of Years with Current Organization

Figure 5.9 shows the respondents' experience with the KMS in their current organizations. It will be seen that most respondents had three or more years experience in using KMS, so the technologies themselves were not new to a majority of the subjects.

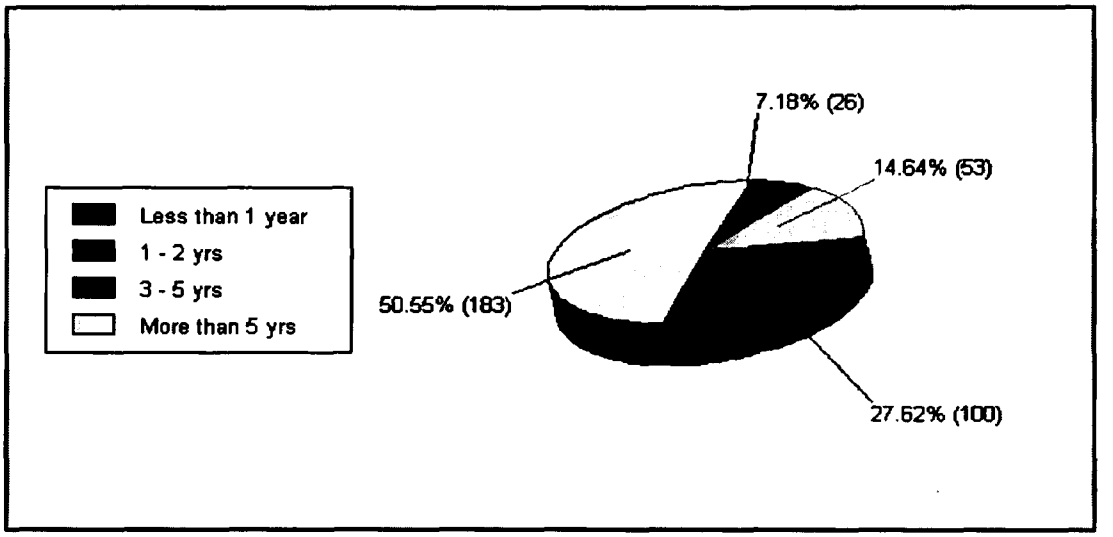


Figure 5.9 Length of Use of KMS within Current Organization

In sum, this sample could be interpreted as a typical group of knowledge workers in terms of their educational background, job titles, duties and positions in their respective organizations. Analysis of the characteristics of the survey participants shows several interesting points:

- The sample subjects are highly educated.
- The sample involved a variety of different industries and organizations, with a diversity of company sizes.
- The sample subjects had been using KMS for some time.
- The participants had been working for their current organization for some time.
- Over 50% of the people in the sample were professionals.

5.2.2 Descriptive Statistics

The characteristics of the sample in terms of mean, standardized error of mean, median, mode, standard deviation, variance, skewness and kurtosis for all the constructs and subconstructs involved in this study have been calculated using SPSS 11. The outputs of the software package are shown in Table 5.2, Table 5.3, and Table 5.4 respectively

Variables / Statistics		EOU	PU	NORMS_S	MORMS_W	INFO_C	INFO_S
N	Valid	362	362	362	362	362	362
Mean		5.997	6.095	6.040	4.311	5.409	4.982
Std. Error of Mean		.0471	.0419	.0516	.0839	.0522	.0587
Median		6.000	6.000	6.000	4.000	5.500	5.250
Mode		6.00	6.00	6.00	4.00	6.00	6.00
Std. Deviation		.896	.796	.982	1.597	.992	1.117
Variance		.802	.634	.965	2.551	.985	1.247
Skewness		-1.548	-1.060	-1.458	-.228	-.962	-.658
Kurtosis		3.536	1.241	3.042	-.531	1.198	.055
Range		5.00	4.00	6.00	6.00	6.00	5.50
Minimum		2.00	3.00	1.00	1.00	1.00	1.50
Maximum		7.00	7.00	7.00	7.00	7.00	7.00

Note:	
EOU: Perceived Ease of Use	PU: Perceived Usefulness
NORMS_S: Perceived support by management and peers in using KMS	NORMS_W: desire to please management and peers by using KMS
INFO_C: Information Content Quality	INFO_S: Information Services Quality

Table 5.2 Descriptive Statistics: Measures of Central Tendency

Table 5.2 demonstrates the descriptive statistics for variables of EOU, PU, NORMS_S, NORMS_W, INFO_C, and INFO_S. The EOU, PU, NORMS_S, NORMS_W, INFO_C, and INFO_S measured on a seven-point scale. It can be seen that the mean of EOU (mean= 6.0 and mode=6.0 on a seven-point scale) and PU (mean= 6.1 and mode=6.0 on a seven-point scale) are rather high, suggesting that most of the respondents perceive their KMS as being both easy to use and useful. The high mean on support from management and peers in using KMS (mean=6.0 and mode= 6.0 on a seven-point scale) implies that the support from management and peers in terms of using KMS is strong, whereas the majority of respondents also feel willing to use KMS for pleasing the management and peers (mean=4.3 and mode= 4.0 on a seven-point scale). Whilst the mean of 5.4 (mode=6.0) on a seven-point scale for information content quality suggests that most of the respondents are quite satisfied with the information content quality provided by their KMS, the mean of 5.0 (mode=6.0) on a seven-point scale for information services quality indicates that majority of respondents appreciate high quality in information services.

The variances for all the variables are small except for the NORMS_W, indicating that most respondents are relatively close to the mean on these measured variables except

for the NORMS_W. The variance of 2.55 for NORMS_W, however, is slightly greater.

Variables / Statistics		INFO_USE	CC_USE	SC_N	SC_T	SC_V
N	Valid	362	362	362	362	362
Mean		3.832	4.064	5.568	5.231	5.068
Std. Error of Mean		.041	.043	.059	.056	.065
Median		4.000	4.250	6.000	5.333	5.000
Mode		4.00	5.00	6.00	6.00	6.00
Std. Deviation		.787	.812	1.114	1.073	1.236
Variance		.620	.660	1.241	1.150	1.528
Skewness		-.496	-.724	-1.038	-.756	-.824
Kurtosis		.021	-.078	1.022	.940	.793
Range		4.00	3.75	5.00	6.00	6.00
Minimum		1.00	1.25	2.00	1.00	1.00
Maximum		5.00	5.00	7.00	7.00	7.00

Note:

INFO_USE: Information-related Usage	SC_N: Personal social networks
CC_USE: Interaction-related Usage	SC_T: Trust building
	SC_V: Shared vision

Table 5.3 Descriptive Statistics: Measures of Central Tendency (con't)

Table 5.3 shows the descriptive statistics for the Performance-related use of KMS (with two dimensions, i.e., INFO_USE and CC_USE) and Social Capital development (with three components, i.e., SC_N, SC_T, and SC_V). The information-related use of KMS (INFO_USE) and interaction-related use of KMS (CC_USE) were measured on a five-point scale, whereas the personal social networks (SC_N), trust (SC_T), and shared vision (SC_V) were measured on a seven-point scale. It can be seen that the means of both INFO_USE and CC_USE are rather high (3.8 and 4.1 on a five-point scale), indicating that the KMS has being used intensively by most respondents both in seeking information, and in communicating and collaborating with peers. The means of SC_N, SC_T, and SC_V are also very high (5.57, 5.23, and 5.07 respectively on a seven-point scale), which suggests that most respondents have perceived positively the impacts of KMS use on the development of social capital. The variances for INFO_USE and CC_USE are small, indicating that most respondents are very close to the mean on the measured variables. However, the variances for SC_N, SC_T, and SC_V (1.24, 1.15, and 1.53 respectively) are slightly greater, indicating that the response might be somewhat dispersed for some variables, such as SC_V.

To sum up, the majority of respondents have strongly perceived their KMS being easy to use and useful. Most respondents have also perceived that their use of KMS was encouraged by their management and peers. Furthermore, the perceived quality in both information content and information services for most respondents is quite high. The data also suggests that KMS are used intensively by most respondents within organizations. In particular, the interaction-related usage is high. The impacts of KMS use on the development of social capital are perceived positively by most respondents. Furthermore, the impact of KMS use on personal social networks is perceived to be slightly greater than that of the other two aspects of the social capital development, trust and shared vision.

Table 5.4 shows the descriptive statistics for the KMS function –related usage. The KMS function-related usage was measured on a five-point scale, but for any function that was not available, respondents ticked "N/A" (coded as 0). The functionality of KMS addressed in this study included email, video conferencing, knowledge repositories, information/knowledge distribution, expert locator, online discussion, virtual community, and virtual teams/collaboration.

Variables / Statistics		EMAIL_U	VCONF_U	KR_U	IKD_U	EL_U	ODF_U	VCOM_U	VT_U
N	Valid	362	362	362	362	362	362	362	362
	Missing	0	0	0	0	0	0	0	0
Mean		4.70	1.18	3.68	3.68	1.84	2.51	1.71	1.93
Std. Error of Mean		.028	.063	.054	.061	.077	.078	.080	.085
Median		5.00	1.00	4.00	4.00	2.00	3.00	2.00	2.00
Mode		5	0	4	4	0	3	0	0
Std. Deviation		.527	1.208	1.022	1.158	1.464	1.485	1.524	1.617
Variance		.278	1.459	1.045	1.342	2.144	2.206	2.322	2.616
Skewness		-1.536	.813	-.712	-1.024	.211	-.045	.461	.286
Kurtosis		1.452	-.227	.261	1.275	-.995	-.962	-.890	-1.122
Range		2	5	5	5	5	5	5	5
Minimum		3	0	0	0	0	0	0	0
Maximum		5	5	5	5	5	5	5	5

Note:	
EMAIL_U: Email	EL_U: Expert Locator
VCONF_U: Video Conferencing	ODF_U: Online Discussion Forum
KR_U: Knowledge Repositories	VCOM_U: Virtual Community
IKD_U: Information/knowledge Distribution	VT_U: Virtual Team / collaboration

(Source: Output of SPSS 11)

Table 5.4 Descriptive Statistics for Items of Function-related Usage of KMS

It can be seen that the means on email, knowledge repository, and information/knowledge distribution are high (4.70, 3.68, and 3.68 respectively on a five-point scale), indicating that most of the respondents use these functions heavily in their working life. The mean on online discussion forum is just about the average (2.51 on a five-point scale), suggesting that the online discussion is used moderately, following by the virtual team collaboration (mean=1.93 on a five-point scale). The means on video conferencing, expert locator and virtual community are rather lower (1.18, 1.84, and 1.71 respectively on a five-point scale), indicating these functions may not be used extensively in the organizations sampled or may not be available in some of the organizations. The minimum of 3 and maximum of 5 for email use indicate that email is the most extensively and heavily used electronic communication and collaboration tool for all the respondents. The minimum of 0 for all other functions suggests that these functions might not be available for some of the respondents, whereas the maximum of 5 indicates that these functions could be used extremely heavily by other respondents.

In sum, it is clear that there exists a somewhat unbalanced use and availability of KMS functionality among the respondents. Some functions are used extensively and heavily but other functions are used fairly lightly, or even may not be available to some respondents. Email, knowledge repository and information/knowledge distribution are the top three functions that are used extensively by most respondents, online discussion is only used moderately, and the rest of the functions are not widely used and may not be available for some respondents.

The descriptive statistics for each manifest variable (i.e., scale item) can be found in Appendix III, Descriptive Statistics for Measurement Items calculated by LISREL8.72.

5.2.3 Evaluation of Assumptions: Sample Size and Multivariate Normality

The two SEM techniques have different requirements for minimal sample size. The covariance-based SEM needs at least 100-150 cases for a plausible analysis, while the minimal requirement for PLS ranges from 30 – 100 cases (Chin and Newsted 1999; Gefen, Straub et al. 2000). Examination of the sample (n= 362) showed that the sample size in this study was adequate to enable a reliable and accurate analysis for both covariance-based SEM and PLS.

Since the multivariate normality of measured variables is difficult to assess in practice, skewness and kurtosis have been suggested to justify the application of covariance-based SEM techniques, such as LISREL (West, Finch et al. 1995), as was discussed in Section 4.3.4

The skewness and kurtosis of the measured variables in the study have been computed through LISREL 8.72 (refer to Appendix III, Sample Statistics). An examination of the skewness and kurtosis of the measured variables indicated that the range of skewness was between -0.064 (Info_u3) and -1.973 (EOU1), whereas the range of kurtosis for the measured variables was between 0.090 (Info_s5) and 6.013 (EOU1). According to the rule of thumb suggested by West, Finch et al. (1995), if skewness <2 and kurtosis <7, the underlying distributions of measured variables can be considered not to be substantially non-normal, so the use of LISREL is regarded as appropriate. Consequently, the underlying distributions of the measured variables in this study can be considered to be not substantially non-normal, so reasonable and robust results can be expected from ML or GLS estimates of LISREL (West, Finch et al. 1995).

In summary, the data characteristics of the sample ensured the use of both LISREL and PLS were appropriate. Reliable and robust results can be expected from the analysis using both LISREL and PLS.

5.3 An Assessment of Measurement Models

According to the procedure described in Chapter 4, the validation process comprises two phases. An initial analysis of factor structure and reliabilities of the revised scales was conducted to refine the scales using SPSS 11, and then the measurement model was validated using LISREL. Two principles were applied to the validation process, i.e., the number of items required in each scale was not pre-specified so as to seek a smallest number of items in the scales, and an adequately over-identified scale (in a SEM sense) was required to enhance the scales' psychometric value. These considerations led to keeping at least three items (wherever possible), and at most six items for each scale.

5.3.1 Exploratory Factor Analysis (EFA) and Reliabilities

Since the survey instruments had been modified during and after the pilot test, it was necessary for a re-examination of the factorial structures and reliabilities of the revised scales to be conducted first.

Exploratory Factor Analysis (EFA)

An EFA was conducted to examine the factorial structure of the survey instruments for the multi-dimensional constructs, such as the Performance-related Use of KMS (KMS-use), Information Quality (INFOQ), and Social Capital Development (SC) by means of SPSS11.

As identified in the preliminary study, the scale for the Performance-related Use of KMS (KMS-use) comprised two dimensions, i.e., information-related usage, labelled by Info_Use, and interaction-related usage, labelled by CC_Use. Based on the preliminary study, the KMS-use scale was amended and consisted of eight items, four for the Info_Use (i.e., INFO_U1 ~ INFO_U4), and four items for the CC_Use (i.e., CC_U1 ~ CC_U4). Assuming a two-factor structure, the EFA was run on the KMS-use scale, and the results were shown in Table 5.5.

Item	Component	
	Factor 1	Factor 2
INFO_U1	-.115	.885
INFO_U2	.733	9.132E-02
INFO_U3	.155	.650
INFO_U4	.135	.731
CC_U1	.907	-7.411E-02
CC_U2	.663	.205
CC_U3	.791	.103
CC_U4	.857	-.100
Extraction Method: Principal Component Analysis. Rotation Method: Oblimin with Kaiser Normalization. Rotation converged in 5 iterations.		

Table 5.5 Factor Pattern Matrix 1 of KMS-Use

The outcomes show that a clear two factor structure exists within the scale without significant item cross-loading (i.e., all the cross-loadings were less that 0.4). Factor 1 is

'interaction-related use of KMS (CC_Use)', and factor 2 is 'Information-related Use of KMS (Info_Use)'. However, the fact that item INFO_U2 had a significant loading on factor 1 (interaction-related use of KMS) rather than factor 2 (Information-related use of KMS) resulted in difficulty in interpretation, as the item clearly referred to the information-related usage (information distribution). Therefore, the item was dropped. A FA was performed after removal of the item, and the outcomes are demonstrated in Table 5.6.

Item	Component	
	Factor 1 (CC_Use)	Factor 2 (Info_Use)
INFO_U1	-.132	.898
INFO_U3	.170	.643
INFO_U4	.157	.716
CC_U1	.854	-1.680E-02
CC_U2	.663	.220
CC_U3	.816	.107
CC_U4	.889	-.103
Extraction Method: Principal Component Analysis. Rotation Method: Oblimin with Kaiser Normalization. Rotation converged in 5 iterations.		

Table 5.6 Factor Pattern Matrix 2 of KMS-Use

The factorial structure shown in Table 5.6 is clear, expected, and interpretable. Factor 1 is 'interaction-related use of KMS', and factor 2 is 'Information-related Use of KMS'. An examination of the cross loadings suggested that all the cross loadings were reasonably low.

