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On the contribution of Knowledge Creation and Information Technology in the Organization by applying the undirected and directed independent graph

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by applying the undirected and directed independent graph

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Abstract
Not only in recent advanced information society, the information technology changed ideal way of the individual communication, but also much innovation was also brought about in the business field. Especially, the knowledge creative power becomes decisively important, when the speed of the change of technology and market increases.
In this paper, the fact of how "information technology" and " knowledge creation" which become necessary the organization management in the office influence the organization effectiveness, is verified. The data analysis was carried out with the CGGM and EQS software in order to efficiently analyze these relations. Using the result of the factor analysis, the undirected independent graph and directed independent graph were made in order to require the causal relation of each factor. From the result, the result of getting the knowledge creation and information technology on organizational effectiveness and what kind of relation there is, is reported.

Keywords
Knowledge creation, information technology, questionnaire survey, factor analysis, independent graph

Introduction

Recently, in the Japanese enterprise, the information sharing is attempted by introducing

intranet and groupware with the progress of the open network, and the environment for the collaboration in the group is arranged. Like this, the discussion on the knowledge management progresses in the enterprise. In the enterprise, though the trial of utilizing the information technology in the new direction of "creation of a knowledge" began, it is a stage of trial and error even in each enterprise without yet leaving the area of the stage of the theory in the actuality. In the theory in the area, it is considered a field of the exchange from explicit knowledge to explicit knowledge on the network by computers, etc., and it is not considered "field of the knowledge creation" from tacit knowledge to explicit knowledge. It is considered that until now, the information technology is only to process information. However, by the advanced development of the hardware/software of the information technology, by the way of the utilization of the information technology, it is enabled to convert into explicit knowledge from tacit knowledge, and it is regarded as a possible of to raise in the advanced knowledge creation system.
Then, in this study, questionnaire survey is carried out for the employee of private manufacturing industry A Co., and the structure which lurks in SECI model and back of the information technology introduction is investigated using the statistics soft SPSS Inc. by the multivariate analysis. In addition, knowledge creation and proposal of the model of the information technology were carried out, and the effect of knowledge creation and information technology on relevance and organizational effectiveness was verified. And, the analysis was carried out by both software of CGGM(Conversational Graphical Gaussian Model) and EQS(Structural Equations Program) in order to efficiently analyze the causal relation of knowledge creation and information technology.

Research method

Research object and analysis method

The questionnaire survey was carried out for the employee of manufacturing industry A Co., and usefulness answer number of 358 in 388 was obtained. The investigation was carried out from November, 2001 to January, 2002. The survey item made "on knowledge creation" 31 questions. Here, question item on collaboration, socialization, externalization, and internalization, which show four knowledge conversion mode was established. "On IT" made 16 questions. Here, the question item on environment, proficiency, working condition of IT was established. And, "on individual information" established question item of total of 26. Using measured data, the factor analysis by maximum likelihood method and promax rotation method with the normalization of the kaiser was carried out by SPSS. In addition, the correlation analysis by rank correlation coefficient was done in order to observe the effect between each factor. It was converted as evaluation score of the five stages in order to apply this analysis, in order to the data for the analysis the total of each constitutive variable is calculated at the every factor, and the probability of the answer data becomes equal.

Result of analysis and consideration

Factor analysis

Determination of the number of factors

Exploratory factor analysis was carried out using the result of measuring by the question of each 31 items and 16 items in order to clarify the structure which lurks in the back of

"knowledge creation" and "information technology" which are the observation variable. The eigenvalue adopted the thing over 1 as a factor, and it selected it as a thing that factor load had the variable over 0.55 from pattern matrix for each question and that it strongly has features of each factor. Factor extracted by factor analysis, eigenvalue of each factor and contribution ratio, and variable mean value and standard deviation which constitutes each factors are shown in table 1. In the item of the knowledge creation, it seems to utilize the knowledge which acquired the information technology by utilizing, because the value of " practical use of knowledge" and "the information gathering ability" is high. In the item of information technology, equipping of information infrastructures in the enterprise seem to advance, because the value of " equipment environment" and " use situation" is high.

