

A Methodology for Measuring End-User e-Business Competency

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Abstract

In e-Business environment, end-user e-Business capability is necessitated for performing his or her given tasks and improving his or her business performance in an enterprise of e-Business environment. An instrument of an end-user e-Business competency is extracted from the major components of a general competency. Through a pilot test, this study performed factor analysis, and proposed a 16-item instrument that can measure an end-user e-Business competency in e-Business environment. The application of the instrument is confirmed by applying it to measuring e-Business competency of end-users in an enterprise of e-Business environment and by presenting the measurement results for them.

Keywords:

End-User; e-Business Competency; Measurement Factor and Item; Measurement Instrument

Introduction

For completing end-users' given tasks, they use their e-Business (Electronic Business) systems in an enterprise of e-Business environment. In this environment, we can think that their e-Business ability have an effect on the performance of their tasks in e-Business environment. Hence, this study considers a methodology to efficiently measure end-user e-Business ability and improve it for raising his or her business completion and the competitiveness of an enterprise. But study related to measurement of end-user e-Business capability has barely executed, literature on measurement of end-user computing skills focuses on specific software skills, professional skills, and operational skills and so on [1][2][3]. For end-users effectively accomplish their tasks in e-Business environment, they have to be qualified with not fragmentary e-Business skills but total e-Business capability.

Therefore, this study presents an instrument for measuring an end-user e-Business competency in total capability perspective.

End-user e-Business Competency

In previous research of an end-user, most of studies define that the end-user is an individual who directly interacting with his or her computer [4][5][6]. End-user refers to direct

interaction with application software by managerial, professional, and operating level personnel in user departments [7][8]. E-Business is a term that IBM first used in 1997. Realizing that it was a core paradigm of enterprise management, researchers defined it variously, depending on their views [9].

Table 1- Definition of e-Business

Leem (2000)[10]	E-Business is an approach to improve effectiveness of business process and quality of products/services through standardized data and communication using the internet and information technology.
Lientz & Rea (2001)[11]	E-Business is a management activity including not only e-commerce activities between customer and supplier but also internal work support of the enterprise.
Schubert & Hausler (2001)[12]	E-Business is a business that supports strengthening business processes and business partners, employees, and customer relationships by using electronic media.

Therefore, these studies define e-Business as the approach to increase competitiveness of organizations by improving management activities through using IT and the Internet. So, end-user e-Business defines that an end-user directly interacts with e-Business application software and e-Business system in his or her departments. This study uses these definitions of end-user and e-Business, and it includes the creative application of e-Business technology and e-Business systems to the end-user's tasks in order to improve his or her business performance.

In early 1970, competency has been variously defined by many researchers. Generally speaking, competency is the total set of knowledge, skills, and attitudes as the action characteristics of an organizational member that can do his or her tasks outstandingly in an organizational environment [13]. The competency is a set of observable performance dimensions, including individual knowledge, skills, attitudes, and behaviors, as well as collective team, process, and organization capabilities that is linked to high performance, and provides the organization with sustainable competitive advantage [14]. And, the competency is a measurable pattern of knowledge, skill, abilities, behaviors, and other characteristics that an individual needs to perform work roles or occupational functions successfully [15].

With analysis of the literature, Spencer & Spencer (1993) presented five major components of competency: Motives, Traits, Self-concepts, Knowledge, and Cognitive and Behavioral Skills as shown in Table 2 [16]. In general competency, individual characteristics such as motives, traits, self-concepts and knowledge lead to skills, and the action of a person with skills has an effect on the

performance of his or her business from e-Business perspective. In other words, e-Business competency is to transform general competency into a type of competency based on e-Business perspective.