The Social Capital (SC) scales had been revised after pilot testing (see Table 4.12). The scales for the second data collection included ten items, namely two items for social networks, six items for trust development, and two for shared vision.

EFA was conducted several times on the SC scale for seeking a parsimonious and interpretable factor pattern structure. After dropping several inappropriate items, the final outcomes are presented in Table 5. 7.

Item	Component		
	Factor 1 (SC_T)	Factor 2 (SC_N)	Factor 3 (SC_V)
SC_N1	5.508E-02	.927	1.919E-02
SC_N2	4.054E-03	.912	-5.535E-02
SC_T5	.784	.173	-1.070E-02
SC_T6	.917	-3.963E-02	-3.648E-02
SC_V1	.262	-9.551E-02	-.793
SC_V2	-.110	.110	-.957
Extraction Method: Principal Component Analysis. Rotation Method: Oblimin with Kaiser Normalization. Rotation converged in 9 iterations.			

(Source: output of SPSS 11)

Table 5.7 Factor Pattern Matrix of Social Capital

The results in Table 5.7 show clearly the expected and interpretable three-factors structure, where factor 1 is 'Trust development' (labelled as SC_T), factor 2 is 'Social networks' (labelled as SC_N), and factor 3 is 'Shared vision' (labelled as SC_V). The cross loadings for all the items and factors are reasonable low (≤ 0.40) (Hair, Anderson et al. 1995).

Information Quality comprised two sub-constructs or dimensions, information content quality and information services quality. Ten items were used for measuring the two sub-constructs after the pilot study, namely three items for the information content quality and seven items for the information services quality.

The EFA was run several times on the scales, with two factors identified, and one item was dropped for each trial, in order to seek a parsimonious and interpretable factorial structure. The outcomes of the FA are presented in Table 5. 8.

Item	Component	
	Factor 1(Info_S)	Factor 2 (Info_C)
INFO_C1	-5.027E-02	.933
INFO_C2	.100	.820
INFO_S4	.950	-.103
INFO_S5	.759	9.314E-02
INFO_S6	.685	.250
INFO_S7	.963	-5.484E-02
Extraction Method: Principal Component Analysis. Rotation Method: Oblimin with Kaiser Normalization. Rotation converged in 4 iterations.		

(Source: output of SPSS 11)

Table 5.8 Factor Pattern Matrix of Information Quality

Four items were dropped due to their high cross loadings. The remaining six items show a clear and interpretable two factor structure with reasonably lower cross loadings, where factor 1 is 'Information services quality' (labelled as Info_S), and factor 2 is 'Information content quality' (labelled as Info_C).

EFA was performed on NORMS scale using SPSS 11. The output showed a clear two-factors structure under the latent root criterion (i.e., only keeping the factors with eigenvalues $\geq$ 1) (Hair, Anderson et al. 1995). The factor-structure and loadings are presented in Table 5.9.

Item	Component	
	Factor 1(NORMS_W)	Factor 2 (NORMS_S)
NORM1	9.562E-03	.920
NORM2	-9.222E-03	.927
NORM3	.970	1.434E-02
NORM4	.979	-1.379E-02
Extraction Method: Principal Component Analysis. Rotation Method: Oblimin with Kaiser Normalization. Rotation converged in 4 iterations.		

(Source: output of SPSS 11)

Table 5.9 Factor Pattern Matrix of Social Norms

The results in Table 5.9 showed a clear and interpretable two-factors structure with reasonable low cross loadings, where the factor 1 (labelled as NORMS_S) addresses the support from peers and management in using KMS, whilst factor 2 (labelled as NORMS_W) addresses the user's desire to please management and peers by using KMS.

Reliabilities of the Scales

Based on the results of exploration factor analyses, an examination of the internal consistency reliability of each scale was conducted. The results are presented in Table 5.10. This shows that the Cronbach's alpha for each single scale is well above 0.60, a suggested threshold value for exploratory research (Churchill 1979; Gefen, Straub et al. 2000). That means that all of these scales show acceptable internal consistency reliabilities, in terms of Cronbach's alpha values.

Scales	Number of items	Cronbach's Alpha
KMS-Use	7	
Info_Use	3	0.70
CC_use	4	0.86
INFOQ	6	
Info_C	2	0.75
Info_S	4	0.89
SC	6	
SC_N	2	0.88
SC_T	2	0.78
SC_V	2	0.84
NORMS	4	
NORMS_S	2	0.82
NORMS_W	2	0.95
EOU	2	0.78
PU	2	0.62
Notes:		
KMS-Use: Performance-related use of KMS	**Info_Use:** Information-related Use of KMS	**CC_Use:** Interaction-related Use of KMS
INFOQ: Information Quality	**Info_C:** Information Content Quality	**Info_S:** Information Services Quality
SC: Social Capital Development	**SC_N:** Social Networks	**SC_T:** Trust buildign
SC_V: Shared Vision	**EOU:** Perceived Ease of Use of KMS	**PU:** Perceived Usefulness of KMS
NORMS: Social Norms	**NORMS_S:** Support from management and peers in using KMS	**NORMS_W:** Desire to please management and peers by using KMS

(Source: summarized from the outputs of SPSS 11)

Table 5.10 The Reliabilities of the Scales

Summary

In this section, exploration factor analysis was conducted to purify the newly developed and adapted scales, following by an initial reliability analysis on the scales before the formal construct validation.

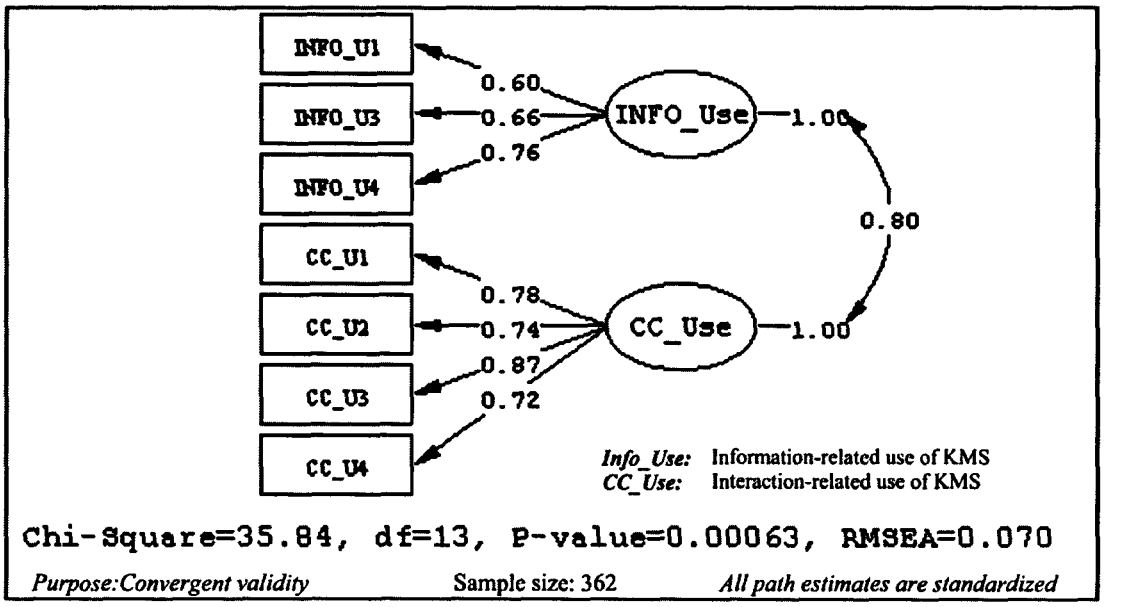
5.3.2 Convergent Validity

CFA was used to examine the convergent validity of newly developed scales, such as scales for Performance-related use of KMS (Info_Use and CC_Use), Information quality (Info_C and Info_S), Social Norms (NORMS_S and NORMS_W) and Social capital development (SC_N, SC_T, SC_V) using LISREL8 (Joreskog and Sorbom 1996; Kelloway 1998; Gefen, Straub et al. 2000). As mentioned earlier, two criteria are applicable for justifying the convergent validity. Convergent validity of a tested construct is established if all the item loadings are above 0.60, and the overall model goodness of fit indices are adequate (Chin, Gopal et al. 1997)

The covariance matrix of manifest variables is presented in Appendix III, Covariance Matrix of Measurement Items.

The convergent validity of Performance-related Use of KMS Scale

After the Exploration Factor Analysis (EFA), which confirmed a two-factor structure of the performance-related use of KMS construct (KMS-Use), the Information-related usage of the KMS (Info_Use) scale retains three items (Info_u1, Info_u3, and Info_u4), and interaction-related usage of the KMS (CC_Use) scale retains four items (CC_u1, CC_u2, CC_u3, and CC_u4). The resulting two factors model is shown in Figure 5. 10. A CFA was performed on the KMS-Use measurement model. Table 5.12 shows a set of selected goodness of fit indices from the analysis.



(Source: output of LISREL 8.72)

Figure 5.10 Convergent Validity of KMS-Use

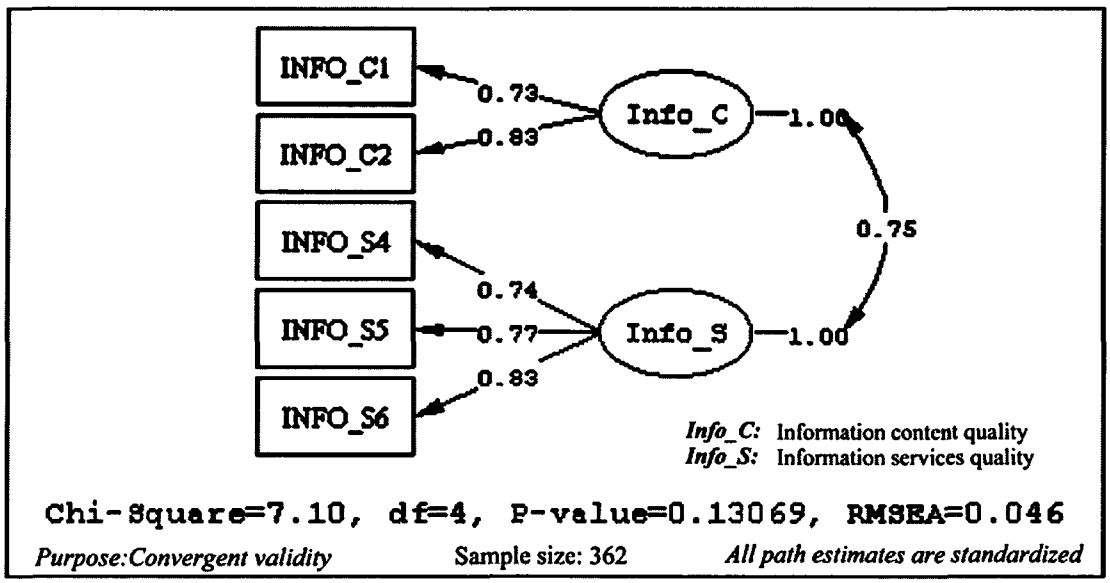
Figure 5.10 demonstrates that all the seven items have loadings well above 0.60, the minimum level for suggesting convergent validity for the new developed scale. Furthermore, all the factor loadings are statistically significant (see Table 5.11).

The results show a significant χ^2 (p-value = 0.00063 < 0.05). Although the model χ^2 (35.84) in this case is significant, but it is also less than three times the model degrees of freedom (13). A further examination of other overall goodness of fit indices, such as GFI, AGFI, NFI, CFI, RMR (see Table 5.12), demonstrates that they are all exceed the threshold values, which indicates a reasonably well-fitting model. This suggests that the measures reflect a two factors structure (See Figure 5.10). Consequently, the convergent validity of the scales for the Performance-related use of KMS (KMS-Use) was considered to have been achieved.

The convergent validity of Information Quality (INFOQ)

After EFA confirmed a two-factors structure of Information quality (INFOQ) (refer to section 5.3.1), the scale for information content quality (Info_C) remained two items (Info_c1 and Info_c2), and four items (Info_s4, Info_s5, Info_s6, and Info_s7) were retained for the information services quality (Info_S) scale for construct validation.

The two-factors measurement model was specified as Figure 5.11. CFA was operated on the model using LISREL8.71. While all six items had loadings above 0.60 (the minimal loadings is 0.71), the model goodness of fit was relatively poor (χ^2 = 75.57 (p-value = 0.0000), df = 8, χ^2/df = 9.45, RMSEA = 0.153).



(Source: output of LISREL 8.72)

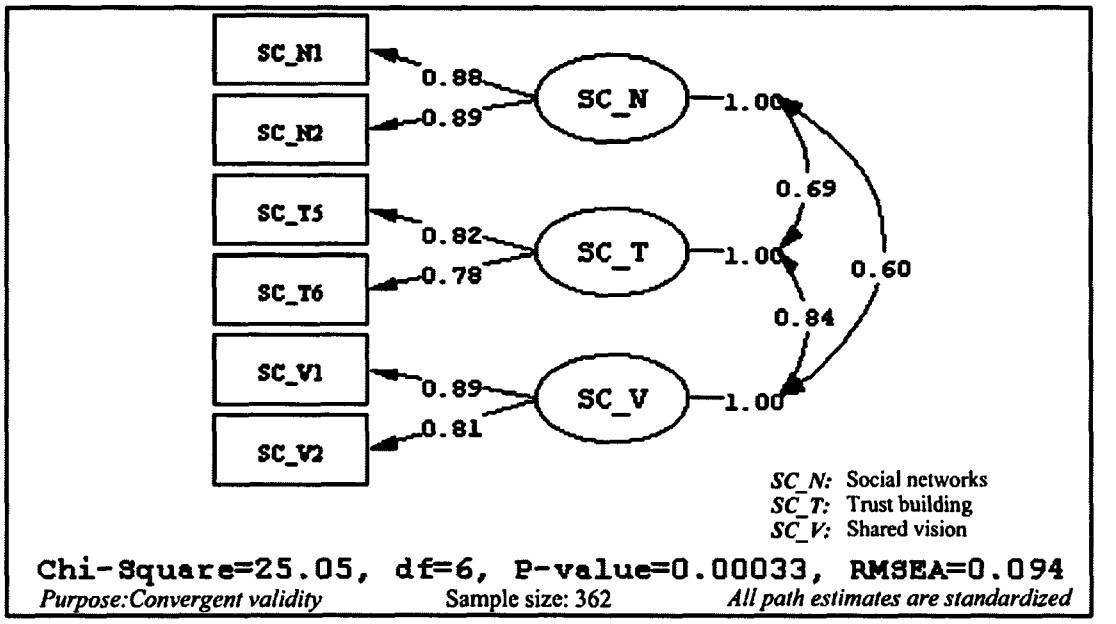
Figure 5.11 Convergent Validity of Information Quality (INFOQ)

To improve the model goodness of fit, the Info_s7 was discarded, as it was very similar to the Info_s4 in meaning. As a result, a well fitting model was achieved. The resulting goodness of fit indices can be found in Table 5.12. An insignificant χ^2 (7.1, p-value = 0.13 > 0.05), χ^2/df = 1.78, RMSEA = 0.046, GFI = 0.99, AGFI = 0.97, NFI = 0.99, CFI = 1, and RMR = 0.026 all suggest a reasonably good-fitting model. The revised measurement model is presented as Figure 5.11. It will be seen that all six items have loadings above 0.76, which are statistically significant (see Table 5.11), and together with the adequate overall model goodness of fit indices, suggest a good convergent validity.

The convergent validity of the Social Capital Development (SC)

EFA showed that the Social Capital Development has three factors with total of six items (see Table 5.7). Of these, the social network development (SC_N) has two items (SC_N1 and SC_N2), Trust development has two items (SC_T5 and SC_T6), and Shared vision (SC_V1 and SC_V2) has two items respectively. A measurement model for the Social Capital Development was established (see Figure 5.12), and CFA run on

the model.



(Source: output of LISREL 8.72)

Figure 5.12 Convergent Validity of Social Capital Development

The results show that all of the items have loadings well above the minimal criterion of 0.60 and that all of the loadings are statistically significant (see Table 5.11). A further examination of selected goodness of fit indices (see Table 5.12), such as $\chi^2/df = 4.2$, GFI=0.98, AGFI=0.92, NFI=0.99, CFI=0.99, and RMR=0.045, confirmed a reasonably good-fitting model, even though the χ^2 is significant (p-value=0.00033<0.05). The convergent validity of Social Capital Development is, accordingly, demonstrated.