Knowledge Creation		
Factor Number and Factor Name	Average Standard Deviation	Eigenvalue Contribution ratio
1 Experience study	1.49 0.97	9.24 32.9%
2 Promotion of exchange	2.37 1.34	1.95 6.96%
3 Practical use of knowledge	3.25 1.20	1.78 6.36%
4 Intellectual property	3.08 1.29	1.34 4.78%
5 Re-creation of knowledge	2.19 1.24	1.19 4.24%
6 Information gathering ability	3.63 0.92	1.09 3.92%
Information Technology		
1 Ubiquitous environment	3.09 1.57	5.97 38.6%
2 Equipment environment	4.21 0.89	1.57 10.5%
3 Database	2.04 1.24	1.24 8.24%
4 Use situation	4.26 0.86	1.02 6.79%

Table 1. Statistic of factors

Correlation analysis

Graphical Modeling

By making the undirected independent graph, the relationship between each factors which complicatedly interwined was clarified. There was the strong relevance as the result between factors of the knowledge creation in "promotion of exchange"-"practical use of knowledge", "practical use of knowledge"-"intellectual property", and "intellectual property"-"re-creation of knowledge". From this result, a knowledge is shared by individual and individual mutually talking, and a new knowledge is created, and it seems to transfer a knowledge to product and service as the result. And, it is considered that the relation in which "experience study"-"intellectual property" is strong utilizes knowledge referring to the best practice of outside company. In addition, there was some the direct relation on "experience study", "intellectual property", "information gathering ability" on other five factors. In addition, it is proven that "promotion of exchange" and "practical use of knowledge" are no correlations between "re-creation of knowledge". The property of the latent knowledge creation is guessed in "experience study and intellectual property and information gathering ability".

In the meantime, it was possible to observe the strong relevance between factors of the

information technology in "use situation"-"ubiquitous environment" and "ubiquitous environment"-"database". It is shown that from the relationship between "use situation" and "ubiquitous environment", the improvement of the IT environment except for the workshop advances on this fact, if "use situation" advances, and that "ubiquitous environment" appears. And, there is the relation that practical use of "database" necessary for promoting information sharing, when the improvement of "ubiquitous environment" advances, also advances. And, that to observe the relevance which is especially strong for "equipment environment"-"use situation" was possible seems to be that the individual proficiency rises by introducing the IT environment, and that it becomes easy to share information.

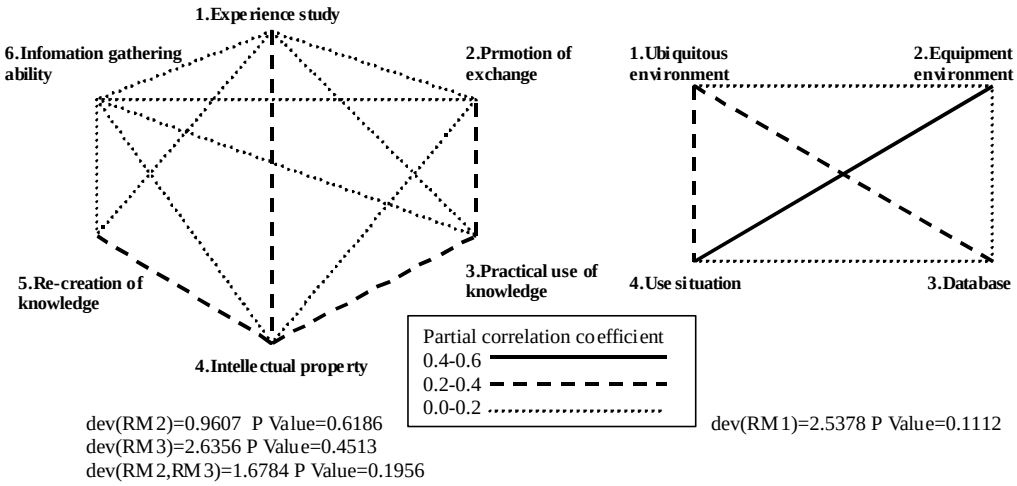


Figure 1. Undirected independent graph

Organizational Effectiveness

In order to examine how knowledge creation, information technology, and organizational effectiveness affect, how some factors extracted by the factor analysis of the knowledge creation and information technology are related to organizational effectiveness (productivity, flexibility, stability, growth, agility, complaint, goal attainment, fiduciary relation), were analyzed, and these results are shown in table 2. Many correlations were obtained between 5 factors of knowledge creation except for complaint and many factors of organizational

