BESSH-16

CONFIRMATORY FACTOR ANALYSIS ON DESIRED ATTRIBUTES OF THE GRADUATES PROGRAM IN ENGINEERING AND SCIENCE

SAGEEMAS NA WICHIAN [1*], SUPITCHA CHEEVAPRUK [2], SOPIDA TUAMMEE [3]

[1,2,3] College of Industrial Technology King Mongkut\'s University of Technology North Bangkok

Abstract. The purpose of this research was to analyze the factors of desired attributes towards the graduates Program in Engineering and Science. The sample group consisted of 776 graduates. The research instruments included questionnaires and Confirmatory Factor Analysis. The research result revealed that the model of desired attributes on the graduates Program in Engineering and Science was in accordance with the empirical data really well. This was considered by the Chi-Square which was different from zero by having no statistical significance (Chi-Square = 47.68, df= 39, P-value = 0.160, GFI = 0.99, AGFI = 0.98, respectively)..

INTRODUCTION

Education is considered as a crucial base for developing human resources of the country to become qualitative persons who know how to think, do, and solve the problems, as well as perceiving how to use the existing material resources to reach the utmost benefits (Kornkanya,2006). If the human resources are the qualitative persons, surely they will become the crucial and powerful drives which enhance society and country to achieve progress. The performance of the critical success factors affects the institution's business excellence. It provides information to the institution's top management on its performance over time and in comparison with other institutions (Gopal,2010)

With these reasons, the educational institutes therefore take really important roles on educational management, which is in accordance with the National Education Act of B.E. 2542 (1999) Section 6. To reach the quality and standard of educational management, it should be managed according to the needs of the graduate users (labor and social market), so that it will become extremely crucial for the human resources development.

Currently, the education management of all educational institutes conducts their education by focusing on producing the graduates in accordance with the needs of the graduate users. The Office of the Higher Education Commission (OHEC) determines the assessment frames of desired characteristics which are so crucial that all graduates should be qualified in order to be ready for

stepping into their potential careers. Graduates' attributes are considered as crucial factors which will reflect the quality of products, and be able to indicate educational standard of educational institutes. (Office of the Higher Education Commission, 2009). When the assessment results of desired attributes of the graduates can be reached, therefore that educational institute can use the got results to improve and develop the instructional curriculum for developing the graduates to achieve knowledge and ability, and appropriate attributes in accordance with the needs of the graduate users. (Angell, 2008: Wilkinson, 2010) The College Of Industrial Technology, King Mongkut's University of Technology North Bangkok is one of the educational institutes established from the economic and academic cooperation project between Thailand and Germany governments, 1959, which have been engaged and aimed at producing the technological mechanics and graduates knowledgeable and skillful both in terms of theory and practice, in order to be able to operate in the modern production industries which emphasize operational skills in the factories and field works, as well as being able to make a living rally. Today, the College of Industrial Technology has the curricula of 6 Programs in Bachelor of Industrial Technology, 11 Programs in Bachelor of Engineering, 1 Program in Bachelor of Science, 7 Programs in Master of Engineering, and 2 Programs in Master of Science. The

*Corresponding author: Sageemas Na Wichian
E-mail: sageemas.n@cit.kmutnb.ac.th

vision of this institute is "Specialist engineer, technology integration, social creativity and international community", and the identity is "skilled graduates, outstanding practice, and specific knowledge". This identity is in accordance with the vision of the King Mongkut's University of Technology North Bangkok, which is, "King Mongkut's University of Technology North Bangkok is the leading educational institute in terms of science and technology, and accepted through the international level". Moreover, the identity of the university is "the thinkable and doable graduates". The King Mongkut's University of Technology North Bangkok applies the educational quality assurance system, and determines the quality of graduates as the crucial measurement index through the desired attributes as "eager to learn and can really practice, do not neglect morality, hold creativity, create good human relationship and ethics, be diligent and patient, follow the philosophy of sufficiency economy, and keep the fame of university". According to these attributes, it is caused by the synthesis of vision and identity of this university, including the standard of Professional Qualification.