Summary

Convergent validity ensures that all the items measure a single underlying construct. The analyses provided clear evidence of the convergent validity for all the tested sub-constructs (see Table 5.11 and 5.12).

Subconstruct Items	Standardized Parameter Estimate	t-value
Information-related Use of KMS (**Info_Use**)		
INfo_u1	0.60	11.19
Info_u3	0.66	12.51
Info_u4	0.76	14.68
Interaction-related Use of KMS (**CC_Use**)		
CC_u1	0.78	16.70
CC_u2	0.74	15.75
CC_u3	0.87	19.60
CC_u4	0.72	15.10
Information Content Quality (**Info_C**)		
Info_c1	0.73	14.02
Info_c2	0.83	15.79
Information Services Quality (**Info_S**)		
Info_s4	0.74	15.07
Info_s5	0.77	15.88
Info_s6	0.83	17.54
Personal Networks (**SC_N**)		
SC_N1	0.88	19.12
SC_N2	0.89	19.37
Trust Development (**SC_T**)		
SC_T5	0.82	17.26
SC_T6	0.78	16.28
Shared Vision (**SC_V**)		
SC_V1	0.89	19.47
SC_V2	0.81	17.32

Table 5.11 A Summary of Items Loadings of Convergent Validation

A summary of selected model goodness of fit indices for convergent validity of the three constructs is presented in Table 5.12.

Statistic	Rec. Value	Performance-related use of KMS (KMS-Use)	Information Quality (INFOQ)	Social Capital Development (SC)
χ^2		35.84	7.10	25.05
χ^2 P-value	> 0.05 (Adams, Nelson et al. 1992)	0.00	0.13	0.00
DF		13	4	6
χ^2/d.f.	< 5 (Salisbury, Chin et al. 2002)	2.76	1.78	4.18
GFI	>0.90 (Gefen, Straub et al. 2000)	0.97	0.99	0.98
AGFI	>0.80(Gefen, Straub et al. 2000)	0.94	0.97	0.92
NFI	>0.90 (Tabachnick and Fidell 1996)	0.98	0.99	0.99
CFI	>0.90 (Tabachnick and Fidell 1996)	0.99	1.00	0.99
RMR	< 0.10 (Salisbury, Chin et al. 2002)	0.033	0.026	0.045
Abbreviation Expansion Rec. Value P-value DF GFI AGFI NFI CFI RMR		Recommended value Significance Degree of Freedom Goodness of Fit Index Adjusted Goodness of Fit Index Normed Fix Index Comparative Fit Index Root Mean Residual		

(Source: summarized from the output of LISREL 8.72)

Table 5.12 Selected Model Fit Indices for Convergent Validity of the 3 Constructs

While the scales were tested in isolation for convergent validity, the next section continues the investigation of construct validity by testing the scales in relation to other constructs of interest. Discriminant validation provides a more rigorous assessment of construct validity than the previous tests.

5.3.3 Discriminant Validity

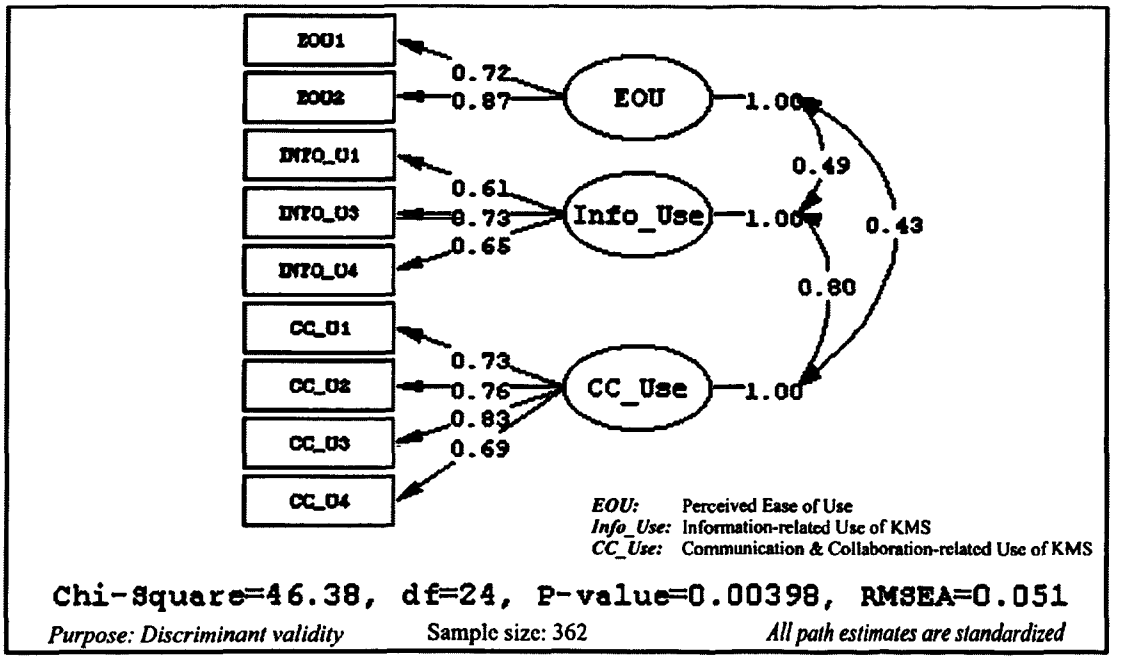
The hypothesized determinant variables of social capital development in the research model are a set of constructs and sub-constructs. Accordingly, the constructs involved in discriminant validation should include the Performance-related use of KMS (KMS-Use), Information quality (INFOQ), Perceived ease of use (EOU), Perceived usefulness (PU), and Social Norms (NORMS). The discriminant validation is performed in three sets of trials. In the first trial, KMS_Use is compared to EOU, PU and NORMS. In the second

trial, INFOQ is compared to EOU, PU and NORMS. Finally, KMS_Use is compared to INFOQ.

The discriminant validation will follow the two-step procedure described in Section 5.1.

Comparing KMS-Use with EOU, PU, and NORMS

KMS-Use was first tested against EOU (see Figure 5.13). First at all, the correlation between perceived ease of use (EOU) and information-related usage (Info_Use), and EOU and interaction-related usage (CC_Use) were fixed at 1.00 in each case. CFA was run to test the entire model-data fit, and produce the overall model-data fit measure χ^2 = 176.80 (d.f. = 26). Then the correlations were allowed to be freely estimated, a new χ^2 = 46.38 (d.f.= 24) was produced, which resulted in a χ^2 difference of 130.42. The difference of degrees of freedom for two analyses was 2, thus, the ratio of χ^2 difference/df difference equals 65.21 (much larger than 3.84 (1 d.f., α = 0.05)), which indicates that the two constructs (or one construct and two sub-constructs) were distinct. In addition, an examination of the loadings of the measurement items on Info_Use and CC_Use in the second model (see Figure 5.13) provides further evidence of the convergent validity of the scales, as there was no significant change to the loadings in the previous convergent analysis (see Figure 5.10).

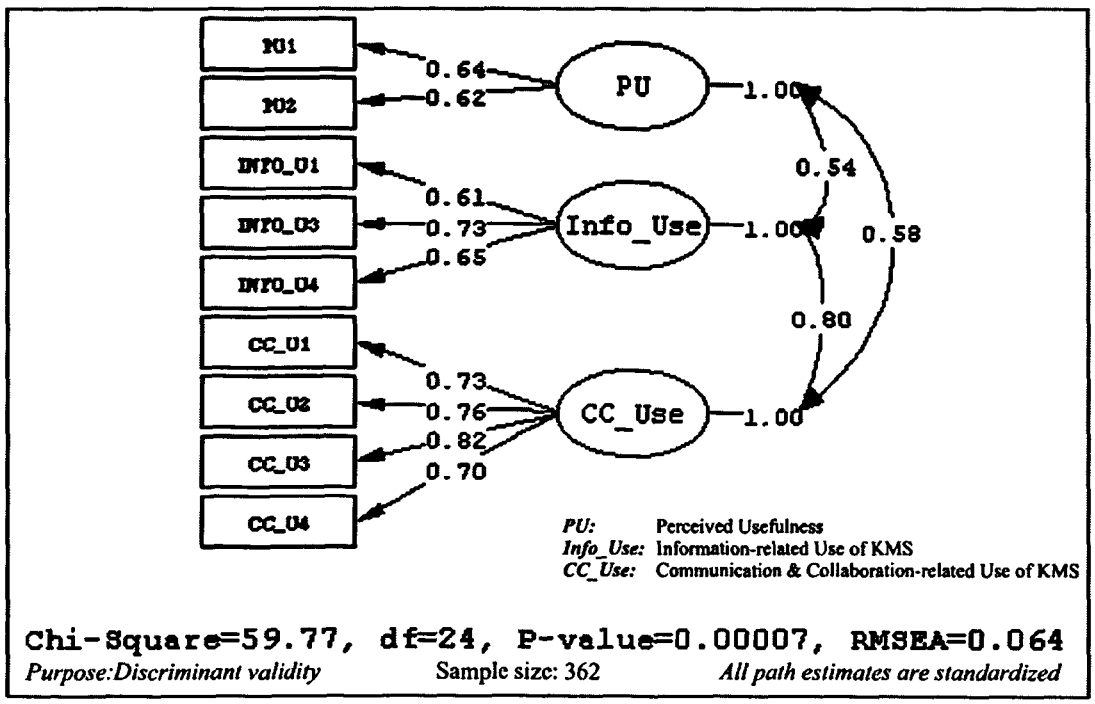


(Source: output of LISREL 8.72)

Figure 5.13 Comparing KMS-Use with EOU (freely estimated correlations)

Similarly, the KMS-Use (i.e., Information-related use of KMS (Info_Use), and Interaction-related use of KMS (CC_Use) was compared with perceived usefulness (PU) (see Figure 5.14). The model with fixed correlation coefficients of 1.00 (between Info_Use and PU, and between CC_Use and PU simultaneously) resulted in a χ^2 value of 107.11 (d.f. = 26), while the freely estimated model yielded a χ^2 value of 59.77 (d.f. = 24). Once again, the χ^2 difference of 23.67 (1 d.f.) was greater than the 3.84 threshold value that indicated the two constructs are statistically different.

The loadings of the scale items on Info_Use and CC_Use in the second model (freely estimated correlations) were similar to the corresponding results in the previous analysis of convergent validity (refer to Figure 5.10) providing further evidence of the convergent validity of the scales.



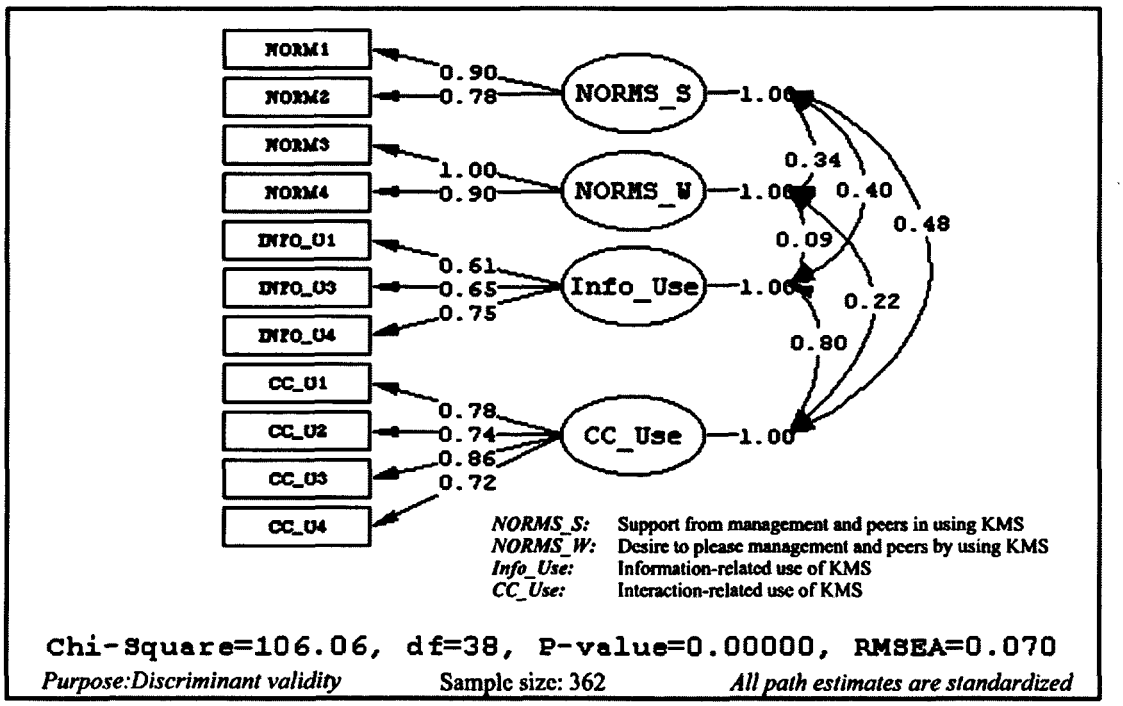
(Source: output of LISREL 8.72)

Figure 5.14 Comparing KMS-Use with PU (freely estimated correlations)

A comparison between KMS_Use (i.e., Info_Use and CC_Use) and Social norms (i.e., NORMS_S and NORMS_W) was performed following the same procedure. The model with fixed correlation coefficients of 1.00 (between the pairs of Info_Use and

NORMS_S, Info_Use and NORMS_W, CC_Use and NORMS_S, and CC_Use and NORMS_W simultaneously) resulted in a χ^2 value of 549.41 (d.f. = 42), while the freely estimated model yielded a χ^2 value of 106.06 (d.f. = 38) (see Figure 5.15). Once again, the χ^2 difference of 110.84 (1 d.f.) was much greater than the 3.84 threshold, indicating that the two constructs are statistically different.

The loadings of the scale items on Info_Use and CC_Use in the second model (freely estimated correlations) were similar to the corresponding results in the previous analysis of convergent validity (refer to Figure 5.10) that confirmed the convergent validity of the scales.



(Source: output of LISREL 8.72)

Figure 5.15 Comparing KMS-Use with NORMS (freely estimated correlations)

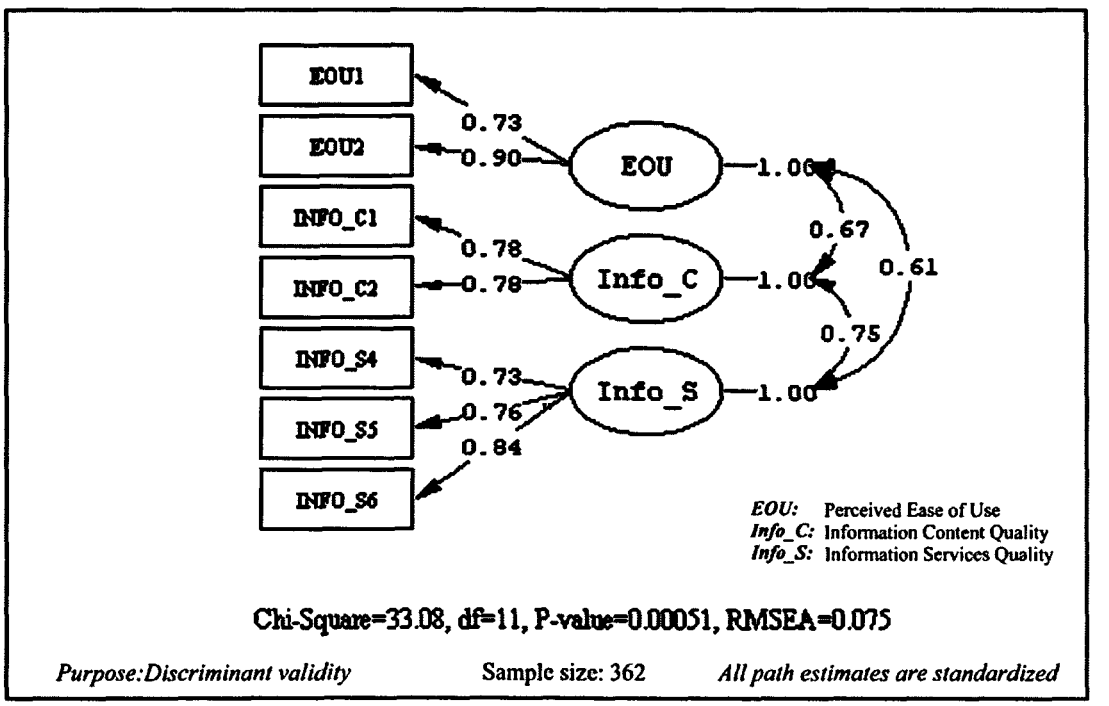
Comparing Information Quality (INFOQ) with EOU, PU, and NORMS

Information quality (INFOQ) consisted of two subconstructs, information content quality (Info_C) and information services quality (Info_S). In order to determine the difference between INFOQ, and Perceived ease of use (EOU), and perceived usefulness (PU), and social norms (NORMS), discriminant validation was conducted by confirmatory factor analysis (CFA) using LISREL 8.72.

