A Review of the Knowledge Management Model based On a Questionnaire Survey of Korean KM Experts

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1. Outline of Questionnaire Survey

1) Purpose of Survey

Based on the current situation of Knowledge Management (KM) in Korea, the purpose of this questionnaire survey is to further review proposed research models[1)], especially in terms of *how it is being recognized and approached*. As a natural course of statistical analysis, we will inquire each capability's validity and reliability in the survey. Else, we will try to infer the correlation among the variables so that we can have a clear picture on how those variables are inter-related. Furthermore, we will investigate the causal relationship among the variables, based on multiple regressions. Through the regression analysis and the subsequent hypothesis testing, we will be able to look into more clear aspects of our research model, such as KM capabilities' effect on KM performance, and causal relationship among the KM infrastructures and KM capabilities. Based on the outcomes of this survey, we proceed towards inferring the issue of KM capability building, the main perspective of this study.

2) Survey Measures and Variables

We have set *infrastructure and process capability* as the two independent variables, and *KM performance* (Effectiveness and Satisfaction) as a dependent variable. Each variable has 5 to 10 proxies as measurement object, based on the discussions in the previous sections. A total of 60 proxies were developed, consisting of C (9), T (9), S (6), PI (8), PII (7), PIII (6), PIV (5), and ES (10).[2)] All these were included in the questionnaire sent to Korean experts of KM, thus adopting multiple-item measures. Compared with single item measures – which tend to be framed narrowly – these measures are thought to enhance confidence, because constructs of interest are comparatively as well as accurately being accessed, bringing forth more consistency (Nunnally, 1978; Churchill, 1979). This is why measurement of complex organizational phenomena is typically done through multiple-item measures. On the other hand, as for the method of

1) Refer to the *Keizai Ronkyu* (経済論究), NO. 120, 2004, p. 137.
2) These abbreviations refer to C (Culture), T (Technology), S (Structure), and ES (Effectiveness and Satisfaction), while PI to PIV refers to the each phase of Process capability.

responding, we have made use of Likert scales with 7 scales to make utmost advantage of standardizing and quantifying relative effects. In the next section, we will focus more on the statistical analysis based on the questionnaire in order to verify the conceptual model suggested earlier in this study, and to infer the further implication of it.

3) Sample Data Collection

The survey was performed during the months of September and October of 2003, mostly in the form of email exchange with the Korean KM experts. In order to secure the creditworthiness of the survey, respondents were requested to fill up respective demographic information such as department, position, name, age[3), etc. Along the same line, respondents were requested to choose the most relevant category about the organization to which they belong, such as type of industry, number of employees, and life cycle of products or services at the point of time of survey. As this research is targeted toward the KM experts or KM-related personnel in Korean organizations, questionnaires were preferentially sent via email to those persons who are believed to work in KM-related sections of their organization.

In the course of identifying those experts, there was enormous cooperation from various organizations, among which are; IPS (The Institute of Industrial Policy Studies), SERI (Samsung Economic Research Institute), KAIST (Korea Advanced Institute of Science and Technology), the Maeil Business Newspaper, Korea Polytechnic University, KOTRA (Korea Trade-Investment Promotion Agency), etc. Some organizations even distributed the surveying questionnaires on behalf of the author in an effort to find out who were most suitable respondents. Throughout these efforts and assistance, of the 1,000 surveys distributed to persons and/or organizations, a total of 162 were deemed usable, while 5 were removed from further analysis due to multiple or missing responses.

In sum, the data collection process yielded assessments of 162 KM-experts, from rank and file to top management. All the respondents were reminded that the survey is designed to assess individual recognition or attitude about KM in their respective organization, thereby not necessarily representing the official opinion of the organization as a whole. The reason for this premise is that individual assessment can produce a more reliable survey, not biased on the organization's formal opinion. In doing so, the multiple data from same organizations could be counted as separate usable data, since the respondents opined their own personal views about the KM in their organizations.

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3) Age itself does not constitute much relevance in this survey. Therefore every respondent was allowed to choose an age group of 10 years interval, instead of filling up actual age.

4) Demographic Distribution of Respondents

Table 1 shows the demographic characteristics of the 162 persons who responded to the survey usably. Firstly as for the position, rank, and file class, the number of general staff was 51 or 31.5%, nearly 1/3 of the total amount of respondents, while the remaining 2/3 was covered by managers and CEOs. Middle managers assuming the job position of team leader, division or department leader, amounted to 85, covering more than half (52.5%) of the whole respondents, while senior or top management assuming CEO, CIO, president, etc. totaled 26 or 16%. Secondly, the age group for the respondents shows that nearly half (49.4%) of the whole respondents were in their thirties, while the remaining were in their forties (30.9%), twenties (10.5%), fifties (8.6%), etc. Thirdly, as for the industry group to which the respondents belong, we learned that the manufacturing industry was represented by 35.8%, while the financing and service industry covered 21.6%. The remaining 42.6% is filled up by other kinds of industry branches, such as trading, consulting, construction, etc. Fourthly, the employment size of the organization seemed relatively well balanced, since 'less than 200 persons' was check-marked by 30.2%, '200-1,000

Table 1 Demographic Distribution of Respondents (N=162)

Item		Frequency	Ratio (%)
Position	Rank and file	51	31.5
	Middle Management	85	52.5
	Senior Management	26	16.0
Age	Twentieth	17	10.5
	Thirtieth	80	49.4
	Fortieth	50	30.9
	Fiftieth	14	8.6
	Sixtieth and more	1	0.6
Industry	Manufacturing	58	35.8
	Financing & Service	35	21.6
	Others	69	42.6
Size of Employees	Less than 200	49	30.2
	200-1000	44	27.2
	1000-2000	28	17.3
	More than 2000	41	25.3
Life Cycle of Product/Service	Introductory	19	11.7
	Growing	54	33.3
	Mature	82	50.6
	Declining	7	4.3

persons' by 27.2%, 'more than 2,000 persons' by 25.3%, and '1,000-2,000 persons' by 17.3%. Finally, as for the life cycle of the products or service for the organization to which respondents belong, nearly half (50.6%) of the respondents considered theirs were in a mature stage. The remaining were well distributed by growing stage (33.3%), introductory stage (11.7%), and declining stage (4.3%)

2. Statistical Validity and Reliability

This section concerns the validity and reliability of the gathered data, in order to prove the efficacy of the questionnaire which represent multiple variables of KM capability component and proxies therein, as well as single variables of KM efficiency. However, in order to be statistically appropriate, these multivariate models need to provide the fullest evidence of measurement efficacy, and they must also reduce the likelihood of compounds. In this context, SPSS (Statistical Package for the Social Science) /PC+8.0 is utilized as an analytical tool for testing statistical assumption and estimation of the measurement.

1) Assessment of Validity

Multivariate questionnaires should provide appropriate means of assessing the efficacy of measurement among scale items. In other words, through analysis of the gathered data, it should be proved whether the survey was statistically set in well enough to substantiate the grouping of items into constructs one each.

Working within this context the assessment of validity of the questionnaire was examined by the established statistical method of confirmatory factor analysis, with a particular emphasis on factor loading, Eigen value, and cumulated variance ratio.

Validity analysis is regarded as a basic process in which validity of a surveying tool (questionnaire) can be inferred in terms of acknowledging whether or not the questionnaire is appropriately designed enough to support the aim of measurement.

According to Nunnally[4)], the validity can be inferred when the factor loading value is examined at a more than 0.4 level, while the Eigen value is measured at a more than 1.0 level. In this manner, we have been able to examine the validity for KM capability variables of infrastructure and process as well as the resultant dependent variables of KM effectiveness and satisfaction, by using the replied data from 162 respondents. As the statistical sampling model, we utilized Principle Components Analysis with the factor rotation method of Varimax.

Table 2 shows the result of this validity analysis for all the variables. All of the variables

4) Nunnally. J. C. "*Psychometric Theory*." New York. McGraw-Hill.1978

Table 2 Result of the Validity Analysis

		Factor Loading Value	Eigen Value	Remark
Infrastructure				
	Culture	0.469 -0.831	4.360	Criteria Cleared
	Technology	Ta 0.673-0.853 Tb 0.746-0.866	3.669 2.441	Criteria Cleared * Divided into two subgroups
	Structure	0.646-0.890	4.136	Criteria Cleared
Process				
	PI	0.753- 0.869	5.524	Criteria Cleared
	PII	0.823- 0.888	5.528	Criteria Cleared
	PIII	0.850-0.914	4.701	Criteria Cleared
	PIV	0.625-0.851	3.064	Criteria Cleared
Performance		0.729-0.853	3.064	Criteria Cleared

proved to meet the above criteria, namely a factor loading value of more than 0.4 and an Eigen value of more than 1.0. These results mean that all the categories of the questionnaire have validity as a surveying tool.

Unlike the other variables that denoted the validity in one single sub-factor group, 'Technology' alone separated the validity into two sub-factor groups[5]. This result seems to be derived from the facts that there is a certain distinction among the two sub-factor groups. The first (Ta) concerns technological infrastructure facilitating knowledge activities of creating, applying, sharing and controlling processes, whereas the second (Tb) is related to technological infrastructure for promoting cooperation and communication on the organizational level. In other words, Ta is considered as direct factors for knowledge activities itself, while Tb is more related to organizational atmosphere, thus supporting the knowledge activity. In any case, Technology also proved to hold validity, subject to division of two sub-groups, thereby ascertaining the validity of the questionnaire as a surveying tool.

2) Assessment of Reliability

Reliability of a multivariate survey should also be proved so that the collected data is consistent enough for functioning as an instrument of analysis. While the previous validity was mainly concerned with grouping of items for convergence, the reliability is more concerned with consistency of the data in relation to confidence level. In this study we measured the reliability at

5) Group Ta consists of 'internal rules for categorizing knowledge', 'Monitoring partners and competitors', 'Utilizing KMS, CRM, SCM and work process', and 'Locating specific knowledge', while Tb consists of 'Cooperating with other units', 'Communicating with multi-departments' and 'Utilizing BBS, forum boards'.

Cronbach's Alpha coefficient to see if all the items hang together in terms of consistency. If the Cronbach's Alpha coefficient is measured at a more than 0.6 level, then the reliability of the surveyed data is deemed properly acknowledgeable.[6] As was the case with validity analysis, reliability for KM capability variables of infrastructure and process as well as the resultant dependent variable of KM effectiveness and satisfaction, have been examined by using the replied data from 162 respondents. Within this framework, the commuted result of this reliability analysis is shown in Table 3. The Cronbach's α has been measured at a 0.8-0.9 level in all categories, which is more than enough to meet the criteria of a more than 0.6 level.

