A Confirmatory Factor Analysis of Virtual Team Campus on Cloud to Support Internal Quality Assurance of Rajamangala University of Technology

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Abstract - **The purpose of this research was to analyze the confirmatory factors composition of the virtual team campus on Cloud to support the internal education quality assurance of Rajamangala University of Technology. The research activities are divided into 2 phases: as follows: 1) to analyze the components of the virtual team campus on Cloud and 2) to analyze the confirmatory factors of the virtual team campus on Cloud. The sample consisted of 537 participants in the quality assurance program at the curriculum level, faculty level and institute level from 9 Rajamangala Universities of Technology through multi-step sampling. The results showed the virtual team campus on Cloud to support the internal education quality assurance of Rajamangala University of Technology is comprised of 3 subsystems, 11 modules and the system components model that the researcher created is in harmony with the empirical data in good level in all 3 samples.**

Keywords - **Virtual Team, Cloud Computing, Internal Quality Assurance, Confirm Factor Analysis**

I. INTRODUCTION

The development of standards and quality assurance in Thai education in present day requires the quality assurance system for education to improve the quality and standards of education at all levels, including the internal quality assurance system and external quality assurance system where internal quality assurance is considered as a mission of the educational administration process [1-2]. Internal quality assurance is a creation of system and mechanism to develop, monitor and evaluate the implementation of higher education institutions in accordance with the policy, goal and quality level determined by the institution and / or agency to provide quality assurance for education. Therefore, it is recommended to have guidelines for quality assurance in education according to the quality cycle consisting of 4 steps as: 1) Plan, 2) Do, 3) Check / Study, and 4) Act [1, 3, 4]. As a sequence, educational institutions must develop their quality assurance systems and mechanisms for education to monitor and evaluate operations to meet the policy, goals and quality standards set by the school or agency. The quality assurance system for higher education is composed of the insurance policy and the quality assurance system of curriculum level, faculty level and institute level [1].

Virtual team is the method used by the organizations that enable them work together, even in different locations and times that cause a limitation to meet face to face. Virtual teams will work together using telecommunications and communications technologies to achieve common goals. With effective management, virtual team can benefit the teamwork and cause superior potential to the current face-to-

face teamwork [5-12]. That is, communication technology is an important part of a virtual team to work [13]. Cloud is a technology that allows users to use their software and applications online from anywhere and anytime. Users can store data in remote locations and access the data from connected devices. Virtual teams can keep all the information in one place. The chance of duplication of documents on another computer is reduced, making sure that the latest version is used [14-19].

Based on the above data, the researcher analyzed the components of the Cloud-based virtual team campus to support the internal education quality assurance of Rajamangala University of Technology in the context of the administration of Rajamangala University of Technology with many educational centres in order to be able to work together as a team according to the system and internal quality assurance mechanism.

II. OBJECTIVES

1) To analyze the confirmatory factors of the virtual team campus on Cloud to support the internal quality assurance of Rajamangala University of Technology.

2) To inspect the consistency of Cloud-based virtual team campus model to support internal quality assurance.

III. RESEARCH METHODOLOGY

Research Process: The researcher divided the operation into 2 phases as follows:

Phase 1: Analyze the components of virtual team campus on Cloud system to support internal education quality assurance of Rajamangala University of Technology through the following steps:

1) The step of study and analysis of documents and researches related to virtual team, Cloud computing and internal quality assurance to be synthesized as a system component.

2) The step of determining the components of system through the three synthesized subsystems as follows:

- ***Subsystem 1:*** Internal Quality Assurance Workflow System (IQA WS) is a system used to conduct internal quality assurance in a team based on the PDCA cycle consists of 5 modules as:

(1) *Planning Module (PM)* is the module used to define a plan of action for internal quality assurance.

(2) *Doing Module (DM)* is a module used to operate, store and record performance data.

(3) *Checking Module (CM)* is a module used to record the quality assessment results and the feedback from the assessment.

(4) *Acting Module (AM)* is a module used to propose improvement guidelines based on evaluation results to be implemented in the next year.

(5) *Reporting Module (RM)* is a module used to issue an operational plan report of the data that has been archived, quality evaluation results and the proposed improvement.

- ***Subsystem 2:*** Information Support System (ISS) is a system that supports the internal quality assurance work in team and between teams, knowledge, information and data file management consists of 3 modules;

(1) *Knowledge Management Module (KMM)* is a module for exchanging knowledge, opinions and information on the implementation of internal quality assurance.

(2) *File Sharing Module (FSM)* is a module for file sharing and co-using.

(3) *Document Management Module (DMM)* is a module for managing shared documents.

