A Estimating Model for Small and Medium Business Information Level

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ABSTRACT

We analyze the information level of local small and medium business in the base of Nolan's growth stage model. To estimate information level we do separate level analysis for six sections and integrated total level analysis. After analyzing information level of business, we focus on the factors of this result to understand the most influential environments. The local business we were studying are the third stage-control stage. But Organization of information department and Planning and control of information are the second stage. The number of computer system application field is very related to information level. We present the critical factors of information level of small and medium business.

Keywords : Business information, Computerization system, Growth stage model, Information level

1. Introduction

Survey of Information level of small and medium business researches on the actual condition, discovers the disadvantages and then suggests the effective way of information system. In the condition focused on ERP(Balanced Score Card) – Oracle solution Research, 2001, BSC(Enterprise Resource Planning)[1], The question arises that small business can introduce this kind of information system and technology successfully indeed. To solve this question, the preceding work is analysis of present management information system level. However there aren't many case studies about information level through scientific methods and the foundation of information is weak and vague.

Estimation of information level has many difficulties. Especially cost and profit of information are imponderable because of many invisible elements. [2]

Delon announces that computerization cost depends on the computerization experience of business because of reliance on outside service. And in Powers, Dickson, Raymond's studies, computerization experience is the decisive factor of information success.[3]

We emphasize the conclusive factor such as computerization will, experience, organization and focus on evaluating the present condition. We analyze the 73 local small and medium business and six sections-computer practical field, organization of information department, planning and control of information, attitude and ability of users, recognition of management, application of DB and network on the basis of Nolan's model. [4][5] Of the environment conditions related to information, the most influential factor is by decided factor analysis.

2. Related Works

To establish the information growth strategies, preceding work is the estimation of information level of specified enterprise. Adequate information planning is needed for successful information. There are various methods to evaluate information level. Swanson estimated product and service of system. Lucas utilized quality of system, attitude and understanding of users, supporting of management level. Senn focus on the accuracy, suitability, duplication of output information, system utilization, application of idea decision. Schewe analyzed frequency of system use to understand information level.

In general, growth stage model suggested by Nolan is the model which classifies the information level of business. Stage

model of Nolan is the condition theory for planning information system corresponding to many kinds of features.

Gibson and Nolan[4] suggested that information technology stages of organization are composed of four stages and in 1979 they introduced six stage model- introduction, extension, control, unification, material management, and advance. King and Kraemer said Nolan's model is the evolutionary model which explains theory and goal of change.[6]

Advantage of this model is accurate explanation and propriety. But disadvantage is the lack of concreteness about change mechanism. Nolan's model is the conceptual model which helps understanding way of change and supports planning information.[7]

In this paper, we use this six growth stage model to estimate information level of business. Even though Nolan's model is descriptive, it is used to framework which can offer the foundation for understanding computerization level.

Especially it is one of the classics to computerization field.[8] So we use the Nolan's stage model to estimate information level of local small and medium business in this paper. The details are as follows in Table 1.

Table 1 - Six stages of Nolan

Stage	Contents
First (Introduction)	The state of spontaneous generation of information system relevant group
Second (Extension)	The dependent part of information system is checked within business systematically.
Third(Control)	Information system is recognized transcriptionally and construction, supply and fixation are the critical tasks.
Fourth (Unification)	Available use can be got by systemizing enterprize mainstay works. End user computing is active using Nonformal works, workstation.
Fifth (Inovation)	There are great changes in system focused on efficeincy, continousness of business, systemizing for competition
Sixth (Advance)	This is the last stage. Generalization of Strategic application of information system, application in the creative fields. In the future it can be developed into next stage by social changes and information technology improvement.

We put the stage intervals to estimate Nolan's growth stage like Table 2.

Generally the standard of computerization purpose is 100%. This method is to calculate the percentage of the estimation index and the arithmetic average. In this viewpoint it is proper that 5 points is divided equally into each stage. The gap between stages is 0.67 to divide into six stages. Small and medium business Administration also use this method in estimating information level (Small and medium business Administration & Korea Information Management Institution for Small and medium enterprises, 2003) .