Hence, the researchers staff are interested to study and analyze the factors of desired attributes towards the bachelor's degree graduates of the College Of Industrial Technology, King Mongkut's University of Technology North Bangkok, Program in Engineering and Science, by synthesizing the vision and identity
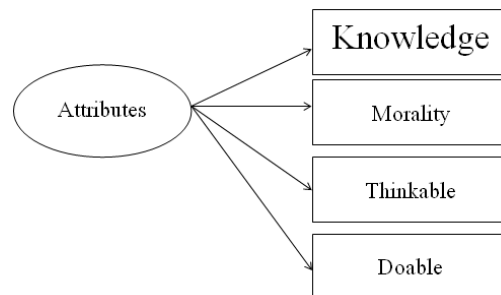
of this university, including the expected learning results in each curriculum according to the standard of professional qualification, in order to determine the questions for creating the assessment form of desired attributes through the graduates, by applying the principles of survey factors analysis, finding the weight value of factors, and analyzing the confirmatory factors. The analysis results will help confirm the quality of the graduates that if their attributes are in accordance with the identity of this university. This will be beneficial for developing the process of graduate production, in order that the graduates from higher educational institutes will become the qualitative human resources who are able to apply their knowledge and competence to develop their own society and country.

Objectives

To develop and examine the construct validity of the desired attributes towards the graduates Program in Engineering and Science.

Research Framework

This research used the matters synthesis from visions, identities, and standards of professional qualifications to organize the factors of desired attributes towards the graduates Program in Engineering and Science as follows: *1)* Knowledge, *2)* Morality, *3)* Thinkable, and *4)* Doable. See the illustration below:

Research Methodology

Sample group

For this stage of the study, the researcher selected the sample group by the Purposive Sampling method from the graduates Program in Engineering and Science from the College Of Industrial Technology, King Mongkut's University of Technology North Bangkok, 2015. The sample group was in line with the population proportion since the Confirmatory Factor Analysis of the sample group sizes should not be less than 200 persons. The number of samples used for this study should be around 20 persons per 1 parameter value (Hair, Anderson, Tatham, & Black; 1995). Regarding this research, the parameter values were totally 34; therefore, the size of sample group should not be less than 680

persons. A number of sample group which could be selected were 776 persons.

Research Instrument

This research used the questionnaire about the desired attributes of the graduates Program in Engineering and Science. The researcher created it by synthesizing the visions, identities, and standards of professional qualifications. The questionnaire was 5 levels of Rating Scale which consisted of 12 questions.

Data Analysis

The data was analyzed by the instant program to find the value of Pearson's Correlation, and analyzed the measurement model: the Second Order Confirmatory Factor Analysis

Data Analysis Results

The data analysis results were found that the the Second Order Confirmatory Factor Analysis consisted of 4 major factors which included Knowledge (F1), which consisted of 1.1 Be Omniscient: be knowledgeable about engineering as well as the directions of tendency and movement, and progress of technological and industrial engineering (A1), 1.2 Profound Knowing: be knowledgeable in professions, and be able to integrate the knowledge variously both at the national and international level, by considering the sustainable development (A2).

2) Morality (F2): 2.1 Be moral and ethical: be disciplined and responsible towards work, be kind and honest towards self and others (B1), 2.2 Hold code of conduct: be neutral and make decision under the empirical data, be honest towards the operations, and hold the sustainable development (B2).

3) Thinkable (F3): 3.1 Be able to think critically: the skills of analytical thinking and synthesis (C1), 3.2 Be initiative and creative: be able to create new things and innovations (C2), 3.3 Be skillful on problems solving: be skillful to solve the problems of operations, and can propose the procedures of problems solving creatively (C3), and 4) Doable: 4.1 Be skillful on professions: be academic open-minded, and can organize information, be competent on cross-culture, and be skillful on

foreign language (D1), 4.2 Be skillful on communication: be able to use language for communication, work presentation, and be able to write standardized articles (D2), 4.3: Be skillful on information technology: be able to retrieve the data by using computer, analyze the data by various programs, and use software for education and data presentation correctly and appropriately (D3), 4.4 Be skillful on mathematics and statistics: be knowledgeable about mathematics and statistics, be able to analyze the numerical and statistical data, and be able to apply them through the operations very well (D4), and 4.5 Be skillful on management skills: be skillful on self-management, and finish work in time (D5).