INFOQ (i.e., information content quality (Info_C), and information services quality

(Info_S) was modelled to correlate with EOU (see Figure 5. 16). First, the correlation between Info_C and EOU, and the correlation between info_S and EOU were fixed at 1.00, which resulted in a χ^2 value of 147.38 (df=13), then, the correlations were allowed to be freely estimated, which yielded a χ^2 value of 33.08 (df = 11). The χ^2 difference of 114.3 divided by df difference of 2 was 57.15 (df=1), which is much greater than the 3.84 threshold and suggests the compared constructs are statistically different (α = 0.05).

In addition, an examination of the loadings of the INFOQ items on Info_C and Info_S respectively provides further evidence of the convergent validity of the scales, as they are not significantly different to the loadings calculated in the previous convergent analysis (refer to Figure 5.11).

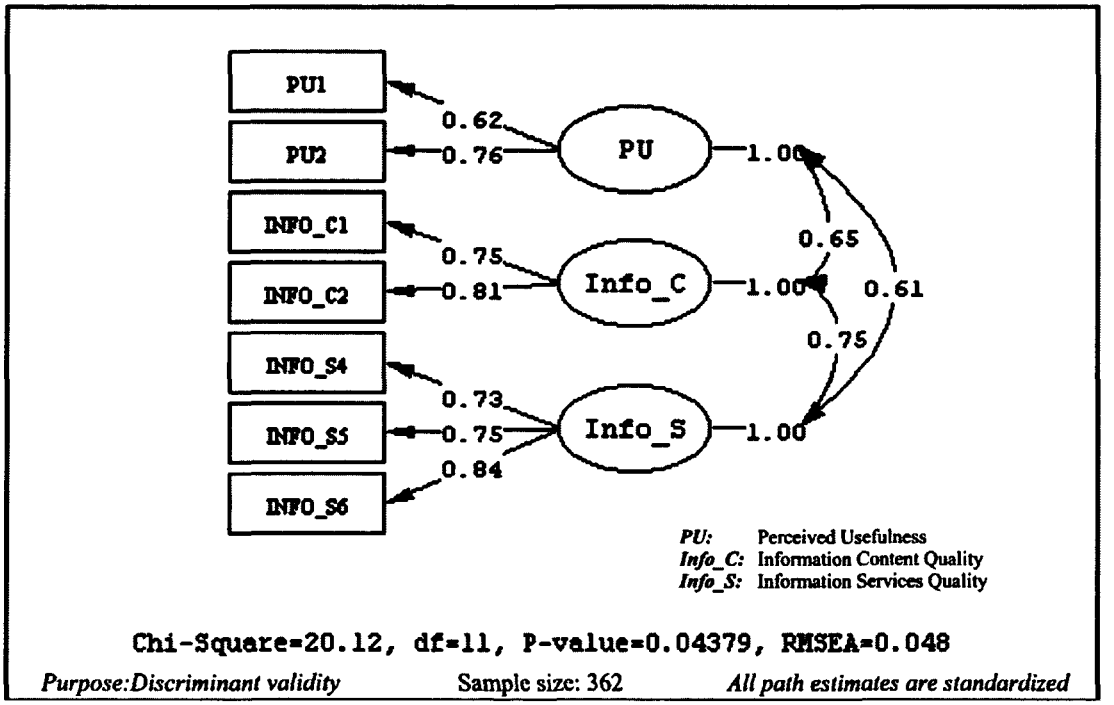


(Source: output of LISREL 8.72)

Figure 5.16 Discriminant Validity: Comparing INFOQ with EOU (freely estimated correlations)

A comparison of INFOQ (i.e., info_C and info_S) and PU was conducted in a similar way. The model with fixed correlations of 1.00 yielded a χ^2 value of 65.95 (df=13), while the freely estimated model resulted in a χ^2 value of 20.12 (df=11), resulted in a χ^2 value difference 45.83 (df=2). The χ^2 difference divided by 2 equals to 22.92 (df=1), which is much larger than the 3.84 threshold value, and indicates a statistical distinction between INFOQ and PU (α = 0.05).

An examination of the loadings of INFOQ items on the corresponding factors of INFOQ construct (i.e., Info_C and Info_S) provides further evidence of the convergent validity of the INFOQ scales (see Figure 5.17), in that there was no significant change from the previous convergent analysis (refer to Figure 5.11).

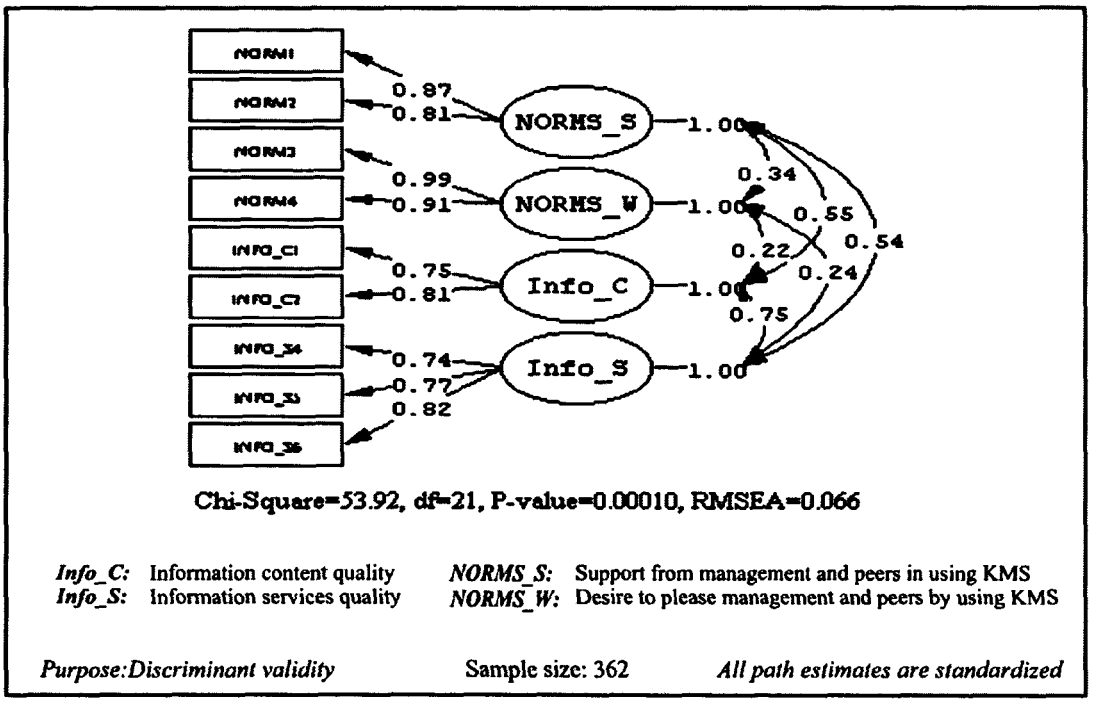


(Source: output of LISREL8.72)

Figure 5.17 Discriminant Validity: Comparing INFOQ with PU (freely estimated correlations)

INFOQ (i.e., info_C and info_S) was compared with NORMS (see Figure 5.18). The model with fixed correlations of 1.00 yielded a χ^2 value of 477.84 (df=25), while the freely estimated model resulted in a χ^2 value of 53.92 (df=21), resulted in a χ^2 value difference 423.92 (df=4). The χ^2 difference divided by 4 leads to 105.98 (df=1), which is much larger than 3.84 threshold value, and indicates a statistical distinction between INFOQ (Info_C and Info_S) and NORMS (NORMS_S and NORMS_W) ($\alpha = 0.05$).

An examination of the loadings of INFOQ items on the corresponding factors of INFOQ construct (i.e., Info_C and Info_S) provides further evidence of the convergent validity of the INFOQ scales (see Figure 5.18), in that there was no significant change from the previous convergent analysis (refer to Figure 5.11).



(Source: output of LISREL8.72)

Figure 5.18 Discriminant Validity: Comparing INDOQ with NORMS (freely estimated correlations)

Comparing KMS-Use with INFOQ

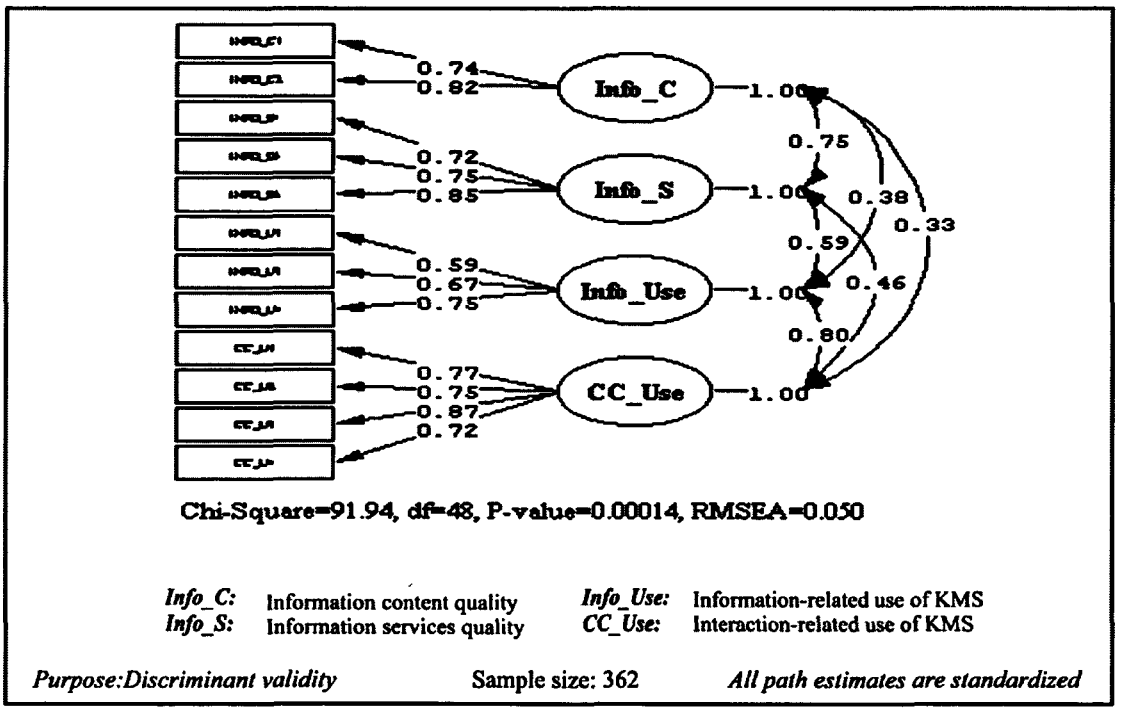
Both the performance-related use of KMS (KMS-Use) and information quality (INFOQ) exhibited discriminant validity compared to the well-established constructs, perceived usefulness (PU), perceived ease of use (EOU), and Social Norms (NORMS). The next logical step was to test the degree of difference between these two new constructs. Four subconstructs were involved in the comparison, namely

- Information-related use of KMS (Info_Use).
- Interaction-related use of KMS (CC_Use).
- Information content quality (Info_C).
- Information services quality (Info_S).

The two constructs (i.e., four subconstructs) are modelled as Figure 5.19. Firstly, assuming that the two constructs were identical, that is the correlations between two constructs were fixed to 1.00, the model produced a χ^2 value of 530.51 (df=52). Secondly, the fixed correlations were released and allowed to be freely estimated, thus, a χ^2 value of 91.94 (df=48) was obtained. The χ^2 difference was normalized by the

difference of degrees of freedom (df=4), and the resulted χ^2 difference of 109.64 (df=1) was much greater than the 3.84 (df=1, α = 0.05) threshold, highlighting that KMS-Use and INFOQ are indeed distinct.

Furthermore, the high loadings of the items on their assigned subconstructs (factors) in the model (the freely estimated model, see Figure 5.19) also provide further evidence of the convergent validity of the individual scale.



(Source: output of LISREL 8.72)

Figure 5.19 Discriminant Validity: Comparing KMS-Use with INFOQ (freely estimated correlations)

Summary

Selected model fit indices for all the discriminant validity analyses are summarized in Table 5.13. The results show that the overall model fit indices for all the testing models (freely estimated correlations) are adequate, and none of the correlations between modelled constructs is equal to 1.00 (in the case of being freely estimated). Therefore, the discriminant validity of KMS-Use and INFOQ could be considered established (Chin, Gopal et al. 1997).

Statistic	Rec. Value	KMS-Use /EOU	KMS-Use /PU	KMS-Use /NORMS	INFOQ /EOU	INFOQ /PU	INFOQ /NORMS	KMS-Use /INFOQ
χ^2		46.38	59.8	106.06	33.08	20.12	53.92	91.94
χ^2 P-value	> 0.05 (Adams, Nelson et al. 1992)	0.004	0.00	0.000	0.001	0.044	0.000	0.000
DF		24	24	38	11	11	21	48
χ^2/d.f.	< 5 (Salisbury, Chin et al. 2002)	1.93	2.49	2.79	3.00	1.83	2.57	1.92
GFI	>0.90 (Gefen, Straub et al. 2000)	0.97	0.96	0.95	0.97	0.98	0.97	0.96
AGFI	>0.80 (Gefen, Straub et al. 2000)	0.95	0.93	0.91	0.94	0.96	0.93	0.93
NFI	>0.90 (Tabachnick and Fidell 1996)	0.98	0.97	0.96	0.98	0.99	0.97	0.97
CFI	>0.90 (Tabachnick and Fidell 1996)	0.99	0.98	0.97	0.99	0.99	0.98	0.99
RMR	< 0.10 (Salisbury, Chin et al. 2002)	0.030	0.03	0.049	0.042	0.032	0.056	0.041

(Source: summarized from the output of LISREL 8.72)

Table 5.13 Selected Model Fit Indices for the Discriminant Validity of KMS-Use and INFOQ

5.4 Evaluating the Structural Models and Testing the Hypotheses

As good psychometric properties in the survey instruments were confirmed by the measurement model testing in section 5.3, this section addresses issues of theoretical hypotheses testing by assessing the structural models.

As designed, PLS was used to evaluate a structural model. The following subsections are devoted to the processes of hypothesis testing via the testing of three structural models sequentially. Hypotheses testing results were based on the structural models testing results.

5.4.1 Testing Structural Model I with PLS

Model I involved a set of multidimensional constructs (latent constructs), which are comprised of a number of sub-constructs (latent sub-constructs).

- Social Capital Development (SC) has three sub-constructs, Personal Networks(SC_N), Trust building (SC_T), and Shared vision (SC_V).

- Performance-related Use of KMS (KMS-Use) has two sub-constructs, Information-related Use of KMS (Info_Use), and Interaction-related Use of KMS (CC_Use).
- Information Quality (INFOQ) has two sub-constructs, Information Content Quality (Info_C) and Information Services Quality (Info_S).

Before commencing the structural model testing, it was necessary to compute the scores of sub-constructs as the indicators of the latent constructs so as to assess the relationships between the latent constructs (Bagozzi and Edwards 1998; Yi and Davis 2003). There exist various methods to approximate the scores of sub-constructs. For instance, Bagozzi and Edwards (1998) and Yi and Davis (2003) suggested that the scores of sub-constructs (called "second-order factors" in their paper) could be approximated by aggregating (i.e., summing or averaging) across the items, and using the composites so formed for each sub-construct as indicators of the latent construct.

Following Yi and Davis (2003), there is a more convenient and rigorous way of approximating the latent constructs. Instead of calculating the sub-constructs scores by summing or averaging items, SmartPLS can be used to assess the measurement models of latent sub-constructs (e.g., SC_N, SC_T, SC_V, etc.). Then, the outputs of the computed scores of the latent sub-constructs could be treated directly as inputs to the corresponding latent constructs (e.g. SC). The latent sub-constructs scores output from PLS were considered to be more reliable than the results of simply summing or averaging the items, because different weights could be taken into account when the latent sub-constructs scores were computed by the software, rather than assuming all the weights to be equal in summing or averaging the items.