3. Statistical Analysis of Gathered Data

1) Analysis of Mean by Variable Group

This section depicts the statistical analysis of survey results from the 162 KM experts in Korea. We first looked into the aggregated means of KM infrastructure as independent variables and it's E/S (Effectiveness/Satisfaction) as a dependent variable. Obviously the measured means represent the Korean KM experts' view in average about KM capabilities and its effectiveness. We brief the data along the questionnaire first and then further analyze them in such groupings as Position, Age, Industry, Size of Employees, Life cycle of products/services, so that we can trace characteristics of Korean views on KM and its implication therein. Apart from the means for all the respondents, we have also calculated the means for the independent variables of the respondents who are in the top 20% and bottom 20% in terms of the points in the dependent

Table 3 Result of Reliability

		Cronbach's Alpha	Number of Items	Remark
Infrastructure				
	Culture	0.8620	9/9	Criteria Cleared
	Technology	0.8987	9/9	Criteria Cleared
	Structure	0.9076	6/6	Criteria Cleared
Process				
	PI	0.9356	8/8	Criteria Cleared
	PII	0.9428	7/7	Criteria Cleared
	PIII	0.9444	6/6	Criteria Cleared
	PIV	0.8368	5/5	Criteria Cleared
Performance		0.9406	10/10	Criteria Cleared

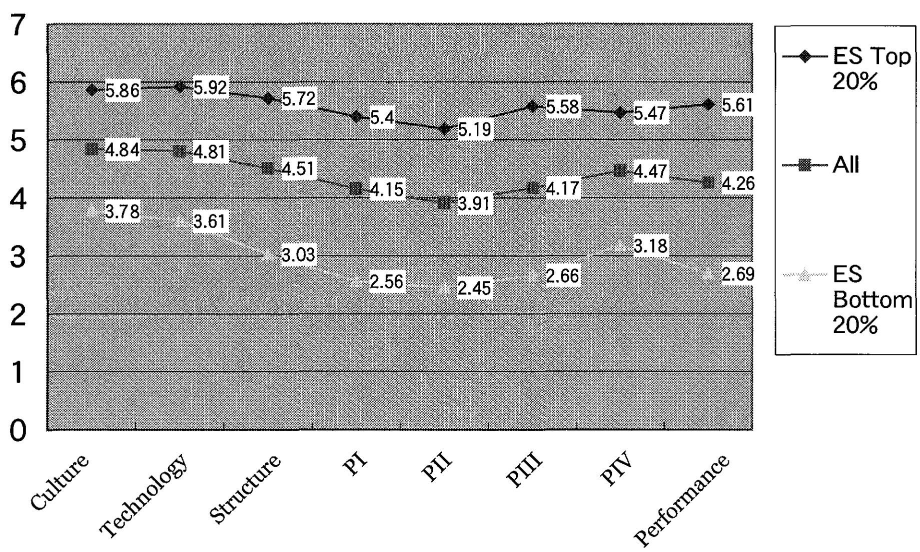
6) Murphy & Davidshofer (1991) set the standard of acceptable reliability at a 0.7 level. In our estimation here all surpass even that level.

variable, namely E/S (Effectiveness Satisfaction).

The reason for this separate calculation for E/S is to find out how people share different views of KM capabilities in accordance with their attitude toward KM performance. The top 20% of respondents (32 persons) in the rating of the E/S questionnaire can be regarded as the group that is attaching very positive importance to KM performance in terms of their respective experience or expectation. Likewise the bottom 20% (32 persons) in the rating of the E/S questionnaire can be regarded as the group that is attaching a relatively low level of positive importance to KM performance. Obviously the E/S rating itself is based on aggregated means of 10 different proxies, such as productivity contribution, management renovation, improvement of customer satisfaction, etc.; therefore it is not directly representing a particular outcome of KM performance, like revenue improvement, to mention but one. Rather it is representing general attitude or awareness about KM performance among the Korean respondents. As such some of them may have answered based on their experience of KM operation, while others may have answered simply based on their expectation about KM, as there could be a lot of companies which are at the stage of early introduction of KM at the time of survey.

As is shown in Fig.1, the means of 32 persons in the E/S top 20% is measured at 5.61, and the same in the E/S bottom 20% at 2.69, while the means of the whole 162 respondents is measured at 4.26. Therefore, the difference between the top and bottom 20% group is reaching 3.0 points, comparatively big considering the 7-points scale. This clear distinction between the two extreme groups apparently represents the fact that the more experienced the respondents are about KM, the more tendencies they have to value KM performance. Next, we can see that the

Fig.1 Analysis of Mean by Variable Groups



means of infrastructure capability (culture/technology/structure) is much higher than the process capability (PI, PII, PIII, and PIV). Interestingly, ES top 20% group seems to value Technology between the infrastructure and PIII among the process, unlike the means of all the respondents, while the bottom 20% values Culture and PIV respectively. With these overall results in mind, let us see the details of the means by variables.

a) Statistical Mean for KM Infrastructure

As seen in Table 4, Korean KM experts are believed to share a relatively positive attitude about the infrastructure for KM, since the means of the 3 variables are all surpassing the average Likert scale (4.0) on all respondents basis.

Among the 3 infrastructure variables, organizational culture turns out to be more valued than technology and structure. This result can also be seen from the number of proxies valued more than a 5.0 level. Culture has 5 items valued at a more than 5.0 level out of 9 items, whereas technology has 4 items and structure no single items respectively for this level. This result clearly implies that Korean KM experts in general are regarding organizational culture as utmost important factors to tackle KM successfully. Putting it differently, merely as a rhetoric or slogan for management issues, it is a realistic managerial tool for them.

Now, if we look into the ES top 20% and bottom 20%, the ES top 20% respondents are putting greater value on technology (5.92) than culture (5.86) and structure (5.72), while the ES bottom 20% of respondents value in the same order as the average of all the respondents together, namely

Table 4 Statistical Mean for KM Infrastructure from Survey Results

	Mean	Proxies								
Culture	-	**C1**	**C2**	**C3**	**C4**	**C5**	**C6**	**C7**	**C8**	**C9**
All	4.84	5.03	4.49	5.01	4.81	4.46	5.13	4.09	5.44	5.12
ES Top 20%	5.86	6.13	5.88	6.16	5.59	5.44	6.09	5.25	5.94	6.25
ES Bottom 20%	3.78	3.78	3.13	4.06	4.03	3.31	3.75	3.03	5.19	3.72
Technology	-	**T1**	**T2**	**T3**	**T4**	**T5**	**T6**	**T7**	**T8**	**T9**
All	4.81	5.24	4.45	5.25	5.62	5.14	4.80	4.49	4.44	3.88
ES Top 20%	5.92	5.97	5.72	6.13	6.50	6.22	6.06	5.88	5.81	5.03
ES Bottom 20%	3.61	4.06	3.37	4.09	4.75	4.16	3.47	2.97	3.06	2.56
Structure	-	**S1**	**S2**	**S3**	**S4**	**S5**	**S6**			
All	4.51	4.69	4.66	4.28	4.40	4.43	4.64			
ES Top 20%	5.72	5.97	5.84	5.19	5.84	5.56	5.91			
ES Bottom 20%	3.03	3.81	3.25	2.72	2.94	2.63	2.84			

Note) ES Top and Bottom 20% is calculated only for the respondents whose KM Performance (Effectiveness & Satisfaction) points are in the top 20% or bottom 20%.

culture to technology to structure. Next, if we look into the gap of the average between the E/S top and bottom 20% respondents, it seems clear that structure and technology have a comparatively wider gap than in culture. These results seem to reflect the extreme duality among the respondents, in particular among the positive viewers and the least positive viewers of KM performance. The more positive they view the KM performance, the higher they value the technology and structure, whereas they are not reacting as sensitively toward the cultural side of KM capability. This may be due to the more technical characteristics of technology and structure as compared with culture, which only evolves around the mental and psychological situation. Apparently the respondents whose organizations have already experienced the KM activity seem to be of a very positive view about the KM performance. These respondents may find the technology and structure more easily understandable and appealing, based on their experience.

On the contrary, the respondents whose organizations are still in the infancy stage of KM, or else, in a planning stage, may give lower points for technology and structure. This may be due to the lack of experience or preoccupation they might have.
These factors may be behind the extreme duality in the case of technology and structure in terms of the gap between the E/S top and bottom 20 percent of respondents. If turning now to the individual proxies of each variable, the following characteristics are traceable:

First of all, in the category of adaptation for organizational cultural infrastructure, Korean KM experts seem to attach more value to management role, in that C6 (Clear stating of vision and mission) and C9 (Top management support) are measured at 5.13 and 5.12, relatively higher than other proxies. In particular, it is notable that positive viewers of KM performance (E/S top 20%) give their highest point (6.25) to the C9 (Top management support) among all categories. Unlike these higher points toward management role, it is to be noted that items related to employee's participation seem to get relatively lower attention, since C2 (Level of participation by individual) was valued at 4.49 and C5 (Atmosphere of information exchange by communities of practice and club, etc.) at 4.46. However, when it comes to the E/S top and bottom 20%, the top 20% of KM performance are giving relatively high points to these two proxies, i.e., 5.88 for C2 and 5.44 for C5, whereas the bottom 20% of KM performance are tended to give lower points. When we calculate the ratio of average the top 20 and bottom 20% of KM performance against the average of total respondents, the ratio of the top 20% in the C2 amounts to 1.31 and that of the bottom 20% to 0.69. These figures are representing the highest and lowest ones in its group respectively. If we consider that the total average in the culture group is 1.21 (top 20%) and 0.78 (bottom 20%) respectively, it is clear that positive viewers of KM performance are still paying a certain level of attention to individual participation, while the least positive viewers of KM performance are not so much enthusiastic about this particular proxy. As far as we look at the means of E/S top and bottom 20% in this culture group, positive viewers of KM performance are giving high points, namely C9 (top management support/6.25), C3 (encouraging KM in general/ 6.16) and C1 (recognition about importance of knowledge/6.13), whereas the least positive viewers of KM performance are paying attention to C8 (Recognition of more benefits than costs for KM/ 5.19), and see this factor as most important within the respondent group. Due to these favorable evaluations even from the E/S bottom 20%, the total average of C8 (Recognition of more benefits than costs for KM) was valued at 5.44, the highest in this culture category. Taking into consideration that the respondents are the very person in charge of KM activity in the respective organization, this result seems to be a quite natural and logical response.