According to the Confirmatory Factor Analysis, it was found that the model of desired attributes towards the graduates Program in Engineering and Science as shown in the Table *1-2* and Figure *1* revealed the factors and models in accordance with empirical data at the very good level. This could be considered from the Chi-Square different from zero by having no statistical significance *(*Chi-Square = *47.68*, df= 39, P-value = 0.160), the Goodness-of-Fit Indices *(*GFI) was equal to 0.99, Adjusted Goodness-of-Fit Index *(*AGFI) was equal to 0.98, and the value of Root Mean Squared Residual *(*RMR*)* was equal to *0.012*.

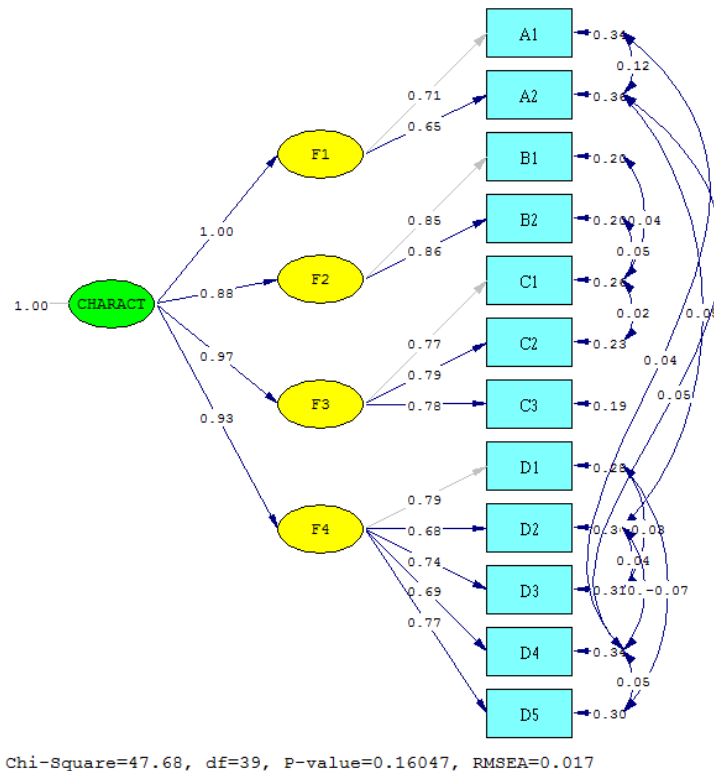Chi-Square=47.68, df=39, P-value=0.16047, RMSEA=0.017

Figure 1: The result of Confirmatory Factor Analysis and Desired Attributes Model of the graduates Program in Engineering and Science

TABLE 1
THE VALUE OF THE SECOND ORDER CONFIRMATORY FACTOR ANALYSIS

Variable	Factor Loading			R^2
	b	S.E.	t	
F1	1.000	0.040	24.924*	1.000
F2	0.881	0.035	25.267*	0.776
F3	0.965	0.037	26.253*	0.932
F4	0.932	0.037	25.193*	0.868

Chi-Square goodness of fit =47.681df = 39 p = 0.160 χ^2/df =1.22 RMSEA = 0.016 GFI = 0.99
AGFI = 0.98 RMR = 0.012