Table 2 - Setting Up Steps Intervals

Step	Interval (more than-under)
First(introduction)	1.00-1.67
Second(extension)	1.67-2.34
Third(control)	2.34-3.01
Fourth(unification)	3.01-3.68
Fifth(material management)	3.68-4.35
Sixth(advance)	4.35-5.00

3. Survey of Present Information Condition of Small and Medium Business

3.1 Inquiry

3.1.1 Constitution of factors

In this paper, there are six factor sections, fore sections are from Nolan's model and two sections, recognition of management and application of DB and Network, are added.

In case of recognition of management section, information needs long term, investment and human power. Work computerization is the necessity for improving business organization. Moreover application of DB and network has influence in efficiency and effectiveness of computerization and general business. Information advances are critical at rapid information transmission between enterprises, enterprise and clients. Therefore two factor sections are added in this paper. Each six section is composed as follows.

(1) Computer Practical Field
This section focus on unification, efficiency, effectiveness of computer system.
(2) Organization of information system
In this section we understand the role of information system and skill ability and education of organization member.
(3) Planning and control of information system
Control degree, planning, institutionalization degree of system are presented.
(4) Attitude and ability of users
We analyze attitude and ability of users with the exception of computerization department.
(5) Recognition of management
We know management will and recognition about information system
(6) Application of DB and network
This section says application degree of DB and network.

We classify questions into six sections and know the growth stage of computerization by the arithmetical average. Finally more one section composed by total average of upper six sections is added. So we estimate information level using seven sections.

3.1.2 Survey method and object

We select 73 enterprises about manufacturing industry and manufacturing service industry at random. We analyze 35 enterprises from June to November, 2002 and 38 enterprises from June to October, 2003.

We visited enterprises and information administrators drew up inquiries directly. But when some questions have various meaning and standards, employees supplement query contents and write down by hand.

3.2 Analysis of information level by each section

Nolan's six stage-introduction, extension, control, unification, material management, and advance-model study is composed by computer practical field, organization of information department, planning and control of information, attitude and ability of users, recognition of management, application of DB and network. Also in this paper we estimate information level of business in Chungbuk using six sections.

We analyze trust in these six sections to know critical factors.

The result of inadequate variables is represented in Table 3. Cronbach's alpha value is 0.918897. But removing pertinent variables, Cronbach coefficient is not bigger than Cronbach's Alpha. So we don't need to get rid of variables.

Table3 - *Cronbach Coefficient when Removing each factor*

Factors	Cronbach's Alpha
Computer Application Field	0.927715
Organization of MIS Department	0.891663
MIS Planning and Control	0.892256
Attitude & Ability of Users	0.899425
Recognition of Management	0.902765
Application of DB & Network	0.910607

Table 4 is presents survey sections, average, stages and the standard deviation.

Table 4 - Result of Information Level

Department	Average	Step	Standard deviation
Computer Application Field	2.54	3	0.78
Organization of MIS Department	2.25	2	0.67
MIS Planning and Control	2.29	2	0.67
Attitude & Ability of Users	2.75	3	0.65
Recognition of Management	2.70	3	0.70
Application of DB & Network	2.44	3	0.75
Total average	2.49	3	0.60

3.3 Level analysis of information system

In this paper, level of information system of local small and medium business is the third stage, control stage. In this stage, because information system field is recognized transcriptionally , main tasks are construction, supply, and fixation of transcriptional period system. Because of continuous computerization promotion, rapid increase of cost, management and control of information is begun at this stage in the viewpoint of investment and effect.

Considering details, computer practical field is the third, control stage and organization of information department is the second, extension stage. Planning and control of information is also the second, extension stage. Attitude and ability of users, recognition of management, application of DB and network are the third, control stage.