Table 2 - Major Components and Contents of Competency

Division	Definition and Contents
Motives	- This is a cause of activity leading an individual to do what he wants to do and what he consistently had in mind to do. - This is an action which selects and instructs a trigger for a specific activity or an objective.
Traits	- This means a consistent response to physical characteristics, situation or information. - An emotional self-control and careful attitude is a consistent response of a more complicated form.
Self-Concepts	- This means attitude, a sense of value, and a self-portrait. - A sense of value is an element which reflects on responsible activities in a given situation for a short-period.
Knowledge	- Information that knows for specific department. - It only indicates that what a person can do, but does not predict what a person will actually do.
Cognitive/Behavior Skills	- The ability to perform specific mental or physical tasks. - Mental or cognitive skills include analytical or cognitive thought.

Hence, end-user e-Business competency (EUEC) can be defined as the total set of knowledge, technology, skills and attitudes which function as action characteristics of an organizational member who can do his or her task outstandingly in e-Business environment. Namely, EUEC indicates individual total ability to apply e-Business technology, solution and e-Business systems to his or her tasks in e-Business environment. Finally, EUEC means total e-Business ability that an end-user can efficiently perform his or her given tasks in e-Business environment. This study generated 28 items to measure end-user e-Business competency based on five components of competency such as motives, traits, self-concepts, knowledge, and cognitive and behavioral skills. These measurement items were generated by about 50 experts such as postdoctoral researchers, professors and senior developers in IT and e-Business research centers, and the previous literature on e-Business [1][17][18] [19].

Methods

In previous research, the validity of a measurement instrument construct was studied by many researchers. Kerlinger (1978) presented two methods of construct validation: (1) correlations between total scores and item scores, and (2) factor analysis [20]. Doll & Torkzadeh (1988) [21] and Etezadi-Amoli & Farhoodmand (1996) [22] used factor analysis to verify the validity of the measurement tool construct. Torkzadeh & Doll (1999) [23] and Torkzadeh & Lee (2003) [1] used correlation analysis to verify the validity of the measurement tool construct. This study is likely to verify the validity of the measurement instrument construct and the extraction of adequate items by factor analysis. The ratio of sample size to number of measurement items (11:1) was above the minimum (10:1) ratio suggested for factor analysis by Kerlinger. The measurement questionnaire used a five-point Likert-type scale; where, 1: not at all; 2: a little; 3: moderate; 4: good; 5: very good. The survey was gathered data from a variety of industries, business departments,

experience, and major educations.

Sample Characteristics

A sample of 294 usable responses was obtained from a variety of industries and business departments, and from management levels with considerable experience. All respondents had college or university degrees in: humanities and society (12.8%), management and economics (24.2%), engineering (46.7%), and science (16.3%). The industries represented in the sample were manufacturing (11.2%), construction (10.2%), finance, banking and insurance (20.3%), transportation, communication and services (26.7%), and information consulting and system implementation services (31.6%). The respondents identified themselves as top managers (5.4%), middle managers (38.7%), or workers (57.9%). The respondent had on average of 7.4 years of experience (S.D.=1.147) in their field, their average age was 34.6 years old (S.D.=5.664), and their sex, male (66.8%) and female (33.2%). The survey method used in this measurement questionnaire was based on two kinds of collection methods: by direct collection and e-mail.

Analysis and Discussion

The collected questionnaires were analyzed by using SPSS ver.12.0 software. By factor analysis on the first developed 28 measurement items, Items that their correlation with the collected item-total was < 0.5 or that their correlation with the factor loading was < 0.6 were excluded to extract the suitable items that can efficiently measure end-user e-Business competency. The correlations with the corrected item-total and the criterion item were significant at $p \leq 0.01$ and similar to those used by others in previous researches [1][17][18].

Table 3 - Factor loadings, corrected item-total correlation and coefficients alpha of the extracted items

Variable	Factor Loading				Corrected Item-Total Correlation	Coefficients Alpha
	Factor 1	Factor 2	Factor 3	Factor 4		
V1	0.794				0.682	
V2	0.728				0.621	0.814
V3	0.663				0.524	
V4		0.809			0.710	
V5		0.768			0.637	
V6		0.712			0.616	0.836
V7		0.704			0.564	
V8		0.661			0.557	
V9			0.779		0.716	
V10			0.737		0.615	
V11			0.712		0.583	0.842
V12			0.679		0.626	
V13			0.657		0.597	
V14				0.803	0.701	
V15				0.749	0.623	0.798
V16				0.648	0.512	