Correlation Matrix of ETA and KSI
F1   F2   F3   F4   CHARACT

F1	1.000				
F2	0.881	1.000			
F3	0.965	0.850	1.000		
F4	0.932	0.821	0.899	1.000	
CHARACT	1.000	0.881	0.965	0.932	1.000

*p<.05

TABLE 2
FACTOR LOADING COEFFICIENT VALUE OF VARIABLES PREDICTION CATEGORIZED BY FACTORS

Indicators	Factor loading												R^2
	F1			F2			F3			F4			
	b	S.E.	t	b	S.E.	t	b	S.E.	t	b	S.E.	t	
A1	0.710	-	-	-	-	-	-	-	-	-	-	-	0.598
A2	0.654	0.025	26.239*	-	-	-	-	-	-	-	-	-	0.541
B1	-	-	-	0.850	-	-	-	-	-	-	-	-	0.786
B2	-	-	-	0.860	0.027	31.721*	-	-	-	-	-	-	0.788
C1	-	-	-	-	-	-	0.769	-	-	-	-	-	0.694
C2	-	-	-	-	-	-	0.792	0.026	30.685*	-	-	-	0.736
C3	-	-	-	-	-	-	0.779	0.027	19.364*	-	-	-	0.766
D1	-	-	-	-	-	-	-	-	-	0.788	-	-	0.692
D2	-	-	-	-	-	-	-	-	-	0.681	0.030	22.919*	0.563
D3	-	-	-	-	-	-	-	-	-	0.744	0.031	24.292*	0.643
D4	-	-	-	-	-	-	-	-	-	0.687	0.030	13.179*	0.578
D5	-	-	-	-	-	-	-	-	-	0.773	0.033	23.505*	0.667

*p<.05

When considering the value of loading factors through variables, it was found that the total loading factors had the positive value from .88 to 1.00. The loading factors of all variables had the statistical significance at .01 level. The significance weighting of all 4 factors had the proportion of: 23:26:25 according to the factor of Knowledge (F1) which had the factors loading equal to 1.00, the variances with desired attributes of the graduates Program in Engineering and Science were 100.00%, secondly was Thinkable Factor (F3) which had the loading factors equal to 0.97%, the variance with desired attributes of the graduates Program in Engineering and Science were 93.20%, the Doable Factor(F4) had the factor loading equal to 0.93% which had the variance with desired attributes of the graduates Program in Engineering and Science at 86.80%, and the Morality Factor (F2) had the factor loading equal to 0.88%, and the variance with desired attributes of the graduates Program in Engineering and Science at 77.60%, respectively.

Regarding the analysis of correlation between Latent Variable, it was found that every factor had the relationship with desired attributes of the graduates Program in Engineering and Science, and the correlation between the latent variance in each component had the value between 0.821-1.000 in the positive direction at a high level of every factor.

CONCLUSION, DISCUSSION, AND RECOMMENDATION

The model analysis result measured by the second-order Confirmatory Factor Analysis revealed that the model was in accordance with the empirical data, it was shown that to create the desired attributes for the students who would be graduated from Engineering and Science in the future, it should be considered through 4 factors altogether, which include, giving profession knowledge, creating skills of Thinkable, Doable, and Morality. This is in accordance with the attributes of learners in the 21st Century considered as the desired attributes of Thai people, and the attributes according to the Thai Qualifications Framework (TQF) which emphasize to enhance individuals to become crucial power for country development, and be the world citizen at the same time. The direction of operations which focuses on such factors can be considered as the right management which has to be conducted continuously. It is found that the Profound Knowledge: to have professional knowledge, and be able to integrate knowledge variously both in the national and international level, by realizing the sustainable development (A2). For the variable of communication skills: to be able to present the contributions and be able to write the standardized articles (D2), and the variable of mathematics and statistics skills: to have knowledge about mathematics and statistics, be able to analyze the numerical data and statistics, and adjust for operations very well (D4) still has the value lower than other variables. Therefore it is necessary for the involved organizations both which determine policies and organize education, as well as the instructors and learners who have to adjust themselves to develop such variables to get the values to be higher so that it can enhance the students of Engineering and Science to be ready for the operations in this present period of time.

REFERENCES

Angell, R. J., Heffernan, T. W., & Megicks, P. (2008). Service quality in postgraduate education. *Quality Assurance in Education*, *16*(3), 236-254.

Hair, J. F. J., Anderson, R. E., Tatham, R. L., & Black,W. C. (1995). Multivariate data analysis (4th ed.). Saddle River, NJ: Prentice Hall.

Kornkanya, R. (2006). *Desirable and actual characteristics of graduates majoring in Thai, Faculty of Education, Chiang Mai University*. Unpublished Thesis, Chiang Mai University.

Kanji, G. K., Malek, A., & Tambi, B. A. (2010). Total quality management in UK higher education institutions. *Total Quality Management*, *10*(1), 129-153.

Office of the Higher Education Commission. (2009). Thai Qualifications framework for higher education TQF: HEd.

Wilkinson, A., Roberts, J., & While, A. E. (2010). Construction of an instrument to measure student information and communication technology skills, experience and attitudes to e-learning. *Computers in Human Behavior*, *26*(6), 1369-1376.