Organization of information department and planning and control of information are the second stage

4. Analysis of environment factor related to information system

4.1 factor analysis model

Many studies make steady progress to discover critical factors for successful information. Main performers are Ball and Harris[9], Raymond[10], Guiljo Kim & Sungsu Kim[11], Jongmin Yoon, Kyoungsu Han & Jaemin Han[12]. The criterions for level estimation of information technology are the system development method[13], The number of application system[14], the number of terminal or CPU[15], the elaborateness of application system, computerization investment cost [16], the intensity of information technology.

In this paper we study the most influential factor among information environment. We consider values of seven sections including total information system as dependent variables and environment factors related to information as independent variables. environment factors related to information are selected by expressing in number from non-number data and are limited in comparative items.

The nine independent variables are the number of workers, sales, work experience, the number of server, PC retention, PC supply , the experience of computerization, the number of computer system application field, the type of DB application.

Table 5 is express the details used in analysis model. Other models are as follows.

$$Lij = \alpha j + \sum \beta ij EFi + \varepsilon j$$

Lij is the information level variables such as computer application field, organization of information department, planning and control of information, attitude and ability of users, recognition of management, application of DB and network and total information level. EFi is the environment factor variable such as the number of workers, sales, work experience, the number of server, PC retention, PC supply , the experience of computerization, the number of computer system application field, the type of DB application. εj is the gap of regression.

Table 5 - Variables for Factor Analysis

Dependent Variable	Independent Variable

· Computer Application Field · Organization of Information system Department · Planning & control of information · Attitude and ability of users · Recognition of management · Application of DB and network · Total Information level	· The number of workers · Sales · Work experience · The number of server · PC retention · PC supply · The experience of computerization · The number of computer system application field · Type of DB application.

The basic assumption of this model is that seven dependent variables are influenced by nine environment factors. We try to estimate the degree of influence.

Example: Model 1

Computer application field*(LI1)* = $\alpha 1$ +{$\beta 1$*the number of workers*(EF1)* + $\beta 2$*Sales*(EF2)*+$\beta 3$*Work experience*(EF3)* +$\beta 4$* the number of servers*(EF4)* + $\beta 5$*pc introduction*(EF5)* + $\beta 6$*the rate of PC supply*(EF6)* + $\beta 7$*experience after computerization*(EF7)* + $\beta 8$* the number of computer system application*(EF8)* + $\beta 9$ *DB application*(EF9)* } +$\varepsilon 1$

In this basic model βij is removed because of no relation.

Next sentence is represents the foundation of nine independent variables. These factors are recognized generally and set as variables in this study. All of them are expressed in number to correlative analysis and regression analysis.

We use the number of workers, servers, PC with no modification. Sales are converted into values from 1 to five by denomination three billion won. In the case of work experience and the computerization experience, we use the values from subtraction from year 2003 to relevant year. The rate of PC retention is calculated by percentage of PC for the number of workers. And the number of computer system application field indicates the number of work processed by computer system of 22 details.

The type of DB application is classified into 5 steps. The first step is the manual work level, the second is office application, the third is basic program application, the fourth is practical program application, and the fifth step is ERP, S/W management level.

4.2 Model analysis and result

We try to correlation analysis between seven dependent variables and nine independent variables.

Followings are the multiple regression model for each significance level(0.01) based on correlation analysis.

Computer application field = $\alpha 1$ +{$\beta 1$*the number of workers*(EF1)* + $\beta 2$*Sales*(EF2)*+$\beta 4$* the number of servers*(EF4)*+$\beta 5$*pc introduction *(EF5)* +$\beta 8$* the number of computer system application*(EF8)* }+$\varepsilon 1$

Organization field of MIS department =$\alpha 2$ + {$\beta 4$* the number of servers*(EF4)*+$\beta 5$*pc introduction *(EF5)* +$\beta 8$* the number of computer system application*(EF8)*} +$\varepsilon 2$