* Significant at $P \leq 0.01$

After conducting factor analysis, first 28 measurement items were reduced to 16 items, and 12 items were deleted. The elimination was considered high enough to ensure that the retained items were adequate measures of the EUEC. The validity of the developed instrument was verified through factor analysis, and it was used to identify the underlying factors or components that comprise the EUEC construct. So, the inadequate measurement items for the developed instrument were deleted by the analysis results. These deletions resulted in a 16-item scale for measuring end-user e-Business competency. Each of the 16 items had a factor loading > 0.648 and the coefficients alpha of four potential factors had the values > 0.798, above the threshold recommended for exploratory research [24]. The descriptions and loadings for the 16 items are presented in Table 3, and grouped by their high factor loading. Each of the 16 items had a corrected item-total correlation > 0.512. The correlation for each of the 16 items was positive and significant ($p = 0.01$ or below). Hence, the measurement items with a validity and reliability were extracted by carrying factor analysis as shown in Table 3 and Table 4. However, efforts to provide additional evidence of the instrument's validity, internal consistency, and stability are encouraged. Although there may be reasons for additional questions to measure specific aspects of EUEC, the 16-item instrument is general in nature, relates to end-user mind, knowledge, application ability, and development possibility, and can be used across departments and for a variety of situations.

Measurement Instrument

Framework of Measurement Instrument

By factor analysis on the first measurement items, we extracted the 16 items to measure EUEC and the extracted items were classified as four factor groups. The 4 factor groups indicate the potential factors that can measure EUEC and they include 16 measurement items.

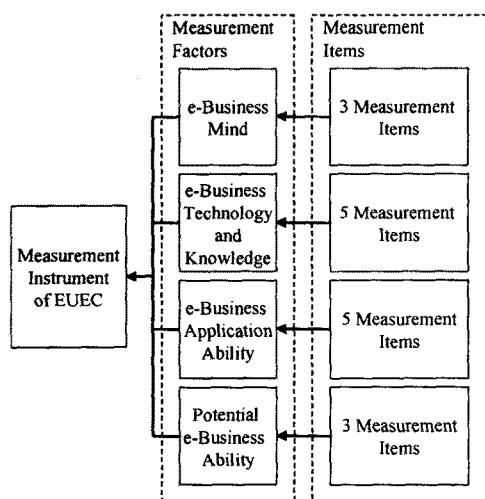


Figure 1 - Framework of Measurement Instrument

With investigating the measurement items of each factor, this study generated the 4 potential factors as follows: factor 1: e-Business mindset; factor 2: e-Business technology and knowledge; factor 3: e-Business application ability; factor 4: potential e-Business capability.

E-Business mind means understanding, sense of value, attitude and adaptability related to e-Business, and e-Business technology and knowledge indicates the technology and knowledge of e-Business solutions and systems. E-Business application ability is a skill of e-Business application to efficiently execute his tasks on e-Business systems and potential e-Business ability refers the potential ability to improve e-Business competency in terms of breadth and depth. The four potential factors are considered as the measurement factors of the developed instrument in this study. Figure 1 shows framework of the measurement instrument for end-user e-Business competency based on four potential factors and sixteen measurement items.

Measurement Domains and Items

The e-Business mind with 3 measurement items is the realm where measures acknowledgement, attitude, a sense of value, and adaptability on e-Business. It includes the measurement items that can identify end-user e-Business mind such as concepts of Internet and e-Business, understanding of e-Business trends in e-Business leading countries, and ethic consciousness of e-Business.