Next, in the category of utilization of Technological infrastructure, on the basis of average for all the respondents, T4 (Communicating with multi-departments by IS) was valued most high at 5.62, followed by T3 (Cooperating with other units) at 5.25. In particular, average of E/S top 20 % group only, T4 was valued at 6.50, the biggest in all of the categories. This group also gave high points to the T5 (Utilizing BBS, forum board etc/ 6.22) and T3 (Cooperating with other units/ 6.13). This trend is also to be found from the average of E/S bottom 20% group as well, 4.75 and 4.09 for the T4 and T3, highest and second highest among the group. These results apparently imply that Korean KM experts are thinking highly of KM-related technology facilitating collaboration and communication among the internal members and departments. Contrastingly they do not seem to place much value on sophisticated Internet technology for linking outside customers and suppliers, as T9 (Utilizing CRM, SCM) was measured at 3.38, which is the lowest level among the infrastructure variable in the whole. The E/S top 20% group and bottom 20% group also follow the same trend as all the respondents. This is reflecting the fact that technology that enables intra-firm communication is imminent for them, since the most organizations are still at KM infancy stage. At this point, the sophisticated CRM and SCM can be a future task for them. However, we can find extreme duality between the E/S top 20% and E/S bottom 20% group in the proxy of T7 (Locating specific knowledge), T8 (Use of work process and general information), and T9 (Utilizing CRM, SCM). When we calculate the ratio of average top 20 and bottom 20% of KM performance against the average of all the respondents, the ratio of top 20% in the T7 for example, amounts to 1.31 and that of bottom 20% to 0.66. The same ratio is calculated at 1.30/ 0.69 for T8 and 1.29/0.69 for T9, while the total average in this technology group is 1.23 (top 20%) and 0.75 (bottom 20%) respectively. This shows that there are wider gaps in existence between the two groups, suggesting that positive viewers of KM performance are still attaching relatively higher attention to sophisticated internet technology – apparently out of their own experience of operation –, whereas the least positive viewers are underestimating these technologies.

Finally, looking at the variable of structure, on the basis of the average for all the respondents, S1 (Promoting collective behavior) was measured at 4.69, the single most points in this category, followed by S2 (Systematic facilitating of new knowledge creation/4.66) and S6 (Systematic facilitating of easy access to knowledge holders/4.64). This result suggests that as for the role of organizations with respect to structure variable of KM capability, Korean experts seem to think highly of 'promoting collective behavior' among others.

However if we look at the average of the E/S top and bottom 20% of respondents, it is strikingly interesting that the E/S bottom 20% group is severely underestimating the S3 (Reward and incentive system), S4 (well-designed process for knowledge sharing), S5 (Systematic guideline of encouraging knowledge sharing) and S6 (Systematic facilitating of easy access to knowledge holder), all of which are averaged under 3.0 level. The ratio of average between the bottom 20% of KM performance against the average of all the respondents in these 4 proxies are calculated at 0.63, 0.67, 0.59 and 0.61 respectively, while the total average of the bottom 20% in this structure amounts to 0.67. Considering the same ratio for the top 20% is nearly similar to the total average of 1.26 level, we can say that 'the least positive viewers of KM performance' are attaching lower importance to proxies such as internal guideline for KM and incentive system, etc. It is particularly to be noted that reward and incentive systems are valued at lowest level, as the average of total respondents for S3 (Reward and incentive system) was valued at 4.28, the lowest among this category. This is nearly the same situation in the E/S performance grouping: the average of S3 for the E/S top 20% and bottom 20% was valued at second lowest level within the category, followed by S5 (systematic guideline for encouraging knowledge sharing), lowest in both groups. These results imply that most KM experts in Korea seem to put emphasis on voluntary participation of employees in KM activity rather than being guided or obligatorily imposed to participate in it. This trend can also be inferred in that they do not give much attention to incentive system or internal guideline, etc.

b) Statistical Mean for KM Process

As seen in Table 5, Korean KM experts showed a relatively neutral attitude towards the KM process, since the means of the survey response are just centered on 4.0 levels. This apparently makes sharp contrast with the KM infrastructure, where the means reached a more than 4.5 level in all 3 of the components. From this we can conclude that process capability is being less valued than infrastructure capability among the Korean KM experts in general.

Looking into the 4 process variables, it is clear that PIV (Protection/Controlling Process) had a relatively high rating, namely 4.47, and PII (Conversion/Accumulation Process) had the lowest ratings of 3.91, while PI (Acquisition /Creation Process) and PIII (Application/Sharing Process)

Table 5 Statistical Mean for KM Process from Survey results

	Mean	Proxies							
PI	–	**PI1**	**PI2**	**PI3**	**PI4**	**PI5**	**PI6**	**PI7**	**PI8**
All	4.15	4.15	4.49	4.62	3.65	4.02	3.91	4.07	4.30
ES Top 20%	5.40	5.53	5.63	5.84	4.63	5.34	5.28	5.25	5.72
ES Bottom 20%	2.56	2.50	2.97	3.03	2.34	2.41	2.38	2.50	2.37
PII	–	**PII1**	**PII2**	**PII3**	**PII4**	**PII5**	**PII6**	**PII7**	
All	3.91	3.96	3.94	4.02	4.14	3.65	3.80	3.82	
ES Top 20%	5.19	5.06	5.37	5.31	5.44	4.88	5.00	5.28	
ES Bottom 20%	2.45	2.47	2.31	2.69	2.59	2.31	2.34	2.44	
PIII	–	**PIII1**	**PIII2**	**PIII3**	**PIII4**	**PIII5**	**PIII6**		
All	4.17	4.03	4.17	4.07	4.28	4.27	4.21		
ES Top 20%	5.58	5.25	5.62	5.56	5.75	5.69	5.62		
ES Bottom 20%	2.66	2.50	2.75	2.63	2.72	2.56	2.78		
PIV	–	**PIV1**	**PIV2**	**PIV3**	**PIV4**	**PIV5**			
All	4.47	4.60	4.73	4.30	3.91	4.77			
ES Top 20%	5.47	5.88	6.03	5.69	5.09	6.03			
ES Bottom 20%	3.18	3.37	3.41	2.84	2.66	3.59			

covered the in-between ratings. The reason behind this lowest point for PII may be due to the notion that the Conversion/ Accumulation Process does not contribute much in terms of value-added KM activity as it can be regarded as a mechanical process being supported by information technology. In this context PI could have received highest rating, as it is the very beginning of KM value-added activity. Nevertheless, as it turned out to be, PI did not get much attention. It was rated the third highest, following PIV and PIII.

On the other hand, if we look at the average of E/S top and bottom 20% only, we come to know that the top 20% of KM performance is placing PIII higher than PIV by 0.11 (5.58-5.47), though the order of PI and PII remains the same as the average of all the respondents. This higher attention on PIII (Application/Sharing Process) by positive viewers of KM performance is not a surprise at all considering KM value-added activity is performed in this process. In the meanwhile, the E/S bottom 20% group follows the same order of the average for all the respondents. These results clearly imply that positive viewers of KM performance apparently see the PIII as most important process out of their experience. In case of PIV, highest in terms of the average point from the all respondents, there seems to be a kind of centralization tendency. This is apparent if we compare the ratio of the average top 20 and bottom 20% of KM performance against the average of all the respondents. Namely the first rate is 1.22 and the second 0.71 respectively, thus the difference of these two figures being minimized to 0.51, whereas the same figure in PI, PII and PIII is 0.68, 0.69 and 0.69, all numbers far above the 0.51. These tendency about PIV seems to be derived from the general notion that protection and controlling of existing knowledge can be regarded as realistic KM activity rather than creating new knowledge. Obviously the ever-increasing attention on the protection of intellectual property must have affected this attitude. As for the individual proxies of each variable, the following characteristics are traceable:

First of all, in the category of PI (Acquisition /Creation Process), KM experts in Korea seem to attach relatively higher importance to the knowledge acquisition process for improving the project or daily routine job performance. This is being supported in that PI3 (Distributing knowledge throughout the organization) was measured at the highest level of 4.62, apparently recognizing the needs for easy access to necessary knowledge on individual employee level. It is also in this connection that PI2 (Using feedback to improve subsequent projects) and PI8 (Identifying best practice and its upgrading) were measured at relatively high averages of 4.49 and 4.30 respectively. On the contrary, acquisition processes not directly linked to project improvement gathered lower ratings, as is the case with 3.65 points for PI4 (Exchanging knowledge with external partners) and 3.91 points for PI6 (Acquiring knowledge about competitors within industry). Other proxies had neutral ratings as is shown by the 4.02 points of PI 5 (Acquiring knowledge about new products and services), 4.07 points by PI7 (Bench-marking performance) and 4.15 points by PI 1 (Generating knowledge from existing knowledge).

If we look at PI only on the basis of two groups, i.e., the ES top 20% and bottom 20% of respondents, both groups valued PI3 and PI2 in common but had different views about P8. The ES top 20% group placed it at second highest proxy but the ES bottom 20% group placed it at second lowest one. This is an interesting result, which may be due to the difference of experience for best practicing between the two groups.

Secondly, in the category of PII (Conversion/Accumulation Process), most proxies had medium or lower points. Among the 7 proxies, there were only two that surpassed average level 4.0 as PII4 (Absorbing individual knowledge into organization) got a point of 4.14 and PII 3 (Transferring organizational knowledge into individuals) one of 4.02 points. The remaining 5 proxies were valued at lower than 4.0 points, including the lowest point of 3.65 for PII 5 (Absorbing partner knowledge into the organization). Now if we look at PII only on the basis of two groups, i.e., the ES top 20% and bottom 20% of respondents, PII3 and PII4 are both valued but PII5 and PII6 (Integrating different sources of knowledge) were underestimated. However, it is interesting to note that the ES top 20% group gives first priority to PII4 (Absorbing individual knowledge into organization) but the ES bottom 20% group valued the PII3 (Transferring organizational knowledge into individuals) most importantly. These results reflect the difference of viewing points where the ES top 20% group is more interested in creating organizational knowledge first. It seems to be for this reason that they also value PII2 (filtering and evaluating of knowledge) for sharing purpose. Contrastingly ES bottom 20% group seems to be more interested in catching up with the organizational knowledge first before they are able to create them.