- ***Subsystem 3:*** Communication Support System (CSS) is a system that supports the internal quality assurance work in teamwork and teamwork. The communication consists of

3 modules:

(1) *Instant Messaging Module (IMM)* is module for instant messaging.

(2) *Video Conferencing Module (VCM)* is a system for chatting or meeting the Internet.

(3) *Electronic Mail Module (EMM)* is a system for sending text messages.

Phase 2: Analyze the confirmatory factors of the virtual team campus on Cloud system to support the internal quality assurance of Rajamangala University of Technology that comprise the following steps:

1) The step of implementing of system. The evaluation was done by the 3 sample groups involved in the internal quality assurance namely the curriculum level, faculty level and institute level at 9 Rajamangala Universities of Technology through multi stage random sampling which were 537 people in total.

2) The step of analysing the evaluation result of system.

IV. RESEARCH RESULTS

The researcher conducted the analysis based on the sample of those involved in quality assurance in 3 groups and obtained the result as follows:

1) The analysis result of confirmatory factors in curriculum level.

Subsystem 1: IQA WS - The module component weight values were positive between .16 and .43 and statistically significant at .05 indicating that all 5 modules were important variables of IQA WS that the module's components were weighted as follows: RM, CK, DM, PM, and AM .43, .40, .38, .27 and .16 which had the components' weight as 43, .40, .38, .27, and .16 respectively.

Subsystem 2: ISS - The module component weight values were positive between.30 and .63 and statistically significant at .05 indicating that all 3 modules were important variables of ISS. The module's components were weighted as follows: FSM, KMM, and DMM which had the components' weight as .63, .31, and .30 respectively.

Subsystem 3: CSS - The module component weight values were positive between .39 and .47 and statistically significant at .05 indicating that all 3 modules were important variables of CSS. The module's components were weighted as follows: IMM, EMM, and VCM which had the components' weight as .47, .43, and .39 respectively.

The subsystem component weight values were positive between .79 and .99 and statistically significant at .05 indicating that all 3 modules were important variables. The module's components are weighted as follows: IQA WS, CSS, and ISS which had the components' weight as .99, .85, and .79 respectively. Each component has a variance of 98, 72, and 62 percent, respectively. That is, in the part of IQA WS has the most important weight in describing system components while ISS has the least important weight.

The results of the model consistency inspection showed that the chi-square test (x^2) was equal to 36.30 at the independent degree (df) of 24. The chi-square was divided by the degree of freedom (x^2/df) 1.51. The probability (p) was .05 and the root mean square of the approximate error (RMSEA) was .03. The system components constructed by the researcher was in harmony with the empirical data in a good level [20] and consists of three subsystems, 11 modules, as shown in Table I and Fig. 1.

TABLE I
THE ANALYSIS RESULT OF CONFIRMATORY FACTORS IN CURRICULUM LEVEL

Variable	Factor Loading	R^2	FS
IQA WS			
PM	.27*	.13	.15
DM	.38*	.26	.24
CM	.40*	.22	.15
AM	.16*	.06	.01
RM	.43*	.27	.19
ISS			
KMM	.31*	.47	.76
FSM	.63*	.40	.24
DMM	.30*	.45	.74
CSS			
IMM	.47*	.46	.45
VCM	.39*	.39	.41
EMM	.43*	.42	.43
IQA WS	.99*	.98	
ISS	.79*	.62	
CSS	.85*	.72	
x^2 = 36.30 df = 24 x^2/df = 1.51 p = .05 RMSEA = .03			

* p < .05

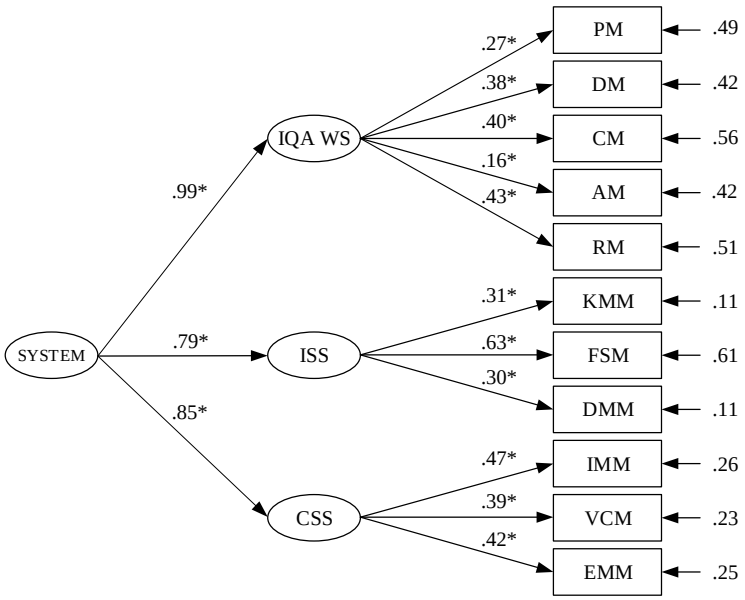

Fig. 1 The Analysis Model of Confirmatory Factors in Curriculum Level

2) The analysis result of confirmatory factors in faculty level.