Table 4 - Measurement Factors and Items

Factors	Extracted Measurement Items
e-Business mindset	-V1: Concepts and understanding on Internet/e-Business -V2: Understanding of e-Business trends in e-Biz leading countries -V3: Recognition and ethic consciousness of e-Business
e-Business Technology Knowledge	-V4: Knowledge related to H/W, S/W, N/W and D/B etc. -V5: Solution knowledge related to ERP, SCM, KMS, CRM, PDM, HRM etc. -V6: Knowledge related to e-Business (B2E, B2C, B2B) -V7: Knowledge related to e-Business security system -V8: Knowledge related to O/S application
e-Business Application Ability	-V9: OA Ability of Spreadsheet, Presentation and Word processing -V10: Ability using solutions of ERP, SCM, CRM, KMS, DW etc. -V11: Ability using H/W, S/W, N/W, D/B of e-Business Systems -V12: Ability applying e-Business systems to Business (B to E, B to C, B to B) -V13: Ability of security establishment and management
Potential e-Business Ability	-V14: Number of working years in e-Business department -V15: Completion of domestic & oversea education and training related to e-Business -V16: Number of papers and articles published in journals

The e-Business technology and knowledge including 5 measurement items indicates a department that an end-user has to know to efficiently apply e-Business technology and e-Business systems to his or her works. It comprises the items that can measure the e-Business technology and knowledge such as knowledge related to H/W, S/W, N/W and D/B, solution knowledge related to ERP, SCM, KMS, CRM, PDM, HRM, knowledge related to e-Business (B2E, B2C, B2B), knowledge related to O/S computing security system, and knowledge related to O/S application as the knowledge of operation and technology of e-Business

systems in his or her enterprise.

The e-Business application ability which implicates 5 measurement items is the ability that an end-user effectively applies e-Business knowledge and systems to his or her business tasks. This measures the capability that utilizes e-Business knowledge and skills to do an end-user's given tasks. It includes OA ability such as Spreadsheet, Presentation and Word processing, the ability to use business solutions such as ERP, SCM, CRM, KMS, and DW, the ability to use hardware, software, network and database of operating systems, the ability to apply the e-Business systems to an end-user's tasks such as e-business of the form B to E, B to B, and B to C, and the skills related to establish and manage the security system.

The potential e-Business ability which comprises 3 measurement items refers the potential development probability of end-user e-Business competency by job experience, degree and certificate, participation of domestic & overseas education and training, and publication of paper and article on journal related to e-Business. This is the important domain for the development of e-Business knowledge and ability, and the extension of e-Business competency in terms of the breadth and depth of end-user e-Business ability.

As shown in Table 4, the instrument with 4 measurement factors and 16 items is an important theoretical construct to measure the end-user's total e-Business ability that can efficiently do his or her tasks in e-Business environment.

Measurement System

Structure of Measurement System

The measurement system as shown in Figure 2 comprises the measurement stages and processes to gauge end-user e-Business competency, and has measurement stage and the presentation stage of the measurement results. The measurement stage extracts the measurement problems from problem database based on each factor and its items.

By the characteristics of each measurement factor, the measurement problems are identified as three kinds of problem forms such as questionnaire test, written test and application test. The factors such as the e-Business mind and the potential e-Business ability are examined by a questionnaire form, and the e-Business technology and knowledge and the e-Business application ability are tested by a written and an application form.

After generating the measurement problems, the instrument examines the end-users by the extracted measurement problems. The measurement results are analyzed by extracting the measurement values of each factor and applying the weight values to the measurement values of each factor. And, the presentation of the measurement results provides the interpretations of the measurement results of the end-user. The results are explained by each measurement index extracted from each measurement factor, and the interpretation presents the present states and problems of the EUEC, and the directions and methods to efficiently improve the EUEC based on the extracted

measurement indices.