The third category of PIII (Application/Sharing Process) gets a more than average level in all proxies. Among the proxies, PIII4 (application of knowledge to improve efficiency) and PIII5 (to adjust strategic direction) was valued most highly, 4.28 and 4.27 respectively, while PIII 1 (Applying knowledge from past mistakes) was measured at 4.03, the lowest level in this category. This trend is similar if we look at the E/S top 20%, whereas the order of preference is a bit different from the E/S bottom 20% group giving preference in order of PIII 6 (Linking sources of knowledge for solving problems), PIII 2 (Using knowledge to solve new problems) and PIII4 (Applying stored knowledge for improve efficiency). These differences of the two groups may be derived from the extent of their expectations from the KM activity.

That is to say, positive viewers of KM performance find the importance of PIII (Application/Sharing Process) in more aggressive and company-level perspectives of value-added KM activity such as improving the efficiency and adjusting strategic direction, whereas the least positive viewers find the same in passive and individual-level KM activity in an apparent move to prevent mistakes or solving imminent problem facing individuals.

Finally, in the category of PIV (Protection/Controlling Process), which gained the highest points in the process variables on the average basis, PIV5 (Communicating the importance of protecting knowledge protection on corporate level) and PIV2 (Restricting access to some sources of knowledge by password tech) were mostly valued. Instead PIV4 (Identifying restricted knowledge easily) was least valued.

These trends are also true in case of the E/S top and bottom 20% groups in common. When we think of variance between two groups by the ratio against the average of all the respondents, it is notable that PIV has a relatively narrow difference between the ratios of two groups. As such, Korean KM experts have a consistent tendency towards the PIV (Protection and Controlling) process regardless of how they are viewing the performance of KM. From this we can say that there seems to be a certain degree of awareness already established among the Korean KM experts about the PIV. This even to the degree that in some cases knowledge protection is already being regarded as a core competition tool among the large corporations.

c) Statistical Mean for KM Performance

As seen in Table 6, Korean KM experts showed relatively high attitude towards KM Performance (Effectiveness and Satisfaction) as the means was measured at 4.26 above the average level of 4.0. Almost all the proxies were measured between 4.02 and 4.57 excluding ES9 (Reducing redundancy of information), which was measured at only 3.93, the only proxies below 4.0 levels. This result represents the fact that Korean KM experts are considering the positive role of KM in terms of management renovation in various ways. There seems to be no remarkable difference among the proxies, but if we look into the means of each proxy, we can trace the following characteristics; Korean experts seem to find the most important motive of KM in the knowledge sharing activity itself, as ES10 (Enhancing atmosphere for knowledge sharing and organizational learning among employees) was valued at the highest level of means (4.57). As the next priority they depict the KM driver in the relation to customer service, as observed in such specific issues as ES6 (Decreasing customer response time/ 4.46) and ES5 (Improving customer satisfaction / 4.43). This is clearly indicating that Korean KM experts attach importance to knowledge sharing preferably on the points of customer service as this improves day-to-day cash flow operation of the firm, affecting bottom line. Other proxies for KM motives gathered relatively neutral attention, and centered on the specific issues such as ES7 (Avoiding overlapped approach by units/ 4.43), ES8 (Streamlining and integrating internal process /4.27), ES3 (Developing new products and services/ 4.25), and ES1 (Contributing to productivity and management renovation/ 4.20). Proxies which gathered relatively low attention were ES2 (Coordinating the development efforts of different units/ 4.10) and ES4 (Adapting to unanticipated changes/ 4.02) but these two also were more than the average level of 4.0, apparently enough to justify a part of motive for KM.

d) Statistical Mean in Demographical Grouping

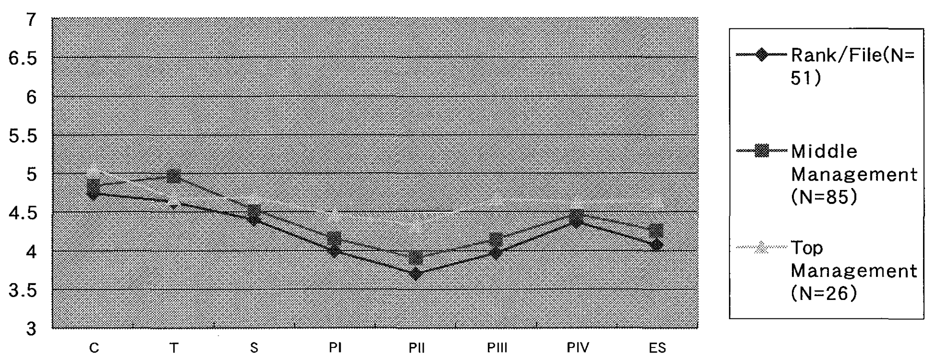
In this section we will look into the statistical means of the surveyed sample in demographical aspects such as position, age, industry, size of employees, life cycle of products/services, etc. In so doing we can analyze the Korean KM expert's perspectives about the KM infrastructure and process capability along with the resultant contribution to various management issues.

Table 6 Statistical Mean for KM Effectiveness and Satisfaction

	Mean	Proxies									
ES		**ES1**	**ES2**	**ES3**	**ES4**	**ES5**	**ES6**	**ES7**	**ES8**	**ES9**	**ES10**
All	4.26	4.20	4.10	4.25	4.02	4.43	4.46	4.43	4.27	3.93	4.57
ES Top 20%	5.61	5.78	5.50	5.69	5.22	5.69	5.63	5.91	5.81	5.22	5.69
ES Bottom20%	2.69	2.47	2.59	2.52	2.53	2.69	2.84	2.88	2.71	2.59	3.06

As seen in Fig 2, top management people among Korean KM experts are believed to share more positive attitudes toward nearly all the KM variables including the KM Effectiveness/Satisfaction. The means of top management response in Likert scale was the highest among the 3 position groups, only with the exception of Technology where top management's mean was second to middle management. As for the KM infrastructure as a whole, there seem to be different patterns of attention being paid among the 3 positions. Rank and file front line staff were paying attention in the order of C>T>S, middle management T>C>S, whereas top management in the order of C>S>T. From this we can say that middle management is more relying on technology than frontline staff or top management. The fact that every single item in the KM infrastructure was measured at a more than 4.5 level clearly shows the relatively high attention on this, regardless of position. In case of process capability, it seems clear that the figures of mean in this category are much lower than that of the infrastructure. At the same time this category also shows difference of order by the respondent group: Rank and file group along with the middle management showed attention in the order of PIV>PI>PIII>PII, but the top management showed an order of PIII >PIV > PI>PII>. It is interesting to note that top managers are showing greatest interest in PIII (Application/Sharing), whereas rank and file along with middle management places much emphasis on PIV (Protection/Controlling) and PI (Acquisition/Creation). This attitude seems to reflect the difference of immediate concern as the top managers are more geared to promote the sharing of knowledge on a resultant perspective, while the middle management and ordinary staff is more geared to create knowledge and protect the knowledge base on a causal perspective. Combined with the first priority on cultural aspect of KM infrastructure by top management, it seems clear that top management pays much attention to corporate knowledge sharing on an idealistic view. In contrast, middle managers and ordi-

Fig.2　Statistical Mean by Position

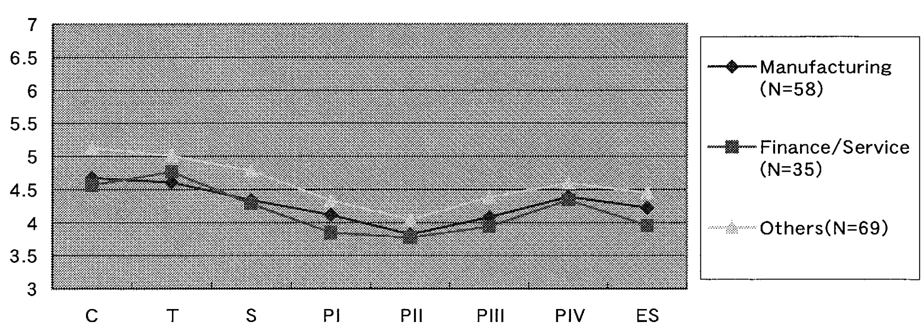


Note) C= Culture, T= Technology, S=Structure, PI=Acquisition/Creation, PII=Conversion/Accumulation. PIII=Application/Sharing, PIV=Protection/Controlling, ES= Effectiveness/Satisfaction nary staff pay much attention to protection and creation of knowledge on a realistic view: this result might represent the notion that sharing of knowledge can be done only after there is be knowledge to be shared and that the existing knowledge should be accessed by the eligible person only to protect the knowledge from theft or leakage, as well as to maximize the knowledge.

It is also interesting to note that rank and file staff does not seem to value process aspects of KM capability, as the means of PI to PIII was falling short on the average level of 4.0. The reason behind this result seems to be derived from the preoccupation among them that the issue of process can be a quite natural and automatic issue rather than a separate value-creating capability.

When we look into the statistical means aggregated by industry group in Fig.3, there apparently seems to be higher attention paid to infrastructure rather than process regardless of business line. This might be along the same line as before. In the process capability, it is to be noted that the finance and service sectors have lower points of mean, namely three out of four variables not reaching the average level of 4.0. In this group of industry, they give the highest points to technology among the three infrastructure variables. This result may be due to the facts that in this group there are many IT-related venture companies included. From these companies' points of view, process aspects can be seen as easily accessible capability through their technology infrastructure which unavoidably gathered highest attention, thereby valuing relatively higher means than any other capabilities. Notwithstanding this, the satisfaction levels of these companies do not seem to be high. In fact, among all industry groups, the level of ES from the finance and service industry was measured at the lowest level. This implies that there could be some difficulties still facing these venture companies, probably due to the over-reliance on an IT-oriented KM approach. Another reason behind the low level of effectiveness and satisfaction among the finance and service sector seems to derive from the complexity of measurability for KM in this sector in comparison to the manufacturing industry. Unlike the manufacturing industry, it is not an easy job to set expected norms or criteria quantitatively for service

Fig.3 Statistical Mean by Industry Group



improvement etc. As such the evaluation about the effectiveness and satisfaction of the KM could also be relatively difficult to define compared with the manufacturing industry.