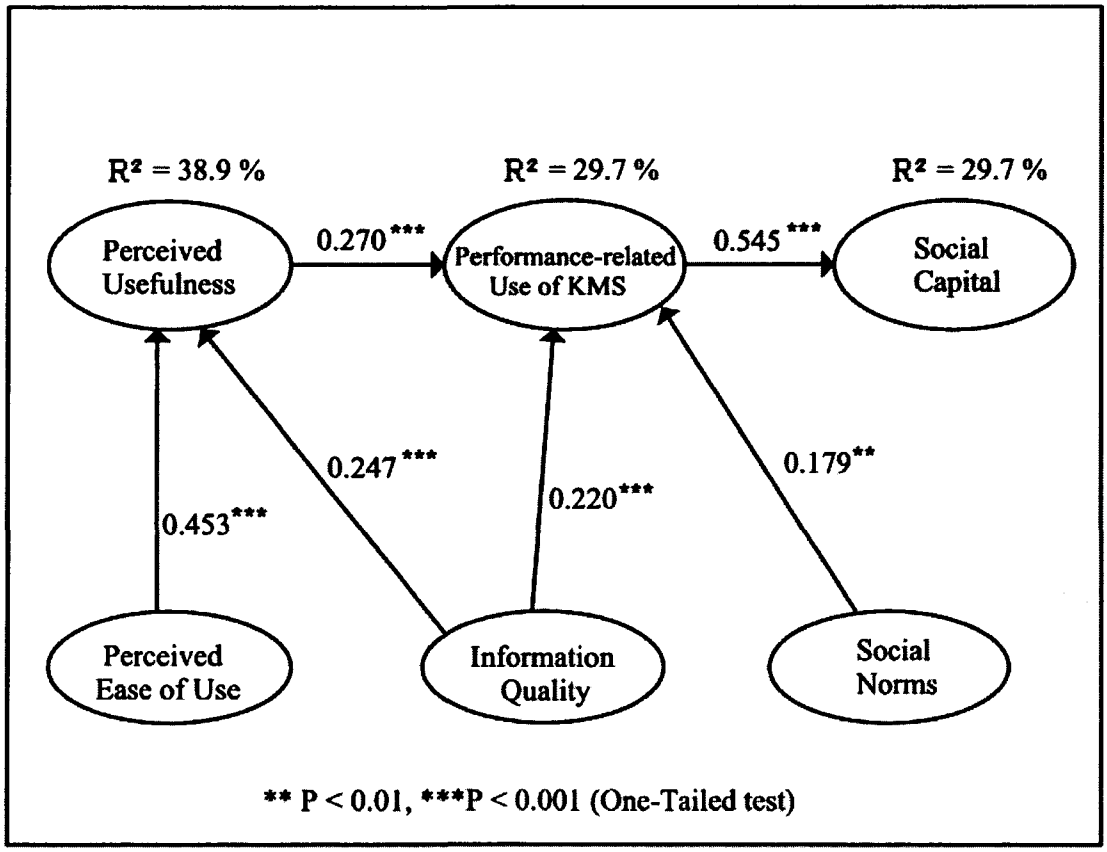
The latest version of SmartPLS (Version 1.01) was run for assessing Structural Model I. A calculate model procedure, and a bootstrapping procedure (with 500 random re-samples, 350 cases per sample) were performed sequentially to estimate the path coefficients, and the significance of the path coefficients (Yung and Chan 1999). As PLS does not generate overall model fit statistics, the predictive validity is assured primarily by examining the R-square and the structural paths. Figure 5.20 and Table 5.14 present the results of the PLS structural model test.

Path	Coefficient	T-Statistic	R-square
KMS-USE -> SC	0.545***	15.021	0.297
INFOQ -> KMS-USE	0.220***	3.516	0.297
PU -> KMS-USE	0.270***	4.525	
NORMS -> KMS-USE	0.179**	3.051	
INFOQ -> PU	0.247***	4.603	0.389
EOU -> PU	0.453***	7.837	
Notes: ** P < 0.01, ***P < 0.001 (One-Tailed test)			
SC: Social capital development		EOU: Perceived Ease of Use	
KMS-Use: Performance-related Use of KMS		PU: Perceived Usefulness	
NORMS: Social Norms		INFOQ: Information Quality	

(Source: Output of SmartPLS V1.01)

Table 5.14 Results of PLS Analysis of Model I: Path Coefficients

As shown in Table 5.14 and Figure 5.20, the model accounted for substantial variances in social capital development (SC, $R^2 = 0.297$), in that 29.7% of the variance in social capital development has been significantly explained by the performance-related use of KMS (KMS-Use). For KMS-Use ($R^2 = 0.297$), 29.7% of the variance in the performance-related use of KMS has been significantly explained by perceived usefulness, information quality, and social norms. For Perceived usefulness (PU, $R^2 = 0.389$), 38.9% of the variance in perceived usefulness has been significantly explained by ease of use and information quality. In addition, for the two constructs measured by reflective indicators (PU and EOU), all the standardized item loadings were well above 0.707 of the recommended threshold value, the cross loadings between two constructs were rather lower, and both average variances extracted (AVE) were well above 0.50 of threshold value (AVE = 0.827 for EOU and AVE= 0.736 for PU) (Yi et al 2003).



(Source: outputs of SmartPLS Version 1.01)

Figure 5.20 Results of PLS Run for Structural Model I

Table 5.14 also shows that all the paths coefficients are quite magnitude and significant at the level of 0.01 (one-tailed test).

Model I represents six hypothesized causal-effect relationships, i.e., H1, H2, H3, H4, H5, and H6, six global hypotheses. The results of the analysis supported all the six global hypotheses.

Hypothesis 1 (H1) proposed an overall causal-effect relationship between the use of KMS and its impacts on the development of social capital. Hypothesis 1 was confirmed by the analysis, indicating strong support for the overall positive role of KMS in developing social capital (path coefficient = 0.545, $p < 0.001$).

The remained five hypotheses addressed the relationships between the performance-related KMS use and its antecedents.

Hypothesis 2 (H2) was supported (path coefficient = 0.27, $p<0.001$), suggesting a higher perceived usefulness of KMS would lead to a heavier performance-related KMS usage. This result confirmed perceived usefulness as an important predictor to the user acceptance and use of KMS.

Hypothesis 3 (H3), addressed the impact of social norms on the performance-related use of KMS, was supported (path coefficient = 0.179, $p<0.01$), indicating that positive social norms toward the use of KMS would encourage people to use the KMS.

Hypothesis 4 (H4), dealing with the influence of information quality on the performance-related use of KMS, was accepted (path coefficient = 0.22, $p<0.001$), indicating that better information quality would result in heavier performance-related KMS usage.

Hypothesis 5 (H5), related to the influence of information quality on the user's perception of KMS usefulness, was supported (path coefficient = 0.247, $p<0.001$), indicating the positive influence of information quality on users appreciating KMS in terms of their usefulness.

Hypothesis 6 (H6), concerned the relationship between perceived usefulness of KMS and the perceived ease of use of KMS, was confirmed by the analysis (path coefficient = 0.453, $p<0.001$), indicating that ease of use of KMS is still an important and significant determinant of users' perception of the usefulness of the KMS.

5.4.2 Testing Structural Model II with PLS

Structural model II was assessed using SmartPLS1.01. A calculate model procedure and a bootstrapping procedure (with 300 random re-samples, 250 cases per sample) were performed sequentially to estimate path coefficients and the significance of the path coefficients. The analysis assessed the measurement models and structural model simultaneously. Figure 5.21, Table 5.20, and Table 5.21 present the results of the model II testing. The results suggest that a good model fit was established with significant path coefficients and acceptably high R-square, composite reliability, and AVE for each of the latent constructs/sub-constructs (Gefen, Straub et al. 2000).

Table 5.15 presents the results of the assessment of the measurement model of structural model II. The Composite Reliabilities for all the constructs/sub-constructs exceeded the suggested criterion of 0.70 (Gefen, Straub et al. 2000), while the Average Variance Extracted (AVE) for all the constructs/sub-constructs were well above the recommended threshold of 0.50 (Chin, Marcolin et al. 2003). Furthermore, an examination of the item loadings demonstrated that all the item loadings exceeded the required minimum value of 0.60, and their t-values were above 1.96 (Gefen and Straub 2005). The results of the assessments further confirmed good psychometric properties in the constructs/sub-constructs.

Constructs/Dimensions	Composite Reliability	Average variance extracted (AVE)
Personal networks expansion (SC_N)	0.945	0.895
Trust building (SC_T)	0.900	0.818
Shared vision development (SC_V)	0.924	0.859
Information-related Use of KMS (Info_Use)	0.837	0.632
Perceived support by management and peers in using KMS (NORMS_S)	0.920	0.852
Desire to please management and peers by using KMS (NORMS_W)	0.974	0.949
Information Services Quality (Info_S)	0.892	0.734
Information Content Quality (Info_C)	0.891	0.803
Perceived Ease of Use (EOU)	0.905	0.827
Perceived Usefulness (PU)	0.848	0.736
Interaction-related Use of KMS (CC_Use)	0.904	0.701

(Outputs of SmartPLS 1.01)

Table 5.15 Results of PLS Analysis: Measurement Model of KMS Success Model II

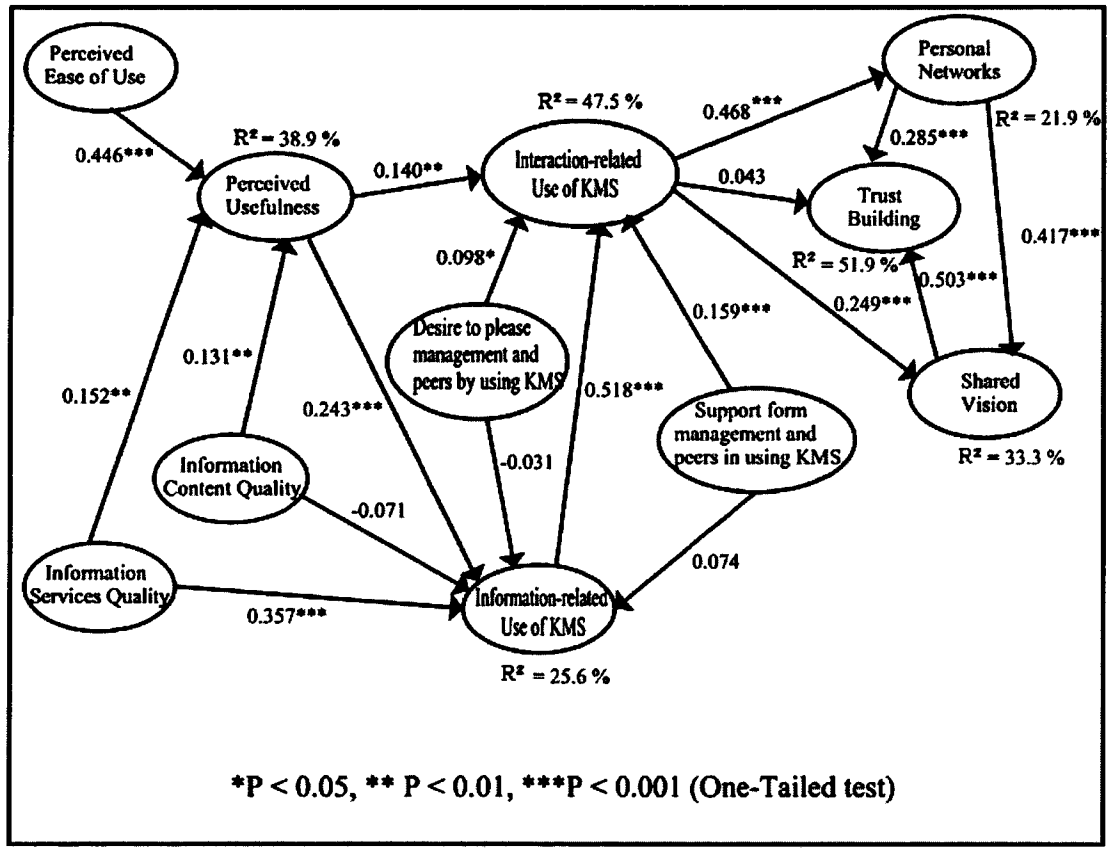
Table 5.16 and Figure 5.21 present the summarized results of PLS run on the structural level. As illustrated, 21.9% of the variance in Personal networks (SC_N), 51.9% of the variance in Trust development (SC_T), and 33.3% of the variance in Shared vision (SC_V) have been significantly explained by the structural model. Furthermore, 47.5% of the variance in the interaction-related use of KMS (CC_Use) and 25.6% of the variance in Information-related use of KMS (Info_Use) have been significantly explained by the structural model, whilst 38.8% of the variance in perceived usefulness

of KMS (PU) has been significantly explained by perceived ease of use (EOU), information content quality (Info_C), and information services quality (Info_S).

Path	Coefficient	T-Statistic	R-square
CC_Use -> SC_N	0.468***	11.856	0.219
SC_N -> SC_T	0.285***	5.203	0.519
SC_V -> SC_T	0.503***	10.442	
CC_Use -> SC_T	0.043	0.911	
SC_N -> SC_V	0.417***	8.169	0.333
CC_Use -> SC_V	0.249***	4.840	
NORMS_S -> Info_Use	0.074	1.064	0.256
NORMS_W -> Info_Use	-0.031	0.625	
Info_S -> Info_Use	0.357***	5.749	
Info_C -> Info_Use	-0.071	1.115	
PU -> Info_Use	0.243***	3.940	
Info_S -> PU	0.152**	2.479	0.389
Info_C -> PU	0.131**	2.345	
EOU -> PU	0.446***	8.518	
Info_Use-> CC_Use	0.518***	11.767	0.475
NORMS_S -> CC_Use	0.159***	3.561	
NORMS_W -> CC_USE	0.098*	2.124	
PU -> CC_Use	0.140**	3.027	
Notes: *P < 0.05, **P < 0.01, ***P < 0.001 (One-tailed Test)			
SC_N: Personal social Networks		EOU: Perceived Ease of Use	
SC_T: Trust building		PU: Perceived Usefulness	
SC_V: Shared vision		Info_C: Information Content Quality	
Info_Use: Information-related Use of KMS		Info_S: Information Services Quality	
CC_Use: Interaction-related use of KMS		NORMS_S: Support by management and peers in using KMS	
NORMS_W: Desire to please management and peers by using KMS			

(Outputs of SmartPLS 1.01)

Table 5.16 Results of PLS Analysis: Path Coefficients



(Outputs of SmartPLS 1.01)

Figure 5.21 Results of PLS Run for Structural Model of KMS Success Model II

Model II represents seventeen hypothesized relationships between the constructs and sub-constructs. Based on the results of Model II testing, the following conclusions can be drawn about the hypotheses.

Four hypothesized relationships were related to the KMS use (H1a) and to its impacts (H1b, H1c, and H1d).

- H1a was supported, highlighting the significant positive impact of information-related use of KMS on the interaction-related use of KMS.
- H1b was supported, indicating a significant positive impact of the interaction-related use of KMS on expanding end-user' personal networks.
- H1c was not supported, suggesting that interaction-related use of KMS would not directly improve the trust between colleagues within organizations.
- H1d was supported, indicating that the interaction-related use of KMS would improve the shared vision within organizations.

Three hypothesized relationships (H1e, H1f, and H1g) addressed the interplay between the three main components of social capital.

- H1e was supported, suggesting that personal network expansion fosters trust within organizations.
- H1f was supported, indicating that personal network expansion would help organizational vision propagation and recognition.
- H1g was supported, confirming that shared vision enhances the trust within organizations.

Two hypotheses (H2a and H2b) address the relationships between the perceived usefulness of KMS and the information-related use of KMS, and the interaction-related use of KMS respectively.

- H2a was supported, suggesting that information-related use of KMS would be enhanced if end-users recognized the usefulness of the KMS in their working life.
- H2b was also supported, indicating that the end-users' perception regarding the usefulness of KMS has a positive role in improving the interaction-related use of KMS.

Four hypotheses (H3a, H3b, H3c, and H3d) were related to the impact of two dimensions (sub-constructs) of social norms (support from management and peers in using KMS, and desire to please management and peers by using KMS) on the two dimensions (sub-constructs) of performance-related use of KMS (information-related use of KMS, and interaction-related use of KMS).

- H3a and H3c were not supported, which suggested that support from management and peers in using KMS or the users' desire to please management and peers by using KMS does not significantly affect the use KMS for information purposes.
- H3b and H3d, however, were accepted, which suggested that both support from management and peers and the users' desire to please management and peers enhances end-users KMS usage for interaction (communicating and

collaborating) within organizations.