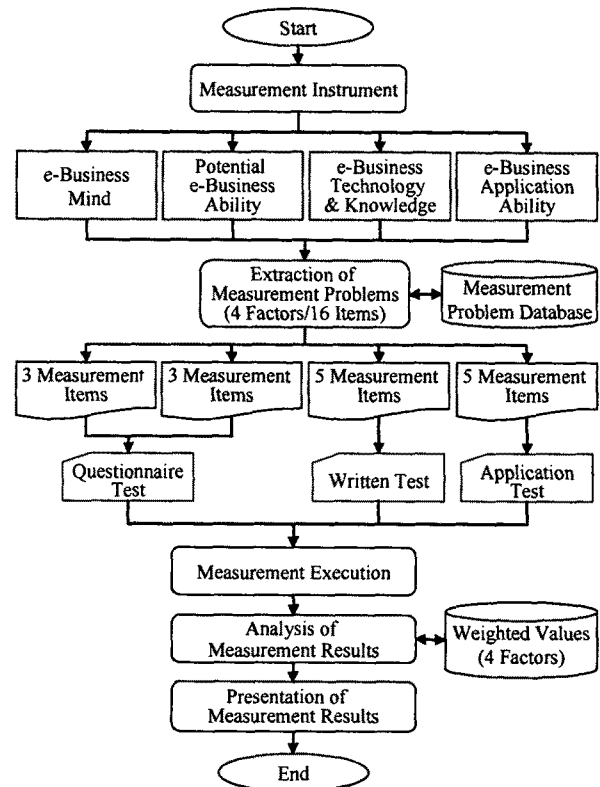


Figure 2 - Structure of Measurement System

Measurement Method

This study uses the weight values for each measurement factor in order to develop an efficient instrument considered the relative importance of each factor in measuring EUEC. The weight values, as shown in Table 5, were extracted from the analysis results of the questionnaire survey for about 40 experts working in IT and e-Business departments.

Table 5 - Weight Value of each Measurement Domain

Measurement Factor	Weight Value
e-Business mindset	0.21
e-Business Technology & Knowledge	0.26
e-Business Application Ability	0.35
Potential e-Business Ability	0.18

The measurement method first calculates the measurement values of each factor based on the measurement results that the end-user is tested by the extracted problems, and figures out measurement indices of each factor by multiplying each weight value by measurement values of each factor. And, the sum of measurement indices of each factor becomes the total measurement index of the end-user. In other words, the total measurement index of the EUEC is the sum of

measurement indices of each factor. In this way, this measurement instrument presents the measurement results of the EUEC based on the total measurement index and indices of each factor.

Case Study and Analysis Results

Sample Characteristics

This case study applied the developed measurement instrument to 187 end-users working at “N” enterprise in South Korea. The business departments of respondents were identified as follows: strategy plan department: 22.6%; development and maintenance department: 19.8%; business application department: 38.3% and administration support department: 19.3%. The business positions of respondents were classified as follows; top managers: 4.7%; middle managers: 24.8% and workers: 70.5%. The respondents had on average 6.8 years of experience (SD = 0.612), and most respondents (82%) had college or university degrees.

Application and Analysis

The case study analyzes the measurement results obtained from the strategy plan department and each business department as the organizational unit, and from an end-user working in the administration support department as an individual unit, and explains the meanings of the measurement results on various points of view.

Application and analysis of each business department

The total measurement index of the overall organization is 62.06 and it is quite high, and the strategy plan department and the business application department are 62.36 and 65.32 as shown in Figure 3.

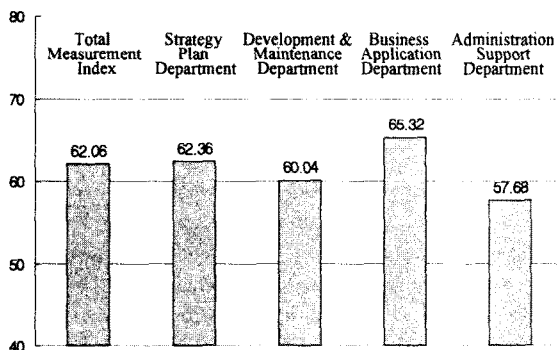


Figure 3 - Measurement Indices of Each Business Department

The measurement results of each business department show that the measurement index of the business application department is highest than those of the other departments. This is due to the ability to effectively accomplish their tasks by frequently applying e-Business knowledge and e-Business system to e-Business of the form B to C, B to B and B to E and by the technology knowledge and abilities

to utilize the various solutions such as ERP, SCM, CRM, KMS and DW in order to do their business tasks in e-Business environment. Especially, the end-users in administration support department have to make an effort to raise total e-Business competency of their department.