MIS panning & Control Field = $\alpha 3$ + {$\beta 4$* the number of servers*(EF4)*+$\beta 5$*pc introduction *(EF5)* +$\beta 8$* the number of computer system application*(EF8)* }+$\varepsilon 3$

Attitude and ability of users = $\alpha 4$+{ $\beta 8$* the number of computer system application*(EF8)* + $\beta 9$ *DB application*(EF9)* } +$\varepsilon 4$

Recognition of management = $\alpha 5$ + {$\beta 8$* the number of computer system application*(EF8)* } +$\varepsilon 5$

Application Field of DB & Network = $\alpha 6$ + {$\beta 4$* the number of servers*(EF4)*+$\beta 5$*pc introduction *(EF5)* + $\beta 6$*the rate of PC supply*(EF6)* + $\beta 8$* the number of computer system application*(EF8)* + $\beta 9$ *DB application*(EF9)* } +$\varepsilon 6$

In the result of multiple regression model, all of them are not 0 in than βi. As investigating significance level of estimate for each βi, most variables with the exception of application of DB and network have meaning in the level of $p<0.05$ in only β8* the number of computer system application(*EF8*). Application of DB and network have meaning in $p<0.05$ in β8* the number of computer system application(*EF8*) and β9 *DB application(*EF9*).

Variables which have correlation with total average are the number of servers, introduction PC, the number of computer application field and application of DB. Table 6 means the result of simple regression analysis for each variables.

Table 6 - The result of simple regression analysis for total average

dependent variables	independent variables	intercept	parameter Estimation	prob>|T|
Level of total information	servers	2.34934	0.18522	0.0006
	PC	2.32872	0.00815	0.0022
	PC supply	2.24474	0.00600	0.0084
	computer application	1.68949	0.07993	<.0001
	DB application	1.77143	0.31278	0.0010

We do multiple regression analysis to put into initial established model for total average.

Total average = α7 + {$\beta 4$* the number of servers*(EF4)*+$\beta 5$*pc introduction *(EF5)* + $\beta 6$*the rate of PC supply*(EF6)* + $\beta 8$* the number of computer system application*(EF8)* + $\beta 9$ *DB application*(EF9)* }+ε7

Table 7 means the result of multiple regression analysis for total average.

Table 7 - Multiple regression analysis

independent variables	parameter Estimation	prob>|T|
Servers	0.08928	0.2049
PC	-0.00059	0.8714
PC supply	0.00284	0.1808
the number of computer system application field	0.07231	<.0001
DB application	-0.02274	0.7987

*intercept : 1.63581(prob>|T|<.0001)

In conclusion, level of total management information system is influenced by only the number of computer system application field according to initial established multiple regression model. Moreover the number of computer system application field has great influence on six models with the exception of application of DB and network in analysis result of separate information level model. It agrees with Bobby and Buchanan[14]'s study that estimation of information technology level is decided by the number of practical system.

The number of computer system application field subdivides the number of the work fields which use computer systems at the process. There are twenty two areas-stock management, material management, production management, process control, accounting, equipment investment, market research, finance, communication, sales of competitive business, sales management, sales or A/S, personal management, salary, finance control, statistics, research, income, financial affairs, private work, and so on.

5. Conclusion

The analysis of present conditions about information level supports the effective information polices of small and medium business. So this paper applies Nolan's growth stage model to local manufacturing business. We estimate the level of management information system and analyze the environment factors. The number of computer system application field is the most critical factor than any other factors the number of workers, sales, work experience, the number of server, PC retention, PC supply, the experience of computeri-zation, the type of DB application.

This study is quite consistent and actual because of direct interview with investigator. However analysis business objects are restricted by Chungbuk area and the number of enterprises is limited. It is possible to standardize the scale of independent variables and to simplify variables to shortening variables of regression.

In the future work we study how to classify the number of computer system application work. We get the objective model able to predict the demands of information according to scales of business. We will achieve establishment of information order in accordance with business and presentation of information environments according to scales of business.

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