Two hypotheses (H4a and H4b) addressed the influence of the two components of information quality (information content quality and information services quality) on the information-related use of KMS.

- H4a was rejected, suggesting that there is no direct effect of information content quality on the usage of information-related KMS.
- H4b was supported, indicating a positive role of information services quality in enhancing KMS usage for information purposes.

Two hypotheses (H5a and H5b) were related to the influence of the two components of information quality (information content quality and information services quality) on user's perception of KMS usefulness.

- Both H5a and H5b were supported, suggesting a significant positive role of information content quality and information services quality in affecting user assessment about the KMS usefulness.

Finally, one hypothesis, H6, stated the causal-effect relationship between perceived ease of use of KMS and perceived usefulness of KMS. H6 was assessed by PLS with the structural mode I (see section 5.4.1). Similar result was achieved in testing model II as that in testing model I.

- H6 was supported, indicating a substantial impact of ease of use of KMS on perceived KMS usefulness. As could be seen, ease of use is the most significant contributor to the user's perception of KMS in terms of usefulness.

5.4.3 Testing Structural Model III with PLS

Structural model III was tested by PLS (SmartPLS Version 1.01). A calculate model procedure, and a bootstrapping procedure (with 300 random re-samples, 350 cases per sample) were performed sequentially to estimate path coefficients, and the significance of the path coefficients. The Table 5.17, Table 5.18, and Figure 5.22 present the results

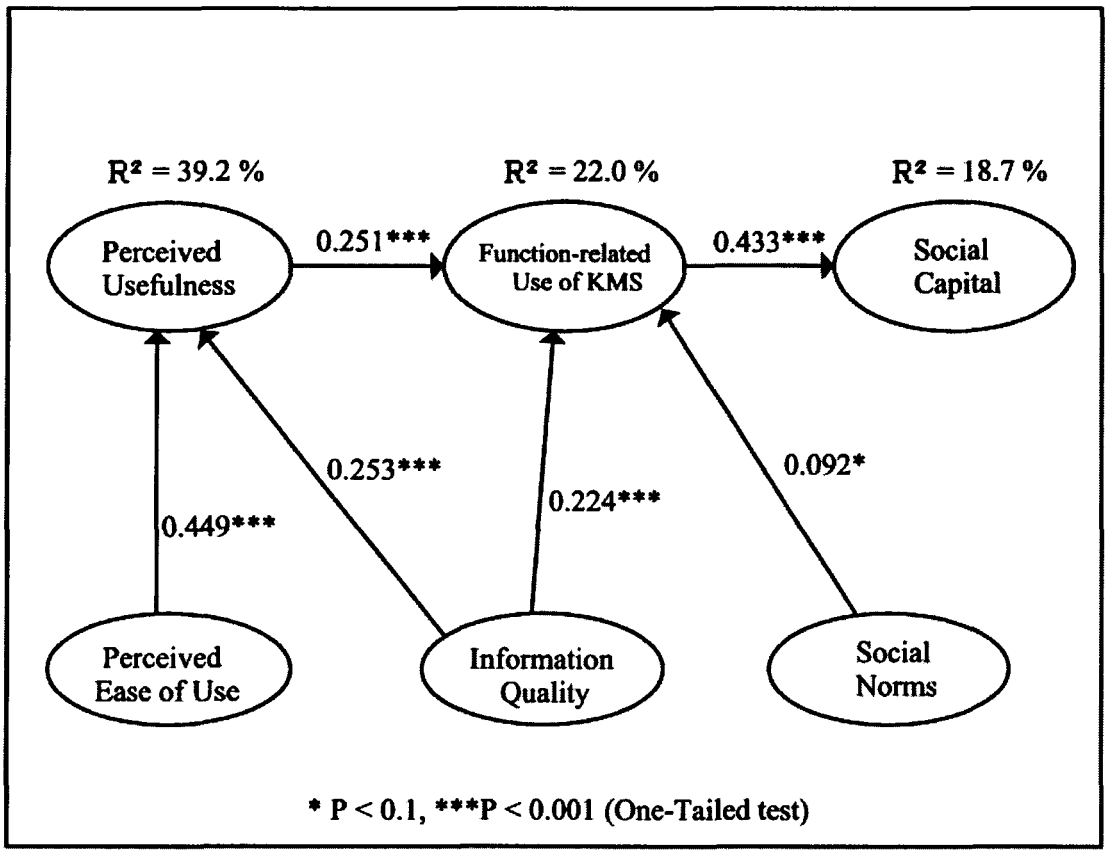
of the PLS run.

Path	Coefficient	T-Statistic	R-square
Use-KMS -> SC	0.433***	10.267	0.187
NORMS -> Use-KMS	0.092*	1.498	0.220
INFOQ -> Use-KMS	0.224***	3.997	
PU -> Use-KMS	0.251***	3.865	
INFOQ -> PU	0.253***	5.107	0.392
EOU -> PU	0.449***	8.081	
Notes: ***P <0.001, *P<0.1 (One-Tailed Test)			
SC: Social capital development		EOU: Perceived Ease of Use	
Use-KMS: Function-related Usage of KMS		PU: Perceived Usefulness	
NORMS: Social Norms		INFOQ: Information Quality	

(Source: Output of SmartPLS V1.01)

Table 5.17 Results of PLS Run for Structural Model of KMS Success Model III

Table 5.17 and Figure 5.22 shows that 39.2% of the variance in perceived usefulness (PU, $R^2 = 0.392$) has been significantly explained by ease of use and information quality. 18.7% of the variance in social capital development (SC, $R^2 = 0.187$) has been significantly explained by the function-related usage of KMS. 22 % of the variance in the function-related use of KMS (Use-KMS, $R^2 = 0.22$) has been significantly explained by perceived usefulness and information quality. With respect to the structural paths, all of the paths coefficients except for the **NORMS -> Use-KMS** are significant at the level of 0.001 (one-tailed test). However, the path **NORMS -> Use-KMS** was significant only at the level of 0.1. In addition, for the two constructs measured by reflective indicators (PU and EOU), all the standardized item loadings was well above 0.707, and there existed significant difference in cross loadings between two constructs. Both of the two average variances extracted (AVE) were well above 0.50 (AVE = 0.827 for EOU and AVE= 0.736 for PU).



(Source: outputs of SmartPLS Version 1.01)

Figure 5.22 Results of PLS Run for Structural Model of KMS Success Model III

The results from the model I tests and the model III tests are similar. Both Model I and Model III tests supported all the global hypotheses (H1, H2, H3, H4, H5, and H6). In addition, both model tests provided good explanations for the variance of central constructs, such as perceived usefulness, performance-related use of KMS, function-related use of KMS, and Social capital development. As a result, the consistency of the results from both model tests implies the reliability and robust of the analytical results.

While both models have explained significant amount of variance in social capital devolvement, the smaller R^2s also suggest their limitations in terms of explanatory power for social capital. A batch of factors could account for the outcomes. For instance, incomplete research model, i.e. critical variables might be missed; social capital measurement might not be enough, i.e., only a part of social capital was tapped; insufficient KMS use measurement model, i.e., only measuring KMS use from a specific perspective; important contingency factors, such as organization size, and gender and education level of end-user, were excluded. In addition, the composite

constructs (i.e., the multidimensional constructs mentioned at the beginning of Section 5.4.1) in the models might cause bigger measurement errors, which might, in turn, result in lower R^2 estimations. Although the values of R^2, for an exploration study, could be accepted according to the previous studies in IS, the models deserve a further development so as to enhance its explanatory power for social capital.

Moreover, the explanatory power of the function-related use of KMS on social capital development (18.7%) is weaker than that for the performance-related use of KMS (29.7%). This may be because the study only included some of the most popular KMS functionality, and thus the study may not reflect the diversity of functionality of KMS.

Table 5.18 represents the loadings of eight functions items on the function-related use of KMS, and their respective significant levels.

Function	Factor Loading	t-value
EL_U	0.528	5.238
EMAIL_U	0.471	4.493
IKD_U	0.738	11.265
KB_U	0.817	12.976
ODF_U	0.363	3.578
VC_U	0.201	2.054
VCONF_U	0.055	0.536
VT_U	0.407	4.063
Note:		
EMAIL_U: Email		EL_U: Expert Locator
VCONF_U: Video Conferencing		ODF_U: Online Discussion Forum
KR_U: Knowledge Repositories		VCOM_U: Virtual Community
IKD_U: Information/knowledge Distribution		VT_U: Virtual Team / collaboration

(Source: outputs of SmartPLS Version 1.01)

Table 5.18 Results of PLS Analysis of KMS Success Model III: Function Items Loadings

As the loadings represent the correlations of the function-related use of KMS and their respective functions, the results suggested that the functions that significantly affect social capital development in this study include knowledge repositories, information and knowledge distribution, expert locator, email, virtual team/collaboration, online

discussion forums, and virtual communities. Video conferencing was not found to be a significant contributor to the social capital development in terms of its magnitude (0.055) and t-value.

5.4.4 Summary

Three structural models were assessed via PLS in this section. Based on the analyses, six global hypotheses and seventeen sub-hypotheses were tested.

The model testing also provided further evidence of the construct validity for all the constructs and sub-constructs involved in this study. As the measurement model was tested with the structural model together, therefore, it also could serve as a nomological validation process for the constructs/sub-constructs validity. As a result, the analyses complemented the validation processes described in Section 5.3.2 and 5.3.3.

A function-related analysis of KMS was conducted via testing model III.

The findings of hypothesis testing are presented in Table 5.19.

Hypothesis	Independent Variable	Dependent Variable	Status
H1	Performance-related use of KMS	Social capital development	Support
H1a	Information-related use of KMS	Interaction-related use	Support
H1b	Interaction-related use	Personal networks expansion	Supported
H1c	Interaction-related use	Trust building	Not supported
H1d	Interaction-related use	Shared vision development	Supported
H1e	Personal networks expansion	Trust building	Supported
H1f	Personal networks expansion	Shared vision development	Supported
H1g	Shared vision	Trust building	Supported
H2	Perceived usefulness	Performance-related use of KMS	Supported
H2a	Perceived usefulness	Information-related use of KMS	Supported
H2b	Perceived usefulness	Interaction-related use	Supported
H3	Social Norms	Performance-related use of KMS	Supported
H3a	Support from management and peers in using KMS	Information-related use of KMS	Not supported
H3b	Support from management	Interaction-related use	Supported

	and peers in using KMS		
H3c	Desire to please management and peers by using KMS	Information-related use of KMS	Not supported
H3d	Desire to please management and peers by using KM	Interaction-related use	Supported
H4	Information Quality	Performance-related use of KMS	Supported
H4a	Information content quality	Information-related use of KMS	Not supported
H4b	Information services quality	Information-related use of KMS	Supported
H5	/Information Quality	Perceived usefulness of KMS	Supported
H5a	Information content quality	Perceived usefulness of KMS	Supported
H5b	Information services quality	Perceived usefulness of KMS	Supported
H6	Ease of use	Perceived usefulness of KMS	Supported

Table 5.19 A Summary of Findings of Hypotheses Testing

5.5 Chapter Summary – Data Analyses and Results

This chapter was dedicated to the data analysis processes in detail. The data analysis strategy was articulated first, setting out the analysis objectives, analysis procedure, and acceptable criteria for the statistical analysis results. The demographic characteristics and descriptive statistics of whole sample were then examined, following by a discussion of the statistical assumptions relevant to the model and hypotheses testing. The basic analyses of the sample data resulted in a good feel for the data, and showed that the sample was applicable for further analysis via both covariance-based SEM technique, such as LISREL, and PLS.

A complete and detailed process of survey instruments validation was presented in this chapter. Three newly developed or adapted instruments (i.e., Performance-related Use of KMS, Information Quality, and Social Capital Development) were subjected to a strict validation process under a well-articulated validation procedure. Following the recommendations in the literature, Covariance-based Structural Equation Modelling (SEM) technique, LISREL, was employed for the validation process. As a result, the convergent, and discriminant validity of three new instruments were established through a strict validation procedure, and parsimonious and useful scales were also achieved.

Following confirmation of good psychometric properties in the measurement model, three structural models were subsequently assessed by PLS, and good model fits were achieved for all the assessments. Based on the outcomes of the structural models testing, significant hypothesis testing results were obtained. Meanwhile, the PLS analysis also further confirmed the results of constructs validation by LISREL analyses.

The results of hypothesis testing were summarized in Table 5.19. Further analysis and interpretation of the results will be presented in Chapter 6, followed by the research conclusions, discussions, and implications drawn from the work done in this study.

6 Conclusions and Implications

This chapter finalizes the study by summarizing the main findings of this research, interpreting and explaining these findings, exploring the implications of the findings both in a theoretical sense and in a practical sense, addressing the limitations of the research and highlighting the potential for future study. Chapter 6 is organized as follows. Section 6.1 is the introduction; Section 6.2 summarizes the main research findings, and provides interpretations and explanations for some of the main findings; Section 6.3 explores the implications of the research both in a theoretical sense and in a practical sense; Section 6.4 discusses the limitations of this study, and the potential issues for future study; Section 6.5 summarizes the discussions in this chapter.

6.1 Introduction

The actual role of Information Technology in knowledge management has long been debated (e.g., McDermott 1999; Alavi and Leidner 2001; Malhotra 2001; Walsham 2001). The debate raises crucial concerns regarding the development and use of KMS in organizations. This study attempted to contribute to the debate by empirical investigation of two crucial issues, and has achieved success in several areas (please refer to section 6.2 for details). The issues are:

Q1: Why do end-users accept and use KMS? What are the fundamental determinants to users' acceptance and use of KMS? And
Q2: What are the impacts of KMS use on the end-user's (i.e., knowledge worker's) social capital?

6.2 Conclusions and Discussion

This study has yielded a set of significant results by exploring the research questions and testing the derived research hypotheses. The research made several contributions to the KM and KMS study. Some of the general contributions are summarized as follows.

- A comprehensive KMS success model, based on existing research on knowledge management and information systems success, has been developed and tested across a variety of organizations and KMS; the research model also

provides a solid basis for further study.

- A set of specific survey instruments for KMS has been developed and validated across a variety of organizations and KMS, which would help organizations to investigate and diagnose their KMS and improve decision-making on investment and operation of KMS.
- A set of potential critical determinants to users' acceptance and use of KMS has been identified and studied across a variety of organizations and KMS. The results have demonstrated different levels of impacts of these factors on the users' acceptance and use of KMS.
- The study has confirmed that knowledge management technology systems (KMS) have significant effects on individual and organizational social capital, a critical social infrastructure for knowledge management;
- The impacts of KMS use on three dimensions of social capital—structural, relational, and cognitive dimension—has been assessed, and significant findings were generated;
- Methodologically, two complementary structural equation modelling methods - PLS and Covariance-based (LISREL) - were applied to the data analysis, which enhanced the accuracy and reliability of the findings.

The detailed research findings can be grouped into two sets. The first set of findings, corresponding to the impacts of KMS on social capital, is highlighted and discussed in Section 6.2.1. The second set of findings, addressing the key determinants of the users' acceptance and use of KMS, is summarized and discussed in Section 6.2.2.

6.2.1 The Impacts of KMS on Social Capital

The hypothesized effects of KMS on the development of social capital have been investigated at both construct level and the sub-construct level. The investigation at construct level focused on examining the hypothesized relationships among the constructs represented in research model I and model III, such as the impact of KMS use on the social capital as whole (see Section 5.4.1 and Section 5.4.3). The investigation at sub-construct level mainly addressed the hypothesized relationships among the sub-constructs (represented in research model II), such as the impacts of the sub-constructs of KMS use, including the information-related use of KMS, and the interaction-related use of KMS, on the sub-constructs of social capital development,

including social networks, trust development, and shared vision (see Section 5.4.2). The empirical investigations and analysis have shown significant evidence that the use of KMS affects the development of social capital at both the constructs and the sub-constructs levels. The relevant main findings can be highlighted as follows:

- The use of KMS was found to have a significant positive impact on the development of personal social capital, both for performance-related and function-related use of the KMS.
- The interaction-related use of KMS was found to have a significant positive effect on the development of personal social networks, in that it could help users by expanding their connections with people in their organization.
- No direct impact of the interaction-related use of KMS on the trust development was found, but an indirect influence has been identified, through social networks and shared vision.
- The interaction-related use of KMS was found to have a significant positive impact on the development of shared vision between colleagues in an organization.
- The development of personal social networks was found to have a significant positive impact on the development of trust in an organization.
- The development of shared vision was found to have a significant positive effect on the development of trust in an organization.
- The development of personal social networks was found to have a significant positive impact on the development of shared vision.
- The impact of information-related use of KMS on user's social capital is mediated by the interaction-related use of KMS.