Now let us have a look into the statistical means aggregated by number of respondent. First and most outstanding to note in Fig.4, is that the more the larger of employees, the greater the means were measured. This result clearly indicates that experts from larger companies or organization feel much more positive toward KM in general, including the effectiveness and satisfaction. A closer look into the means by infrastructure and processes reveals the following trend. In case of small and medium sized company of less than 200 employees, organization culture(C) is measured most high. But companies, which have an employee size of more than 200, put the highest point on technology (T). This clear distinction implies that small companies are more geared to promote cultural environment for KM with an imminent aim of application and sharing of knowledge base, whereas larger companies are more geared to utilize technology as an infrastructure for KM, while being keen to protect the existing knowledge.

As for the process capability, while small company places emphasis in the order of PIII > PIV > PI > PII, larger company with more than 200 employees gave highest points to PIV. But as for the second preference, respondents from companies with an employment size of 200-1000, selected PIII, whereas those who are from an employment size of 1000 – 2000 and more than 2000 selected PI. This implies that whereas smaller companies are more eager to share and apply the existing knowledge for imminent day-to-day routine, larger ones find more necessity to generate and create knowledge as it can bring forth new sources of competitiveness and secure continuous renovation of management.

Now we turn to the statistical mean for KM variables by product life cycle to which respon-

Fig.4 Statistical Mean by Number of Employee

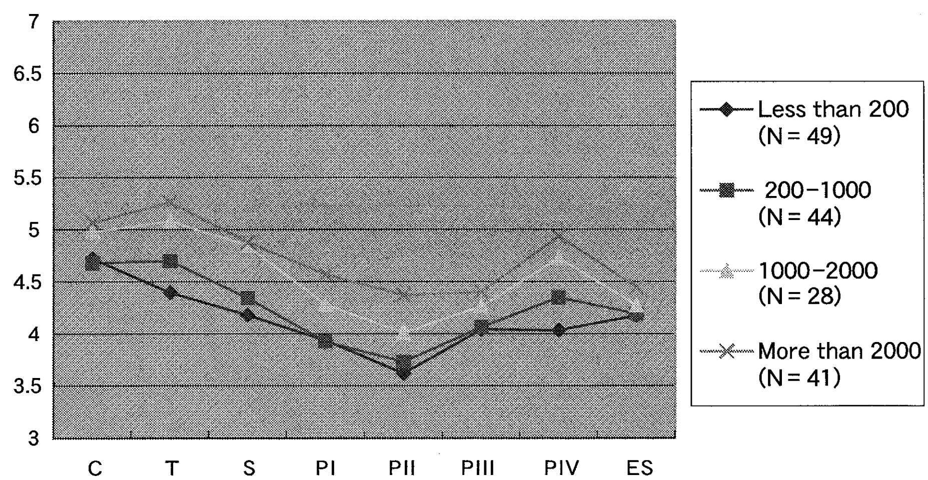
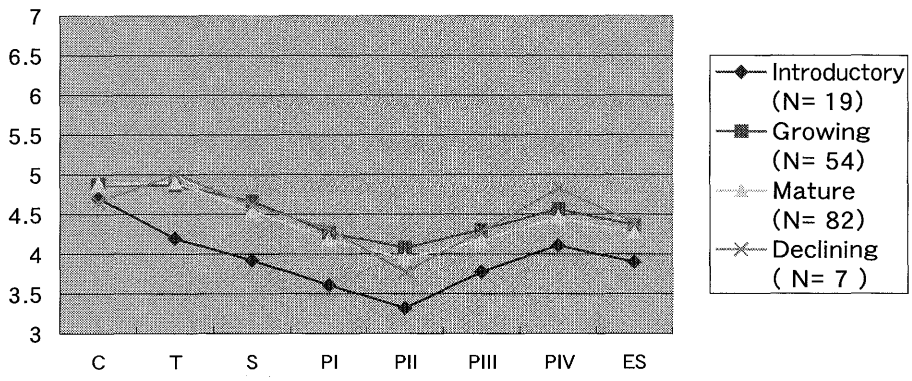


Fig.5 Statistical Mean by Product Life Cycle



dents believe to belong.

First of all, concerning the effectiveness and satisfaction, KM experts from organizations of which the main products or services are positioned at declining stage seem to share the most positive opinions. While experts from growing or mature products of life cycle are showing more than average level of 4.0, experts from an introductory life cycle showed a less than average level. This result reflects that introductory-staged organizations have relatively low level of expectation to KM due to shortage of knowledge available for sharing and applying. However, companies at a declining life cycle stage, having secure knowledge base already established, find much higher degree of expectation for knowledge management apparently out of imminent requirement to break through the aggravating business environment.

Secondly, if we look into KM infrastructure and the KM process as a whole, there is clear distinction between the first two groups and later two groups.

Namely, in case of infrastructure, the first two life cycle group place value in the order of C>T>S for whereas the later two life cycle group preferred an order of T>C>S. This is implying that during the initial stage of product development and market expansion, companies are more eager to encourage organizational culture to KM but as the companies are phasing into mature or declining stage of life cycle, they are getting more interested in introducing IT technology for knowledge management process.

In case of process capability, during the first two stages of life cycle the emphasis was placed in the order of PIV>PIII>PI>PII but during the later two stages of life cycle the emphasis was placed like PIV>PI>PIII>PII. Namely PIII and PI were in adverse between the first and later two life cycle groups. This is apparently showing that during the initial stage of product development and market expansion, companies are more eager to apply and share knowledge (PIII) but as the companies are phasing into mature or declining to stage of life cycle, they are getting more interested in acquiring and creating new knowledge (PI) in order to sustain the existing competitiveness, or even to seek new breakthrough for declining market situations.

Thirdly, if we look into infrastructure capability only, Culture was most high up to growing life cycle group, whereas Technology was valued most highly by the later two groups, namely mature and declining industry groups. This is indicating that cultural capability of KM is most required by the time when the product life cycle arrives at the growing stage, while technology capability of KM should be intensively exploited as a means of effective KM activities to the mature and declining industry.

Fourthly, if we look into process capability only, companies at mature and declining stage valued PIV >PI preferentially, while companies at introductory and growing stage valued PIV> PIII. Apart from the importance attached commonly to PIV, it is interesting to note that the more matured the industries is, the more PI is valued instead of PIII. This indicates that acquisition/creation capability is getting more important to mature and declining industry groups as they are in more need of new knowledge to seek sustainable growth. However, companies at introductory and growing stage might feel much more necessity in sharing existing knowledge in the run-up to expansion of current business.

2) Correlation Analysis

In this section we will look at the correlation among the three variables. This is because our main concern is to see to what extent the KM Effectiveness /Satisfaction is correlated with KM infrastructure and Process capability. Along with this we will analyze the correlation between the KM infrastructure and Process capability.

a) Correlation between KM capabilities and Effectiveness/Satisfaction

As we proposed in the previous chapter, KM capabilities are thought to be an independent or predicting variable to bring forth KM performance. In this study KM performance was measured at effectiveness and satisfaction level in the form of a survey towards Korean KM experts.

As seen in Table 7, which shows Pearson product-moment coefficients with significance (2-tailed), all of the KM infrastructure variables were significantly correlated with KM performance variables of effectiveness and satisfaction at $p<0.01$ level (2-tailed). The strongest correlation was structure (coefficient 0.772), followed by culture (coefficient 0.742), and technology (coefficient 0.693)

At this point we came to know that as far as the correlation is concerned, it is not identical with

Table 7 Correlations between KM Infrastructure and KM Performance

		C	T	S	ES
Culture	Pearson Correlation	1.000	.751	.768	.742
	Sig. (2-tailed)	.	.000	.000	.000
Technology	Pearson Correlation	.751	1.000	.838	.693
	Sig. (2-tailed)	.000	.	.000	.000
Structure	Pearson Correlation	.768	.838	1.000	.772
	Sig. (2-tailed)	.000	.000	.	.000
ES	Pearson Correlation	.742	.693	.772	1.000
	Sig. (2-tailed)	.000	.000	.000	.

the magnitude of mean, as we have previously reviewed. In the previous means analysis, structure was always in the third place after culture or technology in terms of magnitude, but in the correlation analysis structure turned out to be most strongly related to KM performance. This result implies the significance of structural aspects of KM infrastructure in terms of operational perspectives.

If we turn to correlation between KM process and KM performance, as in Table 8 we can see that, all the component variables in these two groups were significantly correlated at the $p<0.01$ level (2-tailed). The magnitude of correlation is somewhat different from the simple mean as we calculated and analyzed before. The strongest correlation was PIII (application/sharing, coefficient 0.827), followed by PI (acquisition/creation, coefficient 0.808), PII (conversion/accumulation, coefficient 0.745) and finally PIV (protection/controlling, coefficient 0.706). What is interesting to note here as well, is that the PIV showed the weakest correlation to the KM performance, despite that the simple means from the survey showed biggest measurement in this variable. This result also implies the significance of application and sharing aspects of KM process in terms

Table 8 Correlation between KM Process and KM Performance

		PI	PII	PIII	PIV	ES
PI	Pearson Correlation	1.000	.892	.864	746	.808
	Sig. (2-tailed)	.	.000	.000	.000	.000
PII	Pearson Correlation	.892	1.000	.843	.715	.745
	Sig. (2-tailed)	.000	.	.000	.000	.000
PIII	Pearson Correlation	.864	.843	1.000	.712	.827
	Sig. (2-tailed)	.000	.000	.	.000	.000
PIV	Pearson Correlation	.746	.715	.712	1.000	.706
	Sig. (2-tailed)	.000	.000	.000	.	.000
ES	Pearson Correlation	. 808	.745	.827	.706	1.000
	Sig. (2-tailed)	.000	.000	.000	.000	.

of operational perspectives. Taking into consideration that knowledge management is even being interpreted as *knowledge sharing* process, these results from Korean KM experts are not surprising at all. This is also true in case of PI (acquisition /creation) which was showing the second strongest correlation to KM performance, as this process was paid particular attention to in the KM literature represented by Nonaka Ikujiro.[7)]

b) Correlation between KM Infrastructure and KM Process

Next, we turn to the correlation between KM infrastructure and KM process, as we consider there might be interrelation between the two capabilities. The computed bivariate correlation analysis shows that all the component variables in these two groups were significantly correlated at the $p<0.01$ level (2-tailed) as is shown in the shaded parts in Table 9. The strongest correlation was between PI and Structure (coefficient 0.856), followed by PIII/S (coefficient 0.803), PII/S (coefficient 0.798) and PI/T (coefficient 0.772), PII/T (coefficient 0.753), PIII/T (coefficient 0.735), PIV/T (coefficient 0.729), etc. This result shows that structure KM infrastructure has its strongest correlation to most process capabilities excluding PIV processes, followed by technology to process capability, while culture has the weakest correlation to process.