	Organizational Effectiveness / Factor	Productivity	Flexibility	Stability	Growth	Agility	Complaint	Goal attainment	Fiduciary
KC	1.Experience study.	*	*		*	**	*	**	**
KC	2.Promotion of exchange								**
KC	3.Practical use of knowledge	**	**	**	*	**		**	**
KC	4.Intellectual property	*	**	*	**	**		**	**
KC	5.Re-creation of knowledge	**	*		**				*
KC	6.Information gathering ability		**			**			*
IT	1.Ubiquitous environment		*			*	**		*
IT	2.Equipment environment	*	**	*	**			**	**
IT	3.Database		**	*	**	**			
IT	4.Use situation	*	**		**				*

P 0.01, P 0.05

Table 2. Effect of knowledge creation

effectiveness. By sharing a knowledge by also including in the knowledge creation in the enterprise, from this fact, the experience, it seems to connect it by quickly corresponding to changing market opportunity, for the formation of the growth basis. In addition, it seems to raise organizational effectiveness from connecting with the improvement in flexibility and productivity by producing a new knowledge by the utilization of existing knowledge. And, the correlation was all obtained 4 factors of the information technology with the factor of either organizational effectiveness. Information sharing is done by utilizing the database, while the IT environment is introduced from this fact in the information technology in the enterprise, and it seems to raise organizational effectiveness, because the business efficiency improvement is improved.

Knowledge Creation and Information Technology

The result of examining by the correlation analysis in order to require the relation between each factors got by factor analysis, is shown at table 3. From test result between factors of showing in table 3, the correlation was obtained "ubiquitous environment" and "equipment environment" between all factors except for "promotion of exchange". It was proven that there was the strong relevance between "database" and 6 factors of the knowledge creation and that there are each correlations between "use situation" and "practical use of knowledge", "intellectual property", and "information gathering ability". Promotion of the knowledge creation can be guessed with that it is possible by arranging the environment which can do information sharing by this fact constructing the database in the enterprise. And, a knowledge of the individual combines by constructing the prototype of the idea by the joint ownership of experience, and the process of connecting to the joint ownership of experience seems to have been formed.

Information Technology / Knowledge Creation	Fac.1 Ubiquitous environment	Fac.2 Equipment environment	Fac.3 Database	Fac.4 Use situation
Fac.1 Experience study	**	*	**	
Fac.2 Promotion of exchange			**	
Fac.3 Practical use of knowledge	**	*	**	*
Fac.4 Intellectual property	**	**	**	**
Fac.5 Re-creation of knowledge	*	**	**	
Fac.6 Information gathering ability	**	**	**	**

P 0.01, P 0.05

Table 3. Correlation of knowledge creation factor and information technology factor

Covariance Structure Analysis

Composition of a model

In the pre-chapter, it was possible to summarize many measured question items as common factor by the factor analysis. Then, it was tried that the causal model between arranged factors was constructed by covariance structure analysis. Here, in order to made to develop to the covariance structure analysis model, it is handled in as of the implication which has taken up

the factor until now as a latent factor, and the causal relation between variables/factors is modeled according to pass figure only using structure equation. On the basis of the effect from the information technology on the knowledge creation, the model was constructed on organizing management and effect on organizational effectiveness. By the information technology, organizational effectiveness was introduced in the premise of activating the knowledge creation, and the expansion of the model was attempted.
It was considered that the improvement in the organization management was influenced by the introduction of the information technology with promotion of the knowledge creation, and the model for knowing the effect of the information technology for 6 factors of the knowledge creation was constructed. This model is shown in figure 2.