Further interpretation and explanation of these findings is set out below.

The research findings provide strong supportive evidences for the argument that the implementation and use of KMS may benefit the end-users and organizations in terms of enhancing both the individual's and the organization's social capital. It is believed that the development of social capital may have profound and long-term influence on the individuals and organizations, in improving organizational knowledge management and performance (Lesser 2000; Cohen and Prusak 2001). It is worth noting that two

alternative measures of KMS use (see Section 5.4.1 for Model I testing, and Section 5.4.3 for Model III testing) have resulted in similar results, which ensured the validity and reliability of findings.

The empirical findings also support the propositions made by Blanchard and Horan (1998), who proposed that computer-mediated communication (CMC) such as electronic mail, online discussion forums and computer conferences, may increase user and/or organizational social capital by

- Expanding the user's personal social networks.
- Strengthening the effects of norms of behaviours (e.g., reciprocity), and
- Raising the levels of trust provided that users are affiliated in some way, such as being members of the same institution.

Consistent with the studies of computer supported social networks (Wellman 1996; Wellman 2001), the interaction-related use of KMS can help end-users:

- To expand their intra-organizational personal connections significantly.
- To know more colleagues within their organizations, and
- Probably have better advice-networks (Cross, Borgatti et al. 2002).

This finding is also consistent with a previous study (Ogata, Yano et al. 2001). Furthermore, following a process of socializing the KMS technology artefacts (Orlikowski 2000), the use of KMS turns the KMS into a social network which connects workers and fosters interpersonal social relationships within organizations, benefiting end-users with information, knowledge, and social support (Wellman 1996). The range of interpersonal social networks - relationships that span multiple knowledgeable individuals and networks - is recognized to increase the opportunities for information and knowledge acquisition and transfer (Yli-Renko, Autio et al. 2001; Reagans and McEvily 2003), and the ability of problem-solving (Cross, Borgatti et al. 2002).

The interpersonal social networks formed and facilitated by KMS may affect the attitude and behaviour of the people using the KMS. Although the direct impact of KMS use (mainly the interaction-related use of KMS) on the trust development among

the end-users was not confirmed, indirect effects might exist. It is reasonable that trust development for knowledge workers in the workplace is a process closely related to mutual understanding based on information and knowledge sharing (Lewicki and Bunker 1996), which can be a complex process (Cohen and Prusak 2001). In addition, information on colleagues' trustworthiness would travel quickly through the relevant social networks. Common language and values and a shared commitment may also encourage the development of trust relationships (Blanchard and Horan 1998; Nahapiet and Ghoshal 1998; Tsai and Ghoshal 1998; Cohen and Prusak 2001). Understandably, personal social networks were found to have a significant positive effect on trust development, so does shared vision. These findings are consistent with the empirical results reported by Tsai and Ghoshal (1998), and are very significant because they provide positive support for the building of professional trust relationships among knowledge workers in the workplace through KMS.

Similarly, the KMS may affect the mental models of the people using KMS, such as shared vision and commitment. By definition, the shared vision addresses:

> *"A set of common values help develop the cognitive dimension of social capital, which in turn facilitates individual and group actions that can be benefit the whole organization" (Tsai and Ghoshal 1998, p.465).*

Findings in this study are evidence of the significant impact of KMS use (mainly the interaction-related use of KMS) on shared vision. Personal social networks were also found to have significant effects on shared vision. Logically, it is the frequent interaction and communication through KMS and/or personal social networks that prompt representation, interpretation, and systems of meaning-sharing among colleagues, leading to shared vision and commitment development (Nahapiet and Ghoshal 1998).

Consistent with the learning theory suggested by Wenger (1998), the information-related use of KMS promotes the interaction-related use of KMS. It is reasonable that a piece of relevant information from KMS may cause and/or enhance the further usage of KMS in interaction. For instance, information retrieval may lead to a further information exchange or collaborative actions, such as a reader of a piece of information

who requires further details, which may in turn drive him or her to email to or to chat with the colleague who owns and/or provides the original information. Furthermore, according to Wenger (1998)'s learning theory, a fundamental duality, participation and reification, plays a vital role in a learning process (see Chapter 2 for details). The participation refers to connection and interaction (i.e., an action of taking part in learning), whereas the reification addresses the utilization of information or explicit knowledge during the learning process. Both participation and reification form a unity and work together to enable an effective learning process including knowledge creation and sharing (Wenger, 1998). Therefore, participation-related activities require relevant technical systems (e.g., KMS) to make connections and enable interaction with other people, whilst the reification-related activities require relevant technical systems (e.g., KMS) to support the utilization of information and explicit knowledge during people's interaction. This implies a strong relationship between the interaction-related use of KMS and information-related use of KMS. The empirical findings in this study clearly support this theory, and also highlight the necessity of the information-related use of KMS.

In sum, this research study has made a significant contribution to the understanding of the effects of KMS use on crucial organizational knowledge management infrastructure, e.g., social capital. Moreover, the research findings also provide supportive evidence for the learning theory suggested by Wenger (1998) and studies of computer supported social networks (Wellman 1996). The findings discussed in this section answer the first research question. With regard to the second research question, this study has explored the antecedents of users' acceptance and use of KMS in organizations.

6.2.2 The Determinants of the Users Acceptance and Use of KMS

This study has empirically investigated the key determinants of users' acceptance and use of KMS, based on the relevant research studies on information systems acceptance and utilization. The main findings regarding the critical factors to affect users' acceptance and use of KMS from this study can be summarized as follows:

- Information quality is a key determinant to users' acceptance and use of KMS.
- Information content quality is not a significant factor in determining information-related use of KMS.

- Information services quality has a significant impact on information-related use of KMS.
- Social norms is an important factor affecting users' acceptance and use of KMS.
- Support from management and peers in the use of KMS was found to have a significant positive impact on interaction-related use of KMS.
- Support from management and peers in the use of KMS was found to have no significant impact on the information-related use of KMS.
- Users' desire to please management and peers by using KMS was found to have a significant positive impact on the interaction-related use of KMS.
- Users' desire to please management and peers by using KMS was not found to have a significant impact on the information-related use of KMS.
- Perceived usefulness of KMS was found to be a key determinant to users' acceptance and use of KMS.
- Perceived usefulness of KMS was found to have a significant impact on the information-related use of KMS.
- Perceived usefulness of KMS was found to have a significant impact on the interaction-related use of KMS.

Further interpretation and explanation of these findings is set out below.

In this study, information quality, social norms, and perceived usefulness were hypothesized as the most important direct antecedents for affecting user's acceptance and utilization of KMS, and perceived ease of use was also taken to be an important factor, but mediated by perceived usefulness, based upon previous empirical studies (e.g., Davis 1989; Straub, Limayem et al. 1995; Venkatesh, Morris et al. 2003).

Consistent with the previous research findings in the studies of information systems success (e.g., Davis 1989; Doll, Hendrickson et al. 1998), perceived usefulness of KMS was confirmed to be a significant factor for a user to accept and use KMS. The study indicated that perceived usefulness of KMS had a significant direct effect on both information-related use of KMS and interaction-related use of KMS. This highlights the fact that perceived usefulness may be a vital factor in the assessment of KMS success. It is worth noting that the results are quite conservative, because the measurement model of perceived usefulness comprised only two items rather than six items as normal

(Davis 1989; Doll, Hendrickson et al. 1998), leading to lower psychometric properties in the measurement of the construct.

With respect to the effect of social norms on the use of information technology, research so far has yielded mixed results in IS literature. While some empirical studies found no significant effect of social norms on individual intention and use of information technology (e.g., Davis, Bagozzi et al. 1989; Venkatesh, Morris et al. 2003, Lewis, Agarwal et al. 2003), some did find a significant effect (e.g., Taylor and Todd 1995; Lucas and Spitler 1999). The findings from this research contribute to the debate by demonstrating the significant effect of social norms on the KMS use as a whole, and mixed results from the sub-construct level analysis.

The findings on the effects of social norms on KMS use are interesting. As a whole, social norms were found to have a significant impact on the use of KMS in both the Model I and Model III testing, whilst the result from Model III testing was only marginally significant ($P < 0.1$), and the magnitude of effect was also marginal (0.092). Davenport and Prusak (1998) identified senior management support as one of the critical factors in knowledge management project success. The results in this study are consistent with their findings.

According to the Theory of Reasoned Action (TRA) and the Theory of Planned Behavior (TPB) (cf. Davis 1989; Venkatesh and Davis 2000), a person may choose to perform a behaviour if they perceive that one or more important referents think they should do so, and they are sufficiently motivated to comply with the referents, or the referents have the ability to reward the behaviour or punish non-behaviour. As this research is a field study of knowledge workers, the majority of which are from professional or business organizations, these users of the KMS are more likely to be influenced by, and comply with colleagues and senior management's expectations (Lucas and Spitler 1999). This explanation provides the rationale for the research findings.

A further sub-construct level analysis (Model II testing) indicated that the support from management and peers in using KMS and the user's desire to please them by using KMS were two significant factors in affecting end-user use of KMS for the purposes of

interaction. However, the effect of user's desire to please management and peers by using KMS was marginal in the magnitude (0.098). The two factors did not show any significant effect on information-related use.

Venkatesh and Davis (2000) found a significant direct effect of social norms for mandatory systems, but not for voluntary systems. Although Lucas and Spitler (1999) found a significant direct effect of social norms on the use of broker workstations, but there was '*not enough voluntary use of the system*' (p.304). The findings of this study are notable because, in this context, KMS is not a sort of proprietary system which people have to use to perform their daily duties. Therefore, the nature of KMS use could be assumed to depend upon individual beliefs and behaviour, and, therefore, be voluntary.

Why would social norms significantly affect end-users' use of KMS, being a voluntary system? There is a plausible explanation. The interaction-related use of KMS involves pairs or groups of people, so the usage may be considered somewhat mandatory because some existing norms of behaviour (e.g., reciprocity) in workplace may enforce usage. The non-significant effect of social norms on information-related use is probably due to the usage being totally voluntary. Moreover, the end-users of the KMS, as individuals, might not value the information yielded.

In addition, among the predictors of KMS use, the effects of social norms are the weakest in terms of magnitude (see Section 5.4.1 and 5.4.3 for the Model I and III testing). These finding are consistent with prior research findings in IS studies (e.g., Venkatesh, Morris et al. 2003).

Furthermore, with respect to the impacts of two sub-constructs of social norms on the interaction-related use of KMS, support from management and peers shown a stronger effect than did the user's desire to please management and peers. A plausible explanation for this phenomenon is that KMS is a system mainly interactive in nature, so that support from management and peers is more important than the user's goodwill.

Another interesting finding was that the effect of social norms seemed irrelevant to the stages of KMS use, as the majority of the respondents in this study had over a year's

experience of their KMS. The prior observed result suggested that social norms would have significant effects only in the early stages of individual experience with the technology (Venkatesh, Morris et al. 2003). This inconsistency may be due to the different nature of the technology systems. KMS is characterized as being evolutionary and interaction-oriented. Accordingly, the value and usefulness of KMS increase over time, and norms of behaviour in communication and collaboration form along with the continuous use of the KMS. The result is that social norms still play a significant role in affecting user's acceptance and use of KMS.

This finding highlights the importance of the nature of the systems in the examination of the direct effects of social norms on the acceptance and use of the systems. This factor has been ignored in prior studies, which may be one of the major reasons for the mixed results. In addition, various inconsistent definitions, operationalizations and measures of social norms may also be reasons for the mixed findings. Therefore, the same or similar definitions, operationalization, and measures of social norms should be employed whenever and wherever possible in order to reduce inconsistency in studies. The definitions, operationalization, and measures of social norms in this study were adapted directly from Lucas and Spitler (1999).

Based on studies of information systems success (DeLone and McLean 1992; DeLone and McLean 2003), information quality was assumed to be one of the most important antecedents in determining the use of KMS, and consequently the success of KMS (Alavi and Leidner 2001). As expected, information quality as a whole was confirmed to be the significant determinant of the use of KMS through both the model I and III testing (see Section 5.4.1 and 5.4.3). A further assessment of Model II suggested that information services quality has significant impact on the information-related use of KMS, whereas information content quality did not show any significant effect on the information-related use. It is understandable that quality information-related services would benefit information-related KMS usage. However, it is hard to see why more accurate and up-to-date information content would not have any significant impact on information-related usage. One plausible explanation might be that the information content quality was not so important for KMS success (even information-related usage) in the opinion of users. Information services quality, which involved locating experts and getting help to access and understand information and knowledge, was significant

for information-related usage.

Both Model I and Model III testing indicated that information quality had significant impact on perceived usefulness, which is consistent with previous studies of information systems success (DeLone and McLean 2003). Moreover, as expected, both information content quality and information services quality were found to have significant effects on the perceived usefulness of KMS by Model II testing.

As expected, perceived ease of use was found to have a significant positive impact on the perceived usefulness in all of the three model tests. This result is consistent with previous studies of information systems success (Davis 1989; Doll, Hendrickson et al. 1998; DeLone and McLean 2003).

6.3 Implications for Theory, Methodology and Practice

This study was motivated by the following recognition:

- Huge investments have been poured into knowledge management systems projects across continents during the past decade, and
- Researchers, IT departments, and top management alike need to better understand what role KMS will play in organizational knowledge management initiatives, how to measure its success, and what drives the KMS to be a success.

In studies of KMS under the knowledge-based theories of the firm, the firm is viewed as a distributed knowledge system (Tsoukas 1996), and KMS has been approached from systemic, dynamic, evolutionary, and constructionist perspectives (DeSanctis and Poole 1994; Spender 1996; Orlikowski 2000; Orlikowski 2002). Instead of focusing on knowledge management processes (Alavi and Leidner 2001), this study focuses on KMS use and its impact on social capital (i.e., social networks, trust, and shared vision), reflecting the development of connections and common knowledge among organizational members. The findings of this study provide empirical evidence for:

- Understanding the role of KMS in organizations.
- The major antecedents to actual KMS use and KMS success, and

- Recommendations for practitioners.

This research has developed:

- Two viable KMS success measurement models, i.e., the socio-technical KM model and AST-based KM success mode, and
- Survey instruments, which can be used both for further study and as practical diagnosis tools for the operation and management of KMS.

This research has several implications for theory, methodology and practice.

6.3.1 Implications for Theory

This study highlights the necessity of examining KMS under the knowledge-based theories of the firm. The knowledge-based theory of the firm provides the rationale for the existence and functioning of KMS within organizations. A variety of available knowledge-based theories of the firm provide opportunities for examining KMS from different angles, which enriches our understanding about KMS and its role in organizations. As organizational knowledge is complex, tacit and emergent, the result of the social interaction of people, processes and organizations are evolutionary distributed knowledge systems (Tsoukas 1996; McDermott 1999; Brown and Duguid 2001), therefore, KMS can be better understood from a social constructionist perspective. This study represents an effort in this direction.

This study has significant implications for the measurement and evaluation of KMS success. The establishment of viable measurement model for KMS success involves the identification of major dependent variables, mediating variables, independent variables, moderate variables and the possible cause-effect relationships among them. In the evaluation and measurement of the success of KMS, a key issue is to identify suitable dependent variables which can reflect the actual understanding of KMS and expectations toward KMS. With a view to facilitating and supporting organizational knowledge management, the effects of KMS can be interpreted from different perspectives. Two main paradigms can be drawn from relevant literature. Alavi and Leidner (2001) suggested that KMS and its effects can be studied from an organizational

knowledge management process perspective. From this perspective, organizational knowledge management is viewed as a set of explicit knowledge management activities and processes, such as knowledge creation, storage/retrieval, transfer, and application, and KMS is used to support these processes in organizations. A significant implication of this view of KMS is that KMS is designed and utilized mainly for supporting the management of information or explicit knowledge, therefore there is no substantial difference between information systems and knowledge management systems (e.g., data mining). This explicit knowledge-focused paradigm can be considered as information-oriented and having knowledge as an objective. Consequently the impacts of KMS on KM processes should be key dependent variables of the success of KMS, and information quality should be one of the key determinants (Alavi and Leidner 2001). Although information is important in thinking activities, this information-oriented perspective may not be so useful and effective in evaluating KMS success because it has confused the fundamental difference between knowledge and information, and has missed the core issues in organizational knowledge creation and sharing, for example social contexts, social process, and human issues (Brown and Duguid 1998; McDermott 1999; Walsham 2001; Malhotra 2003).