Application and analysis of a business department

The total measurement index of the strategy plan department (SPD) is 62.36, and it indicates quite high. The measurement indices of the SPD are quite high in the measurement domains of the e-Business mind, the e-Business technology and knowledge, and the e-Business application ability, except for the potential e-Business ability as shown in Figure 4. But the measurement index of the potential e-Business ability is 59.52 and it is the lowest level among the measurement factors.

Therefore, the end-users of the SPD should make an effort to improve and develop e-Business departments such as the completion of degree and certificate, education and training, and product of e-Business knowledge in order to effectively improve the organizational e-Business competency.

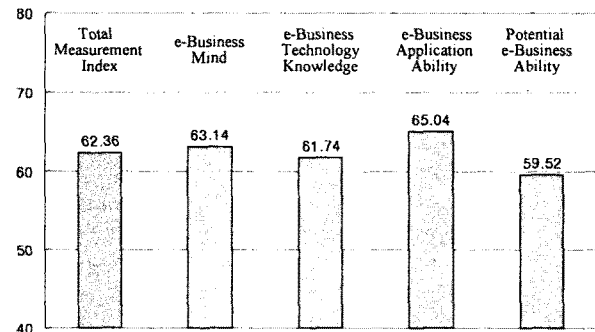


Figure 4 - Measurement Indices of Each Factor of SPD

Application and analysis of individual level

The measurement results of an end-user working in the administration support department (ASD) are taken as an example. The total measurement index of the end-user e-Business competency is 61.61 as shown in Table 6 and Figure 5, and it is a little high. Especially, the measurement index of the e-Business application ability is very high.

Table 6 - Extraction process of total measurement index for an end-user

Division	e-Business Mind	e-Business Technology & Knowledge	e-Business Application Ability	Potential e-Business Ability	Total Measurement Index
Measurement Indices of Each Factor	61.04	60.43	66.79	53.87	-
Weight Value of Each Factor	0.21	0.26	0.35	0.18	1.00
Calculation of Total Measurement Index	12.82	15.71	23.38	9.70	61.61

This means the outstanding application ability for applying the e-Business solution and e-Business system to his or her tasks in an organization of e-Business environment. The measurement indices of the e-Business mind, the

e-Business technology and knowledge, and the e-Business application ability were also quite high, and the measurement indices of the potential e-Business ability were very low.

Therefore, this end-user should make an effort to complete e-Business education and training, acquire diplomas, and produce e-Business knowledge in order to effectively develop his or her total e-Business competency.

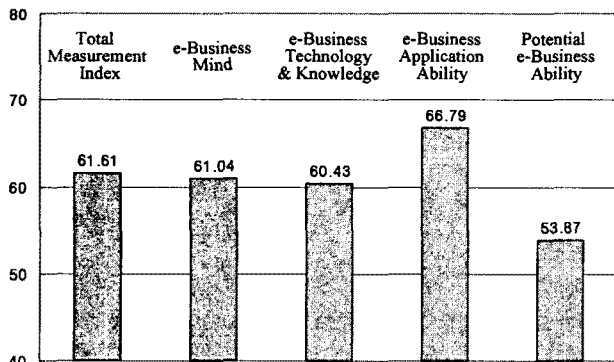


Figure 5 - Measurement Indices of an End-User in ASD

Conclusions

This study presents a methodology with a measurement instrument and measurement system that can efficiently measure end-user computing competency in e-Business environment. It provides the concrete measurement items in terms of end-user e-Business competency. The application of this instrument was confirmed by a case study. The developed instrument opens up a new direction and possibilities of a measurement methodology since it functions as a measurement instrument that can entirely measure it in respect to the required end-user e-Business ability in e-Business environment.