Subsystem 1: IQA WS - The module component weight values were positive between .06 and .61 and statistically significant at .05 indicating that all 5 modules were important variables of IQA WS. The module's components were weighted as follow: PM, DM, RM, CM, and AM which had the components' weight as .61, .56, .48, .45, and .06 respectively.

Subsystem 2: ISS - The module component weight values were positive between .48 and .62 and statistically significant at .05 indicating that all 3 modules were important variables of ISS. The module' components were weighted as follow: KMM, DMM, and FSM which had the components' weight as .62, .52, and .48 respectively.

Subsystem 3: CSS - The module component weight values were positive between .55 and .65 and statistically significant at .05 indicating that all 3 modules were important variables of CSS. The module's components were weighted as follow: IMM, VCM, and EMM which had the components' weight as .65, .60, and .55 respectively.

The subsystem component weight values were positive between .75 and .99 and statistically significant at .05 indicating that all 3 modules were important variables. The subsystems were weighted as follow: IQA WS, ISS, and CSS which has the components' weight as .99, .82, and .75 respectively. Each component had a variance with the system components, representing 98, 68, and 56 percent, respectively. The IQA WS had the most important weight in describing system components while the CSS had minimal weight.

The results of the model consistency inspection showed that the chi-square test (x^2) was equal to 45.22 at the independent degree (df) of 32. The chi-square was divided by the degree of freedom (x^2/df) 1.41. The probability (p) was .05 and the root mean square of the approximate error (RMSEA) was .03. The system components constructed by the researcher are in harmony with the empirical data in a good level [20] and consists of three subsystems, 11 modules, as shown in Table II and Fig. 2.

TABLE II
THE ANALYSIS RESULT OF THE CONFIRMATORY FACTORS FROM FACULTY LEVEL SAMPLE GROUP

Variable	Factor Loading	R^2	FS
IQA WS			
PM	.61*	.60	.70
DM	.56*	.50	.51
CM	.45*	.22	.08
AM	.06*	.01	-.25
RM	.48*	.26	.07
ISS			
KMM	.62*	.37	.27
FSM	.48*	.20	.17
DMM	.52*	.19	.14
CSS			
IMM	.65*	.38	.28
VCM	.60*	.28	.22
EMM	.55*	.32	.26
IQA WS	.99*	.98	
ISS	.82*	.68	
CSS	.75*	.56	
x^2 = 45.22 df = 32 x^2/df = 1.41 p = .06 RMSEA = .03			

* p < .05

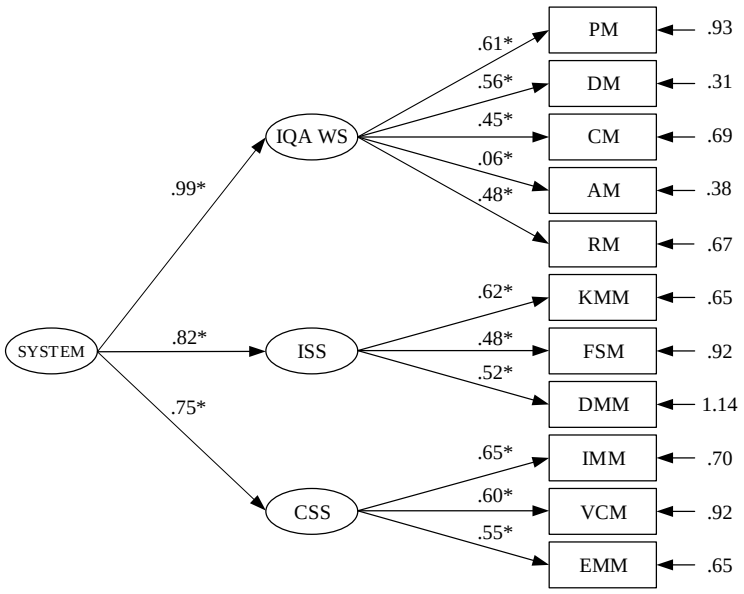

Fig. 2 The Model of the Analysis of the Confirmatory Factors from Faculty Level Sample Group

3) The analysis result of confirmatory factors in institute level.