c) Summary of Correlation Analysis

The purpose of correlation analysis based on the questionnaire survey from the Korean KM experts support main perspectives of this study that infrastructure and process capability have positive correlation to KM performance as the correlation coefficients were significantly at a $p<0.01$ level (2-tailed). When we look into 7 coefficients of correlation of capability infrastructure/ process to KM performance, we came to know that process capability has a bigger coefficient than infrastructure excluding PIV. As seen above, the correlation coefficient of PIII, PI, PII to

Table 9　Correlation between KM Infrastructure and KM Process

		PI	PII	PIII	PIV
C	Pearson Correlation	.697	.624	717	.628
	Sig. (2-tailed)	.000	.000	.000	.000
T	Pearson Correlation	.772	.753	.735	.729
	Sig. (2-tailed)	.000	.000	.000	.000
S	Pearson Correlation	.856	.798	.803	.708
	Sig. (2-tailed)	.000	.000	.000	.000

7) Knowledge creation to effective KM, as is the case with ***'knowledge creating company'***, is main concern for Nonaka Ikujiro

KM performance was measured at 0.827, 0.808, and 0.745 respectively but that of S, C, and T was at 0.772, 0.742 and 0.693 respectively. From this result it can be inferred that process capability itself must be an effective component of KM as an individual operational instrument of KM apart from infrastructure. This result also warns us of fallacy of technology-driven KM as the correlation of technology to KM was at weakest level. At this point one additive result from the Table 9 suggests that correlations among the process capabilities were strong relative to those among infrastructure: there was only 1 out of 4 coefficients exceeding a 8.0 level in the infrastructure group (S/T 0.838), whereas there were 3 out of 6 coefficients exceeding this level in the process group (PI/PII 0.892 PI/PIII 0.864, PII/PIII 0.843). This apparently suggests that process capabilities are more closely related to each other with the exception of PIV (Protection/ Control).

Other findings from this analysis suggest that while infrastructure and process capabilities have also a significant level of correlation to each other, the structure seems to have strongest correlation with most process capabilities *other* than PIV, followed by technology to process capability and finally culture to process capability. From this it is worth noting that cultural aspects of KM infrastructure do not seem to emit much interactivity with process capability relative to structure and technology.

3) Regression Analysis

In this section we will look into the regression among the three variables. We observed in the previous section that there are significant levels of correlation among the three variables. However, this correlation efficient does not represent causal relationship or causation among the variables. Therefore, in this section we will further investigate the causal relationship among the variables based on multiple regression analysis. First we will see whether there are significant levels of causal relationship existing between KM capability variables (infrastructure and process) and KM performance or not, based on the survey data from 162 Korean KM experts. Afterwards, we will look into causal relationships between the KM infrastructure capability and process capability.

Unlike the correlation analysis, the multiple regression analysis is thought to be a helpful instrument for clearly understanding the interactivity among the KM variables, thereby suggesting practical implication to launch effective KM operation.

a) Analyzing Tool

As with the previous analysis, regression analysis was performed with the SPSS (Statistical Package for the Social Science) /PC+8.0. In this course, ANOVA (Analysis of Variance), a test for heterogeneity of means by analysis of group variance was performed, since this test is the most common one used for controlling the entry or removal of independent variables from the regression model. In methodological points, we used common hypothesis testing to verify the causal relationship in terms of statistical significance level. Each hypothesis is set in the format that the predicting variable (independent variable) will have significant effect on the dependent variable. The computed results include the following measurement: 'R Square' and 'Adjusted R Square' for explaining predicative power of the variance for dependent variables, 'Standardized Coefficients 'to measure the strength of effect upon the dependent variable, 't- value' for measuring significance level, 'F-value' for distinguishing goodness of fit for the regression equation. In our study here, F-value significance was measured at the $p < 0.0001$ and t-value significance level was measured at $p < 0.05$ as is the usual case in regression analysis of social science.

b) Multicollinearity

The multicollinearity problem is an unacceptably high standard error of a regression, which occurs when a set of predictors in the regression model are highly correlated. Therefore it is necessary to find out whether this problem exists in our regression analysis here. In that case we have accordingly to take relevant measures in an attempt to have misleading effects minimized before continuing the regression analysis.

To this end we have calculated the VIF[8](variance inflation factor) coefficient along with variance proportion and condition index in accordance with the methodology originally introduced by Neter, Wasserman and Kunter (1990). According to this methodology, multicollinearity problem can exist in case that the maximum VIF is more than 10.0 or the smallest Tolerance is less than '0.1'. It is also generally believed that there could be multicollinearity problems existing if there are two or more predicting variables, of which variance proportions[9] reach more than 0.9 in the dimension where the maximum condition index is situated. With these criteria in mind, let us examine whether there are multicollinearity problems in existence in our regression analysis here.

As is shown in Table 10, all the tolerances are not less than 0.1, while all the VIF's are not more than 10. Therefore there seems to be no multicollinearity problem existing among the infrastructure variables.

8) VIF=1/(1-coefficient), whereas the denominator is referred to as 'Tolerance'. When a predicting variable has no correlation with other predicting variables, then 'coefficient' is defined '0', which makes VIF level at 1 with Tolerance value '1'. On the contrary, when a predicting variable has perfect correlation with other predicting variables, then 'coefficient' is defined '1', which makes VIF level at '∞' (infinity) with Tolerance Value '0'.

9) Variation proportion refers to the predicting power of a determinant variable in relation to variation of the measured regression coefficient

Table 10 Multicollinearity Statistics among Infrastructure Variables

Model		Collinearity Statistics	
		Tolerance	VIF
1	(Constant)		
	Culture Average	.371	2.693
	Technology Average	.270	3.702
	Structure Average	.254	3.943

Note) Dependent variable: KM Performance (ES) Average

This result is also supported when we calculate the collinearity diagnostics for variance proportions. As is shown in Table 11, the maximum condition index can be found in dimension 4, where none of the variance proportions are more than 0.9 level. Therefore we can be relieved in that multicollinearity problem in this regression is non-existent. Likewise, if we try to diagnose the multicollinearity among the KM Process variables, the results are as below.

As is shown in Table 12, all the tolerances are not less than 0.1 and all the VIF are not more than 10. Therefore there seems to be no multicollinearity problem existing either. In the meanwhile as is shown in Table 13, maximum condition index can be found in dimension 5, but there is only one variance proportion, reaching more than 0.9 level (P1). Apparently this is not enough to meet the fore-mentioned criteria of two or more variance proportions more than 0.9 level. Therefore we can also be relieved in that multicollinearity problem is not detectable in the regression where KM process are independent predicting variables.

In sum, there seems to be no multicollinearity detectable among the predicting variables of KM infrastructure as well as process in the regression analysis where dependent variable is set at KM Performance.[10] As such we are now relieved from the multicollinearity problem as far as causal relationship between infrastructure and KM performance - the main concern of this study- is

Table 11 Collinearity Diagnostics among infrastructure variables

Model Dimension		Eigenvalue	Condition Index	Variance Proportions			
				(Constant)	C	T	S
1	1	3.940	1.000	.00	.00	.00	.00
	2	4.00E-02	9.913	.57	.00	.03	.12
	3	1.059E-02	19.288	.18	.78	.50	.00
	4	9.781E-03	20.069	.25	.22	.47	.87

10) In the regression analysis where a dependent variable is set at infrastructure or process, the existence of multicollinearity problems cannot be ruled out. However, since the causal relationship among the capability variable is not main concern of this study, the diagnostics for verification in this area were omitted.

Table 12　Multicollinearity Statistics among Process variables

Model		Collinearity Statistics	
		Tolerance	VIF
1	(Constant)		
	P1　Average	.151	6.626
	P2　Average	.181	5.522
	P3　Average	.222	4.497
	P4　Average	.421	2.377

Note) Dependent variable: KM Performance (ES) Average

Table 13　Collinearity Diagnostics among Process variables

Model	Dimension	Eigenvalue	Condition Index	Variance Proportions				
				(Constant)	P1	P2	P3	P4
1	1	4.893	1.000	.00	.00	.00	.00	.00
	2	6.178E-02	8.899	.71	.02	.04	.02	.00
	3	2.244E-02	14.765	.26	.01	.05	.04	.97
	4	1.401E-02	18.688	.03	.01	.43	.83	.00
	5	8.976E-03	23.347	.00	.96	.48	.11	.02

Note) Dependent variable: KM Performance (ES) Average

concerned. Therefore we do not have to rectify the regression equation itself to eliminate the multicollinearity problem.

With this in mind, we will focus in the next section on the regression analysis to find out the causal relationship among the KM variables in the form of 4 different types of hypothesis testing.

c) Hypothesis Testing

<Hypothesis I>

> KM infrastructure capability will have an effect upon KM performance as is judged by effectiveness and satisfaction.

The results of multiple regression analysis (Table 14) show that F-test value (98.180) for the full model were significant at the $p<0.0001$ level and therefore we can say that there is a composite linear relationship between 3 KM infrastructure (culture /technology /structure) and KM performance. The 3 variables as a whole have 64.4% predicting power of the variance in KM performance as depicted by the adjusted R square (coefficient of multiple determination).

But if we look into the model by standardized coefficient, it is obvious that the major contribu-

Table 14 Effect of KM Infrastructure on KM Performance

Predictors	Standardized Coefficient	Unstandardized Coefficient	t	Sig.
	Beta	B		
Culture	0.357	0.386	4.625	0.049
Technology	0.026	0.02299	0.287	0.775
Structure	0.477	0.394	5.105	0.000
R Square=0.651	Adjusted R Square=0.644	DF=3	F=98.180	$p<0.0001$

tion to this linear relationship is from 'Structure' (Beta value 0.477) and 'Culture' (Beta value 0.357). In case of 'Technology', Beta value was at a such negligible level of 0.026 that it cannot be playing a contributing role to KM performance. This interpretation can also be supported by T-test value as the calculated significance value[11] meeting our earlier premise of $p<0.05$ was 'Structure' (P-value 0.0001) and 'Culture' (P-value 0.049). P-value for 'Technology' was 0.775, far bigger than the significant level of 0.05. In other words, as far as 'Technology' is concerned, we cannot say that it is a major component of KM infrastructure variable contributing to KM effectiveness and satisfaction, as the T-test result was not significant.