References

- [1] Torkzadeh, Gholamreza & Lee, Jungwoo (2003). "Measures of Perceived End-user's Computing Skills", *Information & Management*, Vol. 40, pp.607-615.
- [2] R.P. Bostrom, L. Olfman, M.K. Sein (1990). "The importance of learning style in end-user training", *MIS Quarterly*, Vol. 14, No.1, pp.101-119.
- [3] P.H. Cheney, R. Mann, D.L. Amoroso (1986). "Organizational factors affecting the success of end-user computing", *Journal of Management Information Systems*, Vol. 3, No. 1, pp.65-80.
- [4] Rockart, J. and Flannery, L. (1983). "The management of end user computing", *Communication of the ACM*, Vol. 26, No. 10, pp.776-784.
- [5] Martin, J. (1982). *Application development without programmers*, Prentice-Hall, Eaglewoods, Cal.
- [6] McLean E. R. (1979). "End-user of application developers", *MIS Quarterly*, Vol. 10, No. 4, pp.37-46.
- [7] W.J. Doll, G. Torkzadeh (1989). "The measurement of end-user computing involvement", *Management Science*, Vol. 35, No. 10, pp.1151-1171.
- [8] Brancheau, C., & Brown, V. (2002). "The management of end-user computing: Status and Directions", *ACM Computing Surveys*, Vol. 25, No. 4, pp.437-482.
- [9] Yoon, C. Y. & Leem, C. S. (2006). "A Classification of e-Business Human Resources and Its Applications", *Study of Internet and Electronic Commerce*, Vol. 6, No. 2, pp.1-22.
- [10] Leem, C. S and e-Biz Lab (2003). *e-Business file*, Young-Jin Publications Co.
- [11] Lientz, B. P. & Rea, K. P. (2001). *Dynamic e-Business Implementation Management*, Academic Press,
- [12] Schubert, P. & Hauler, U. (2001). "e-government meets e-Business :A Portal Site for Startup Companies in Switzerland", *Proceeding of the 34th Hawaii International Conference on System Sciences*, pp.123-129.
- [13] Boyatzis R. E. (1982). *The Competent Manager: A Model for Effective Performance*, N.Y, John Wiley & Sons.
- [14] Arthey, Timothy R., and Orth, Michael S (1999). "Emerging Competency Methods for The Future", *Human Resource Management*, Vol. 38, No. 3, pp.215-226.
- [15] Rodriguez, D., Patel, R., Bright, A., Gregory, D., and Gowing, M. K. (2002). "Developing Competency Models to Promote Integrated Human Resource Practices", *Human Resource Management*, Vol. 41, No. 3, pp.309-324.
- [16] Spencer, L. M., & Spencer S. M. (1993). *Competence at Work: Models for Superior Performance*, John Wiley & Son Inc.
- [17] Munro, Malcolm C., Huff, Sid L., Marcolin, Barbara L., Compeau, Deborah R. (1997), "Understanding and Measuring User Competence", *Information & Management*, Vol.33, pp.45-57.
- [18] Rifkin, Kenneth I., Fineman, Michal and Ruhnke, Clara H. (1999). "Developing Technical Managers – First You Need a Competency Model", *Research & Technology Management*, pp. 53-57.
- [19] McCoy, Randall W. (2001). "Computer Competencies for the 21st Century Information Systems Educator", *Information Technology, Learning, and Performance Journal*, Vol. 19, No. 2.
- [20] Kerlinger, F. N. (1978). *Foundations of Behavioral Research*, McGraw-Hill, New York.
- [21] Doll W. J., and Torkzadeh G. (1988). "The Measurement of End-user's Computing Satisfaction", *MIS Quarterly*, Vol. 12, No. 2, pp.982-1003.
- [22] Etezadi-Amoli, Jamshid & Farhoomand Ali F. (1996). "A Structural Model of End User Computing Satisfaction and User Performance", *Information & Management*, Vol. 30, pp.65-73.
- [23] Torkzadeh, G. & Doll, W. J. (1999). "The Development of a Tool for Measuring the Perceived Impact of Information Technology on Work, Omega", *International Journal of Measurement Science*, Vol. 27, pp.327-339.
- [24] Nunnally J. C. and Berstein I. H. (1994). *Psychometric Theory*, third edition, McGraw Hill, New York.