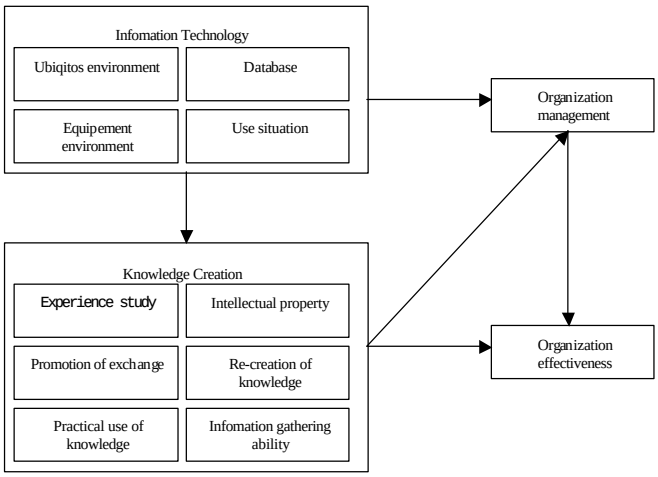
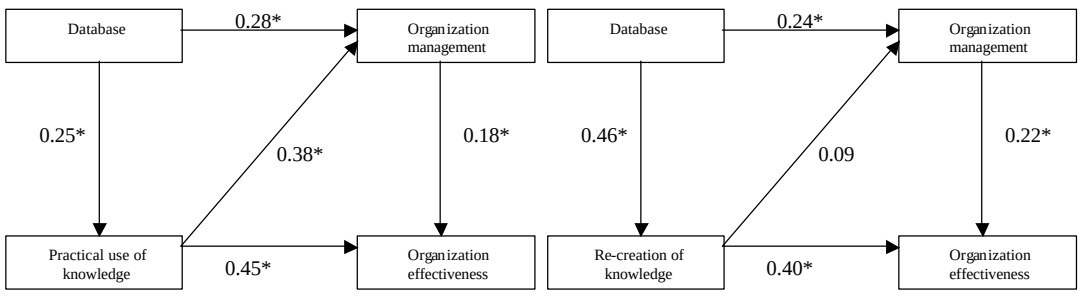


Figure 2. Causal model between factors.

Verification of a model

The pass figure was made from the relational model between knowledge creation and information technology in EQS, and the path coefficient was calculated. From the result of goodness-of-fit test, the best causal model of fit is shown in figure 3(a) and (b). It was proven that goodness-of-fit of the causal model which examined the effect from "database" on "practical use of knowledge" was very high, as it was shown in figure 3(a). The effect on "practical use of knowledge" can be confirmed from "database" from this fact. This got knowledge from the database spreads to the proposal of new concept and idea, and in addition, it seems to utilize it to the education to application performance and subordinate in the job. And, the effect from "practical use of knowledge" to " organization management" was big, and the direct effect on a results was able to be confirmed. It was proven that from this



P Value	GFI	AGFI	RMR	AIC
0.248	0.997	0.996	0.005	-1.742

(a)

P Value	GFI	AGFI	RMR	AIC
0.835	0.996	0.999	0.002	-1.957

(b)

Figure 3. Causal model

fact, the causal relation was a direction of "practical use of knowledge" from "database", and in addition, that it is a direction of "organizational effectiveness" from "practical use of knowledge".
The result that goodness-of-fit was very high even in the causal model which examined the effect from "database" on "re-creation of knowledge" was obtained, as it was shown in figure 3(b). Because the correlation coefficient from "database" to "re-creation of knowledge" is comparatively big, it is the process that information accumulated in the database is utilized in actual project, and it seems to become possible that studying experience is utilized even in the different project. And, it is considered that practical use of the success example is the promotion factor, because the direct effect from "re-creation of knowledge" on a results was able to be confirmed.

Conclusions

In this study, factor of knowledge creation and information technology were extracted, and it was possible to confirm the relation of those factors And, by using the directed independent graph, by modeling the hypothesis, the relationship between factor on the introduction of the information technology and knowledge creation factor were visually shown, and it was possible to examine both relation. The effect which can not be disregarded from the causal model between knowledge creation factor and information technology factor seems to exist.
Not only that it introduces them but also that it constructs the system for raising those situation of utilization seem to be important, because the information technology is the system which supports the environment which does information sharing. In addition, it seems to require that the groupware with the good usability is constructed for the business organization, since the environment which does information sharing is supported.

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