In summary, we can conclude that Hypothesis I proved true when the 3 components are in full model collectively. However, when it comes to the contribution to the model by component variables, 'Structure' was most significant, followed by 'Culture' whereas 'Technology' was not at a significant level to contribute to the resultant KM performance. As mentioned above, our main concern is not to rectify regression equation itself by eliminating insignificant variable, but to infer the causal relation between predictors (independent variables) and dependent variables. As such we will put in the following analysis emphasis on comparing the standardized coefficients (Beta) and calculated significance value (P-value) so that we can judge and compare predicting power among independent variables.

<Hypothesis II>

KM Process capability will have an effect upon KM performance as is judged by effectiveness and satisfaction.

As Table 15 shows, the F-test value (106.868) for the full model was significant at the $p<0.0001$ level and therefore the Hypothesis II proved true when the 4 KM Process (PI/PII/PIII/PIV)

11) This is also referred to as p (probability)-value.

Table 15　Effect of KM Process on KM Performance

Predictors	Standardized Coefficient	Unstandardized Coefficient	t	Sig.
	Beta	B		
PI	0.342	0.283	3.210	0.002
PII	-0.096	-0.0779	-0.992	0.323
PIII	0.492	0.406	5.609	0.000
PIV	0.170	0.148	2.667	0.008
R Square=0.731, Adjusted R Square=0.725, DF =4, F =106.868 p<0.0001				

variables, as predictors in full model collectively to the dependent variable of KM performance. The 4 variables as a whole have 72.5% predicting power of the variance in KM performance as depicted by the adjusted R square (coefficient of multiple determination).

However, when it comes to the contribution to the model by component variables, 'PIII (application/sharing)' is most significant (Beta 0.492), followed by 'PI (acquisition/creation, Beta 0.342) and PIV (protection/control, Beta o.170) whereas 'PII (conversion/accumulation, Beta -0.096[12])' is not at significant level to contribute to the resultant KM performance. At the T-test, P-values excluding PII met the significance level criteria of $p<0.05$, so that we can conclude with saying that these 3 variables can have an effect on KM performance. PII (P-value 0.323) was exceeding a significance level of 0.05, so there seems to be no significant causal relation detectable to KM performance.

<Hypothesis III>

KM Infrastructure capability will have an effect upon KM Process capability.

We divided this regression analysis into 4 sub-Hypotheses, all of which have predictors of KM infrastructure relative to dependent variables of each KM process. The results of hypothesis testing proved that the 4 sub-Hypotheses are true when the 3 infrastructure components are in full model collectively. However, if we look at the model by predictor individually, insignificant variables were found at the t-significance level of 0.05 with different contribution to the model. Followings are the outlines of the results.

12) Minus value of Beta does not mean negative causal relationship. The magnitude of causal relationship must be measured by absolute value.

<Hypothesis III-1>

KM Infrastructure capability will have an effect upon KM Process I (Acquisition/Creation) capability.

Table 16 Effect of KM Infastructure on KM PI Process

Independent variable	Beta	p-value	Remark
Culture	0.053	0.421	No persuasive effect
Technology	0.166	0.034	Convincing effect
Structure	0.676	0.000	Convincing effect

- Contribution of each independent variable: 'Structure'(Beta 0.676), followed by 'Technology' (Beta 0.166)
- In case of 'Culture' there is no significant causal relation detectable to KM PI process as p-value (0.421) exceeds a significance level of 0.05 by far

<Hypothesis III-2>

KM Infrastructure capability will have an effect upon KM Process II (Conversion/Accumulation) capability.

Table 17 Effect of KM Infastructure on KM PII Process

Independent variable	Beta	p-value	Remark
Culture	-0.054	0.480	No persuasive effect
Technology	0.304	0.001	Convincing effect
Structure	0.585	0.000	Convincing effect

- Contribution of each independent variable: 'Structure' (Beta 0.585), followed by 'Technology' (Beta 0.304)
- In case of 'Culture' there is no significant causal relation detectable to KM PII process as p-value (0.480) exceeds a significance level of 0.05 by far

<Hypothesis III-3>

KM Infrastructure capability will have an effect upon KM Process III (Application/Sharing) capability.

Table 18　Effect of KM Infrastructure on the KM PIII Process

Independent variable	Beta	p-value	Remark
Culture	0.209	0.006	Convincing effect
Technology	0.135	0.125	No persuasive effect
Structure	0.529	0.000	Convincing effect

- Contribution of each independent variable: 'Structure' (Beta 0.529), followed by 'Culture' (Beta 0.209)
- In case of 'Technology' there is no significant causal relation detectable to KM PIII process as p-value (0.125) exceeds a significance level of 0.05

<Hypothesis III-4>

KM Infrastructure capability will have an effect upon KM Process IV (Protection/Control) capability.

Table 19　Effect of KM Infrastructure on KM PIV Process

Independent variable	Beta	p-value	Remark
Culture	0.096	0.265	No persuasive effect
Technology	0.420	0.000	Convincing effect
Structure	0.282	0.007	Convincing effect

- Contribution of each independent variable: 'Technology' '(Beta 0.420) followed by 'Structure (Beta 0.282)
- In case of 'Culture', there is no significant causal relation detectable to KM PIV process as p-value (0.265) exceeds a significance level of 0.05

<Hypothesis IV>

KM Process capability will have an effect upon KM Infrastructure capability.

We divided this regression analysis into 3 sub-Hypotheses all of which have the predictors of KM process relative to dependent variables of each KM infrastructure. The result of hypothesis testing proved that the 4 sub- Hypotheses are true when the 3 infrastructure components are in full model collectively. However, if we look at the model by predictor individually, insignificant variables were found at the t- significance level of 0.05 with different contribution to the model. Followings are the outlines of the results

< Hypothesis IV-1>

KM Process capability will have an effect upon KM Cultural Infrastructure capability.

Table 20 Effect of KM Process on KM Cultural Infrastructures

Independent variable	**Beta**	**p-value**	**Remark**
PI	0.335	0.015	Convincing effect
PII	-0.201	0.109	No persuasive effect
PIII	0.456	0.000	Convincing effect
PIV	0.197	0.017	Convincing effect

- Contribution of each independent variable: 'PIII' (Beta 0.456) followed by 'PI' (Beta 0.335), and PIV (Beta 0.197)
- In case of 'PII', there is no significant causal relation detectable to KM Cultural infrastructure as p-value (0.109) exceeds a significance level of 0.05

<Hypothesis IV-2>

KM Process capability will have an effect upon KM Technology capability.

- Contribution of each independent variable: 'PIV (Beta 0.302) followed by 'PI' (Beta 0.257)
- In case of 'PII' and 'PIII', there is no significant causal relation detectable to KM Technology infrastructure as p-value (0.073/0.179 respectively) execeeds a significance level of 0.05

Table 21　Effect of KM Process on KM Technology Infrastructures

Independent variable	**Beta**	**p-value**	**Remark**
PI	0.257	0.033	Convincing effect
PII	0.197	0.073	No persuasive effect
PIII	0.132	0.179	No persuasive effect
PIV	0.302	0.000	Convincing effect

<Hypothesis IV-3>

KM Process capability will have an effect upon KM Structural capability.

Table 22　Effect of KM Process on KM Structural Infrastructure

Independent variable	**Beta**	**p-value**	**Remark**
PI	0.532	0.000	Convincing effect
PII	0.070	0.449	No persuasive effect
PIII	0.199	0.019	Convincing effect
PIV	0.119	0.052	No persuasive effect

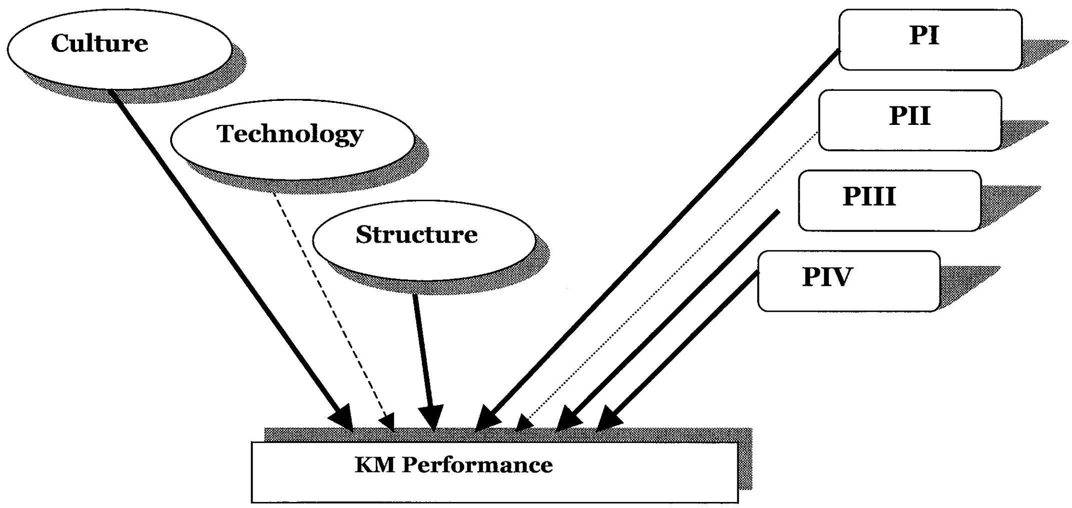
- Contribution of each independent variable: 'PI (Beta 0.532) followed by 'PIII' (Beta 0.199)
- In case of 'PII' and 'PIV', there is no significant causal relation detectable to KM Structural infrastructure as p-value (0.449/0.052 respectively) exceeds a significance level of 0.05

d) Summary of Regression Analysis

(1) KM Capabilities' Effect on KM Performance

As we analyzed in the above Hypothesis I and II, all the other variables in the infrastructure and process capabilities (excluding Technology and PII) were within the significant level of $p<0.05$ criteria. Figure 6 shows the causal relationship of capability as predictors to KM performance as dependent variable. Technology and PII are drawn in dotted line, depicting no significant effect statistically. These results clearly imply that technology-driven KM capability cannot bring about any significant KM Performance. This result also explains why so many KM projects resulted in failure in real practice. It also reminds us that technology itself should be accessed as one instrument of leveraging KM dynamically. It should thus be accessed with other KM capabilities interactively and simultaneously.