An alternative perspective focuses on tacit knowledge, and suggests that KMS should be deployed mainly for helping people to think together (McDermott 1999; Nonaka and Reinmoeller 2000; Wenger 2001). This perspective can be called human-centered (Walsham 2001), and focuses on enhancing people interaction, trust development and shared social contexts among organizational members (Brown and Duguid 1998). In this case, information is significant and important, but not vital for knowledge creation and sharing. Know-who may be more significant and important than know-what (Sveiby 1999). A significant implication of this view of KMS is that KMS is designed and utilized mainly for supporting people interactions (e.g., communication and collaboration), therefore, there is a substantial difference between information systems and knowledge management systems. The evaluation of KMS success lies in assessing the effects of KMS use on social capital, i.e., user's social networks, trust, and shared vision within organizations (Nahapiet and Ghoshal 1998). This study has provided rich interpretations of KMS success from the human-centered perspective. The results of this study explained around 30% of the variance in social capital, and suggest that the research model provides a reasonable and acceptable conceptualization of the

phenomenon of interest.

This research sought to develop a new multidimensional measure of KMS usage, which could provide sufficient explanatory power to facilitate a rich research agenda on the effects of KMS (Doll and Torkzadeh 1998). Compared to the uni-dimensional measure of IT usage such as frequency of use, a multidimensional measure which reflects the main performance-related facets of IT usage behaviour has advantages and presents the richness of actual and purposeful IT usage behavior in work settings. A multidimensional measure enables us to investigate the pattern and extent of KMS use along relevant to the development of organizational soft infrastructure for knowledge management. Thus, it sheds light on how relevantly and effectively organizations are using KMS. Furthermore, as knowledge and KMS are considered as being socially constructed, thus a multidimensional measure of KMS usage, serving as a mediating variable, may provide an important instrument for advancing research on the emergent perspective of the causes to KMS use and its effects. In addition, a multidimensional measure also allows us to assess KMS usage at the application or individual level in real organizational context.

This study has implications for the role of information and information quality in evaluating KMS success. In IS research, information quality has consistently been found to be a significant determinant of IS success by a series of empirical studies (DeLone and McLean 1992; Garrity and Sanders 1998; DeLone and McLean 2003). In this study of KMS, however, it is the information-related services quality, rather than the information content quality that has the more significant effect on the KMS success (e.g., KMS use). In this study, information content quality is assessed in terms of its accuracy, relevance, currency, and level of details, whereas information-related services quality is measured by locatability, accessibility, and assistance (Goodhue 1998). These findings emphasize the importance of information-related services in determining KMS success. They also highlight the fundamental difference between IS and KMS, that is, information and its quality may be relatively unimportant in organizational knowledge management. In information systems such as MIS and EIS, the main output is information, so that the information content quality is understandably critical to the user's acceptance and use of the systems. However, KMS is mainly used for supporting people interaction (communications and collaboration), so that the major concern

naturally shifts to information services quality.

The results of this study have implications for the effects of social norms in a post-implementation context. The role of social norms in predicting IT usage or IS success has long been disputed, and relevant findings from empirical studies are mixed (Venkatesh, Morris et al. 2003). This study provides new empirical evidence regarding the effects of social norms on KMS success in the context of voluntary use and post-implementation. Unlike most information systems which are an integral part of a user's job and whose use is mandatory, KMS is used on a voluntary basis. An interesting finding regarding the effects of social norms was that social norms did not affect information-related usage significantly, but did have a significant effect on interaction-related usage. It is possible that the information stored in the KMS was not perceived as useful and access and utilization of information was completely voluntary. However, when people are involved in interacting (communicating and collaborating) with others via KMS, the usage may not be so voluntary; social norms could cause people to use it. For instance, when a person receives an email asking for help, he or she may feel duty bound to respond. This suggests that the effects of social norms may rely on other factors, such as

- The nature of the user's job task (the extent of reliance on an IT application).
- The nature of the IT application (proprietary working systems or open systems).
- The organizational culture (individualism or collectivism) except during the stage of IT application adoption, and
- The usage context (mandatory or voluntary).

For example, after a broker workstation system was introduced, brokers and sales assistants showed different patterns of use, and investigation of social norms had shown different levels of influence on the usage dependent on their job – non-significant for brokers, and significant for sales assistants (Lucas and Spitler 1999). In addition, when a climate of trust and collaboration permeates an organization, it can be expected that social norms will more easily affect employee's behaviour (e.g., participating in online interactions). In existing relevant literature, the last two factors, the stage of IT application adoption and the usage context, have been partially addressed (Lucas and Spitler 1999; Venkatesh and Davis 2000; Lewis, Agarwal et al. 2003; Venkatesh,

Morris et al. 2003). However, the first three factors, the nature of the user's job task, the nature of the IT application, and the organizational culture, have not attracted significant attention.

6.3.2 Implications for Methodology

Methodologically, the research design in this study has taken advantages of two main Structural Equation Modelling (SEM) techniques. The two SEM techniques were used in a complementary way to improve the data analysis and model tests. Co-variance-based SEM, LISREL, and confirmatory factor analysis (CFA) were used to conduct construct validation, assess the psychometric properties of survey instruments and pursue more precise and reliable assessment of the construct validity. The PLS-based SEM was chosen to assess the structural models so as to better reflect the nature of the study as theory building and prediction, avoiding the effects of sample data characteristics, such as abnormal sample distribution. As a result, it is argued that this strategy enhanced the credibility and reliability of the results and findings. This research design is significant for an empirical management study, because most management studies face problems such as small samples, abnormal sample distribution and poor or incomplete research models.

6.3.3 Implications for Practice

This study has significant implications for managers. Firstly, this study provides empirical evidence for the usefulness and effectiveness of KMS in organizations. Secondly, knowledge rather than information is the core concern of KMS, and organizational knowledge management can only be achieved by connecting people and enabling them to think together, rather than by building large databases of best practices (McDermott 1999). Therefore, more attention should be paid to the communication and collaboration functionality rather than the information and knowledge repositories during the design, development, and utilization of KMS. Thirdly, although KMS is an exciting artefact and requires a significant investment, use of KMS is not automatic; managers should pay attention to the social norms that encourage the use of KMS. Fourthly, it is critical to foster a positive knowledge culture and ensure support from senior management; trust and shared vision within an organization enhances the effect of social norms, which would in turn enhance the effective use of KMS. Fifthly,

information services quality matters more to KMS users than information content quality, in influencing their acceptance and use of KMS. Accordingly, managers should pay more attention to information services quality instead of spending money, time, and human resources on improving information content quality. Sixthly, although it cannot be manipulated, perceived usefulness is still a significant predictor to the use of KMS. This in turn is affected by ease of use and information services quality, highlighting the importance of the KMS interface and of information services quality.

This study provides viable instruments for managers investigating and diagnosing the use of KMS and other causal factors to the KMS use, such as social norms and information services quality. Although the KMS use variable cannot be manipulated, the multidimensional instruments of KMS use can disclose the real status of performance-related use of KMS, and provide significant indicators for evaluating KMS success and its effects within organizations.

6.4 Limitations and Future Research

Like most similar management research, this study has its limitations. Several major limitations are discussed in the hope of offering possible directions for further research.

6.4.1 Limitations

Firstly, there is no unified definition of knowledge and knowledge management. Therefore, research depends on the specific view of knowledge and knowledge management, which may cause difficulty in generalizing the research findings.

Secondly, it suffers from the conceptualization of knowledge management systems. It is impossible to set a boundary for KMS, as it is a bundle of ever-advancing information technologies applied to facilitating and supporting organizational knowledge management. According to the viewpoint of technology-in-practice (Orlikowski 2000), technologies are constituted in use; the actual functions and features of KMS are emergent use structures, which depend upon how the KMS is used in the particular instance. The original properties provided by KMS can only serve as a starting-point of the evolution of KMS. Therefore, KMS can only be conceptualized along with what people actually do with it. In many computerized knowledge management-related

activities, three basic activities were identified and included in this study. These are information access and distribution, electronic communication, and collaboration. As a result, many other important direct knowledge management activities such as knowledge creation, knowledge storage and retrieval, knowledge transfer and knowledge application are left for future study.

Thirdly, this study has been conducted by pure quantitative methods, i.e., by survey and statistics methods. Although quantitative methods are popular in management research and information systems research, the evaluation of KMS use and its effects often involves evaluating a complex socio-technical phenomenon defined by the interaction of people and technology in an organizational context, so qualitative methods such as case studies, or a combination of quantitative methods and qualitative methods, may help in approaching and interpreting this complex processes.

Fourthly, with respect to the measurement of social capital, personal networks were measured by the extent of personal connections with colleagues within organization. This could not reflect the richness of personal networks, e.g., the nature of the relationships (strong ties and weak ties) and the structural holes (Burt 1992), and the range of the networks, which may cross the boundary of organizations (Wellman 1996). Prior study suggests that three types of trust exist in professional relationships (Lewicki and Bunker 1996); the measure of trust in this study only addressed the knowledge-based trust. Although the knowledge-based trust is the dominant type of trust in professional relationships at work, the other two types of trust also deserve further study. Fifthly, this study did not address the moderation effects of contextual factors, such as age, gender, education and organization size. Moderator relationships are recognized as one of the most interesting relationships in recent MIS research, and have been argued to have significant impacts on the results of some relevant MIS research (Carte and Russell 2003). As a result, the findings of this study may not be as rigorous and reliable as expected, as they did not include these moderating factors.

This research is only a first step towards better understanding the KMS use and its effects in organizations. Although the study has achieved its targets, a number of topics remain for further research.

6.4.2 Future Research

The current research model demonstrates a conceptual chain of KMS success, i.e., a systems-to-social capital-to-intellectual capital creation chain of KMS, which comprises upstream and downstream sub-models, mediated by KMS use. While the downstream research domain addresses the impact issues of KMS, i.e., individual or organizational social capital development, caused by using KMS, the upstream research domain is involved in answering why people use KMS or in finding ways to make people use KMS.

More work is needed to elaborate the research model. Firstly, while the upstream model is mainly constructed by a combination of the Post-Implementation version of Technology Acceptance Model (TAM) (Davis 1989; Szajna 1996) and Technology-Task Fit Model (TTF) (Goodhue and Thompson 1995; Goodhue 1998), the model explained around 30% of the variance in KMS use as a whole. Further model II testing indicated that the model explained 25.6% of the variance in information-related use, and 47.5% of the variance in interaction–related use of KMS. Although the model has strong explanatory power for the focal construct (e.g., KMS use), it is obvious that the model can be improved by introducing more causal factors and key moderating variables, such as facilitating conditions, gender, age, experience (Venkatesh, Morris et al. 2003) and collaborative climate (Sveiby and Simons 2002).

The moderation effects of contextual factors, such as age, gender, education level, and organization size may have significant implications for organizationa knowledge management and KMS study. In an empirical investigation, Sveiby and Simons (2002) found that age and education level and organization size have significant impact on knowledge worker's knowledge management. Older people tend to have larger networks and be easier to access knowledgeable colleagues than their junior follows. The individuals with higher education can interpret information/knowledge shared more easily. They also evidenced that bigger organizations have better knowledge sharing than smaller organizations do. In addition, as a fundamental aspect of culture, gender could be expected to have significant influence on knowledge management and KMS too. A cross-culture study of use of e-mail conducted by Gefen and Straub (1997) indicate that male and female hold different perceptions about e-mail communication system. It, therefore, can be expected that the inclusion of age, gender, education level,

and organization size into KMS research would result in significant outcomes.

As a key component of organizational KM culture (Davenport and Prusak 1998; Liebowitz 1999), Sveiby and Simons (2002) argued that a collaborative climate is critical for knowledge workers to improve their productivity and provide empirical evidence for their claims. A collaborative climate focuses on the importance of information and knowledge sharing, and may have significant effect on the use of KMS. Therefore, the effects of collaborative climate on KMS success deserve an empirical exploration.

Another significant opportunity to enhance the upstream model is to extend the task-technology fit construct. In current research, the information quality has been used as a surrogate for the TTF, that is, the TTF has been confined to measure the extent of user's requirements of the information and information-related services are met (Goodhue 1998). However, the TTF can be extended to include communication, and coordination and collaboration dimensions besides the information dimension for matching different task categories (e.g., ad-hoc task vs. repetitive task, complexity vs. simple, etc.). Through identifying knowledge workers' communication and the coordination and collaboration requirements in the working environment, a new TTF with three main dimensions can be formulated and a new multi-dimensional TTF measure developed to measure the extent to which the user's requirements for information, communication, and coordination collaboration are met by KMS. It can reasonably be expected that the new TTF construct and measure would enhance the explanatory power of KMS use.

The measure of KMS use can be further customized. The performance-related measure makes it possible to customize the KMS use measure for specific applications, and the unit of analysis can be the application, the individual, or the work group, and organization. For instance, communities of practice (CoPs) are recognized as important and significant organizational structures for knowledge management (Wenger and Snyder 2000). KMS can play an active role in supporting communities of practice (Wenger 2001; Andriessen, Soekijad et al. 2002). It would be an interesting research task to redefine and measure KMS use specifically from the perspective of supporting communities of practice.

The use of KMS in organizations is a complex phenomenon. Adaptive structuration theory provides us a viable way to understand the phenomenon better (DeSanctis and Poole 1994; Orlikowski 2000). While the quantitative survey and statistic analysis method employed in current research could provide significant insights into the use and effects of KMS in organizations, it may only present snapshots of the whole picture. Therefore, a qualitative historical study would help us to better understand the dynamic evolution of KMS use and its effects within organizations over time. A study of KMS from a multi-method perspective would enrich the KMS literature.

The downstream research model addresses the individual, organizational or economic impacts of KMS use on organizations or individuals. The measures of social capital could be improved. For instance, new measures can be designed and developed for personal networks, trust, and shared vision. In additional, different dependent variables and measures can be chosen for specific research purposes; for instance, a set of community-of-practice-related measures could be established for evaluating the effectiveness of KMS use in supporting communities of practice.

6.5 Summary—conclusions and implications

This chapter is devoted to the discussion of the research findings, implications, limitations, and future research directions. Two complementary second-generation statistic techniques, PLS (SmartPLS1.1) and LISREL8, were used for data analysis (measurements development and research models testing). The results suggest that the research models fit the sampling data well, and most hypothesized relationships have been confirmed. A set of significant insights about the KMS success (i.e., use of KMS and its effects) has been obtained.

Social capital is thought of as the main source of knowledge-based value creation in organizations (Nahapiet and Ghoshal 1998; Lesser 2000), and performance-related KMS usage is a core construct in this research. The study provides clear empirical support for the hypothesized relationships relating the interaction-related use of KMS to social capital development in organizations. It also provides additional empirical evidence for the interacting relationships among the structural, relational, and cognitive dimensions of social capital within organizations, providing supportive evidence for the previous study (Tsai and Ghoshal 1998).

The findings from this study suggest that information-related KMS usage is the major predictor of the interaction-related KMS usage, followed by the support from management and peers and perceived usefulness. The quality of information-related services and perceived usefulness of KMS are the main predictors of information-related KMS usage. Consequently, KMS usage would depend upon the quality of interface (ease of use), information-related services quality and social norms. In other words, organizations can manipulate these three factors to encourage employees to better use KMS. These findings are useful for managers.

This research contributes to the KMS-related theory development by establishing a system-to-social capital-to-intellectual capital creation chain research model, which is a synthesis of variety of theories and models, such as the information systems success model (DeLone and McLean 1992; DeLone and McLean 2003), the technology acceptance model(Davis 1989), the task-technology model(Goodhue and Thompson 1995), the system-to-value chain (Doll and Torkzadeh 1998), adaptive structuration theory (DeSanctis and Poole 1994) (Orlikowski 2000), and the framework of social capital in intellectual capital creation (Nahapiet and Ghoshal 1998) in the context of knowledge-based theory of the firm (Spender 1996; Tsoukas 1996). This model can serve as a foundation for further study in exploring the design, use or success of KMS theoretically and empirically.

Based on the research findings, detailed recommendations have been made to the managers and IT practitioners. Several limitations of this study suggest that some caution has to be taken in using the research findings and the survey instruments developed in the study. The implications for future study have been explored and some potential research topics are proposed.