Fig.6. KM Capabilities' Effect on KM Performance



The reason behind the dropping of PII from the causal variables to KM performance is that PII (conversion and accumulation) are thought to be generating lower levels of value-addition relative to other capabilities. This result also seems to derive from the relatively higher correlation between Technology and PII. As we noted in the correlation analysis, in the four coefficients of correlation with the Technology, that one of PII is second biggest.

(2) KM Infrastructure-Process mutual relationship.

From the result of Hypothesis III and IV, we reconstructed Table 23 and 24. Table 23 shows that Culture does not have much effect on process excluding PIII, whereas IT and Structure are significantly contributing to the processes other than PIII. As such, Culture and Technology have completely reversed the causal relationship. Table 24 shows the effect of the Process capability on the Infrastructure. First of all, among the 4 variables, PI is believed to be the most powerful predictor for Infrastructure, as the result of the regression shows a significant level of causal relationship. While PIII and PIV shows relatively positive causal relationship with infrastructure, it is notable that PII does not seem to generate any positive causal relationship with infrastructure. As the reader can see himself in the number of check marks(√) s in Table 23 and 24, while each capability of Process has just two '√ ' s, among the Infrastructure 'Culture' is marked entirely by '√ ' s, followed by 'Technology' and 'Structure' which have 2 '√ 's respectively. This implies that organizational Culture can be more liable to be affected by KM Process Capabilities.

Table 23　Reconstruction of KM Infrastructure's Effect on Process

Predictor \ Dependent Variable	PI	PII	PIII	PIV
Culture			√	
Technology	√	√		√
Structure	√	√	√	√

Table 24　Reconstruction of KM Process' Effects on Infrastructure

Predictor \ Dependent Variable	Culture	Technology	Structure
PI	√	√	√
PII			
PIII	√		√
PIV	√	√	

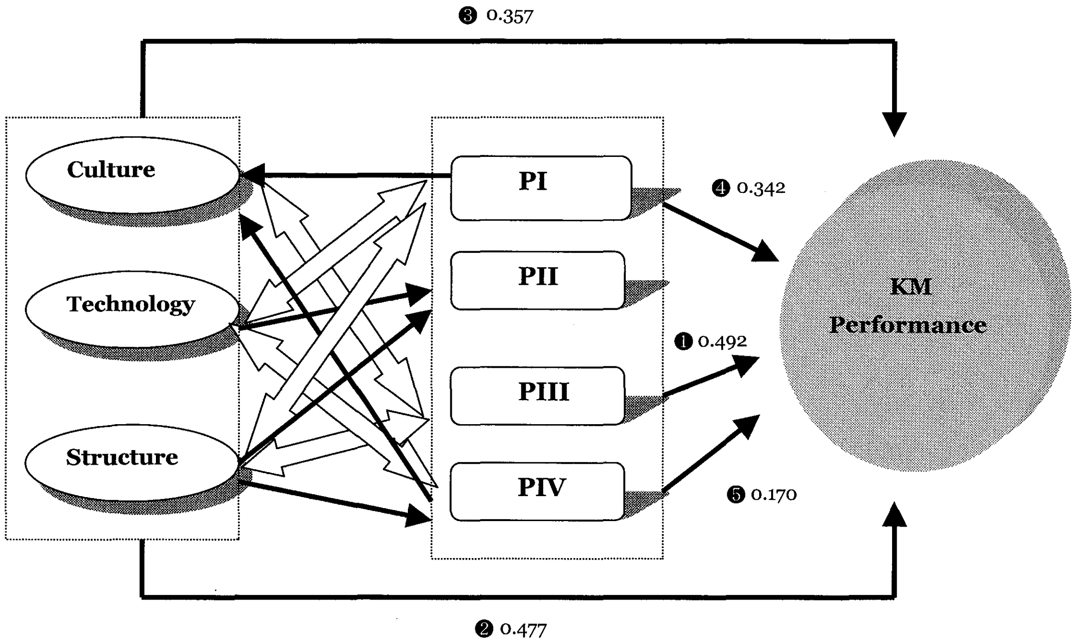
(3) KM Infrastructure-Process-Performance Mutual Relationship

Based on the analysis in above, the whole relation of KM infrastructure-Process-Performance can be depicted as in Fig.6. Among the capabilities, the contributing power to the KM performance by each independent variable is measured in order of PIII (Beta 0.492) > Structure (Beta 0.477) > Culture (Beta 0.357) > PI (Beta 0.342) > PIV (Beta 0.170), while Technology and PII do not seem to affect any persuasive causal relation to KM performance at the T-test significance level of 0.05. As for the relationship among the infrastructure and process, Structure and PI seem to function as determinant rather than dependent, while Culture and PII function as dependent rather than determinant.

4. Conclusion

As a starting point for this comprehensive study, we attempted to integrate two streams of KM perspectives, namely one focusing on the *infrastructure*, and the other one on the *process*. The 'Knowledge Capability Model' conceptualized in this study is based on the very notion that exactly these two organizational capabilities interdependently affect successful running of KM performance, which on itself consists of '*Effectiveness*' (innovativeness, productivity, adaptability) and '*Customer Satisfaction*.'

Fig.7 KM Capability-Process-Performance Mutual Relationship



1) Significance and Limitation of the Study

a) Significance

The main contribution of this study is situated in the statistical identification of the relationship between organizational KM capabilities and KM performance, the ultimate purpose of KM. The 'Knowledge Capability Model' was tested by statistical methods such as correlation and regression analysis based on a questionnaire directed towards Korean KM experts. Our findings from the correlation analysis suggest that, while infrastructure and process capabilities have significant levels of correlation towards each other, process capabilities turn out to be much closer related to KM Performance than Infrastructure does. However, the regression analysis for the Hypothesis testing gave us a much clearer picture of the validity of this model. That is, it enabled us to see the causal relationship among the KM variables, not only in the collective dimension of each capability, but also in the contribution of each variable on itself. In the course of the regression analysis, we came to identify a causal relationship between capability (Infrastructure/Process) and KM Performance at a level of significance of $p < 0.0001$, considering the variables are interpreted collectively. Notwithstanding this, a look into the model by focusing on the individual elements of each variable reveals a clear distinction between a causal relationship vs. a non-causal relationship. As an example we have discussed Technology and PII. On their own they do not seem to have persuasive effect on KM performance at a T-test confidence level of $p < 0.05$. Further and on a broader note this study provided an integration of existing and rather fragmented KM theories, and poured into a new and comprehensive framework for the development of organizational KM capabilities. Moreover, it pinpointed specific attributes of capabilities in the concept of 'proxy' – the main contents of the questionnaire, gone through in an empiric way by KM experts. In this sense, the broad set of 60 proxies introduced in this study will surely help both practitioners as well as researchers to utilize these as starting points for operationalization and further elaboration. On a minor note, contributions of this study also include clarification of KM performance in detail to cover even the 'internal customer satisfaction,' and the pointing of largely neglected issues, such as protection processes, etc.

b) Limitation

Although due to helpful assistance of many institutions we could obtain potential respondents and thus gathered data surpassing the original expectations, we have to admit that a main limit of this study is the relative small sample size of 162 entries. We do have to add, however, that at the time of survey KM was only at an introductory stage in Korea, making a small sample size unavoidable. Nevertheless, the problems still remain that this relatively small sample can limit the generalization of our statistical analysis.

Next, it is possible that the respondent's personal bias could influence the statistical analysis, especially considering the fact that we attempted to be as objective as possible in the current of the questionnaire. In an attempt to alleviate this problem – which also gave us the opportunity to gather a greater sample size – we accepted to have plural respondents from the same organization, in particular larger firms such as Sunkyung and Samsung, etc. Small and medium sized companies were only asked to hand back one questionnaire form.

Another limitation is that this study does not give industry-specific prescriptive suggestions. The reason therefore is that the survey did not intend to select certain target industries in the first place. Admitting the existence of these limitations, we do think that there were sufficient amount of samples that did not mislead or distort the main issue of the KM capability model.

2) Implications for practice and future study

a) Implications for practice

The main implication of this study on the practical level is that a firm should strive to balance the efficiencies of process capabilities with the knowledge creation potentiality of infrastructure capabilities. As we attempted to demonstrate, both infrastructure and process capabilities should be deployed in combination, not in isolation, since organizational KM capabilities are complex and additive in pre-disposition for successful transformation. In other words, the KM should not be approached as a project of simple information, but as a complex transformation project. This was empirically proved by our study: 'Technology-driven KM' does not have as much effect on KM performance as 'Human-oriented KM' does. Moreover, this is supported by the outcome of our regression analysis: 'Technology' and 'PII (Conversion/Accumulation) does not appear to have a convincing effect on KM performance, as opposed to the critical effects verified in the variables of Structure, Culture and PIII, PI, PIV. On a more realistic note, firms should define the aim of KM so that they can deploy different sets of proxies in combination to back up the defined KM. Therefore, it is only logical that they should start with assessing the current situation of KM capabilities, not only at the individual level but also at the organizational level, before moving into launching fully the KM project itself.

However, it is the firm's own responsibility to set the road map of KM development in a time-sequential way with particular emphasis on selecting practicable alternatives within the limited resources available.

3) Suggestion for the further Study

We think that our capability model needs to be elaborated more, in terms of key proxies of variables adapted to specific industries or sector. It would also be advisable to extend the level of analysis across firms, industries, and even national boundaries. As for the sequential development for KM strategy mentioned above, it would be desirable that the researcher develops a theoretical conceptualization in accordance with the product life cycle concept, since the KM capability evolves and upgrades in a time-sequential way. An experimental suggestion for this may be the following phase or cycle of KM capability: Initiation -> Propagation -> Integration -> Networking.

A final suggestion topic for further study is the necessity of the IT infrastructure. In the present study, the technology capability was not fully scrutinized and taken into account, as we were too much preoccupied with the negative effects of technology. However, in view of the ever-developing state-of-the art technology and conversion of on-line and off-line mediums interchangeably, technology will not only change the mode of working, but also the KM paradigm itself. (End)