Subsystem 1: IQA WS - The module component weight values were positive between .45 and .73 and statistically significant at .05 indicating that all 5 modules were important variables of IQA WS. The module's component were weighted as follow: AM, RM, CM, DM, and PM which had the components' weight as .73, .64, .61, 52, and .48 respectively.

Subsystem 2: ISS - The module component weight values were positive between .17 and .67 and statistically significant at .05 indicating that all 3 modules were important variables of ISS. The module's components are weighted as follow: DMM, FSM, and KMM which had the components' weight as .67, .27, and .17 respectively.

Subsystem 3: CSS - The module component weight values were positive between .43 and .53 and statistically significant at .05 indicating that all 3 modules were important variables of CSS. The module's components were weighted as follow: VCM, EMM, and IMM which had the components' weight as .53, .51, and .43 respectively.

The weight of the subsystems was positive between .94 and .97 and was statistically significant at .05 indicating that the subsystems were significant. Composition of subsystems by weight of components was as follows: IQA WS, ISS, and CSS had the weight values of .97, .95, and .94, respectively. That is, the IQA WS had the most important weight in explaining the components of the system while the CSS had minimal weight.

The results of the model consistency inspection showed that the chi-square test (x^2) is equal to 39.61 at the independent degree (df) of 32. The chi-square was divided by the degree of freedom (x^2/df) 1.28. The probability (p) was .05 and the root mean square of the approximate error (RMSEA) was.03. The system components constructed by the researcher were in harmony with the empirical data in a good level [20] and consists of three subsystems, 11 modules, as shown in Table III and Fig. 3.

TABLE III
THE ANALYSIS RESULT OF THE CONFIRMATORY FACTORS FROM INSTITUTE LEVEL SAMPLE GROUP

Variable	Factor Loading	R^2	FS
IQA WS			
PM	.45*	.24	.09
DM	.52*	.32	.18
CM	.61*	.37	.22
AM	.73*	.29	.12
RM	.64*	.30	.15
ISS			
KMM	.17*	.04	.02
FSM	.27*	.26	.31
DMM	.67*	.45	.34
CSS			
IMM	.43*	.22	.15
VCM	.53*	.33	.28
EMM	.51*	.22	.13
IQA WS	.97*	.93	
ISS	.95*	.90	
CSS	.94*	.89	
x^2=39.61 df = 31 x^2/df = 1.28 p = .14 RMSEA = .02			

* p < .05

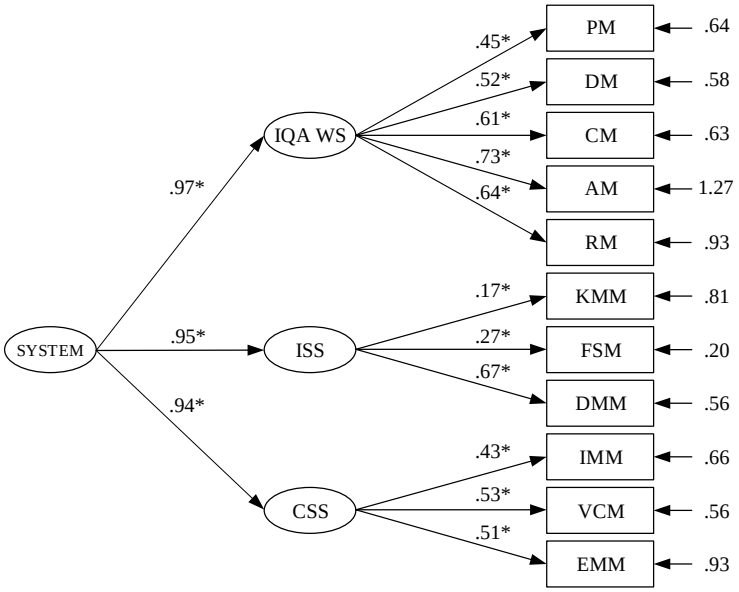

Fig. 3 The Model of the Analysis of the Confirmatory Factors from Institute Level Sample Group

V. CONCLUSION

The components of the virtual team campus on Cloud system to support the internal education quality assurance of Rajamangala University of Technology were analyzed to be used as a component of a system that would be developed to support internal quality assurance within a team and between different teams in a workplace based on the management context of Rajamangala University of Technology.

The researcher found that the system components consist of 3 subsystems as follows: 1) Internal Quality Assurance Workflow System (IQA WS), 2) Information Support System (ISS), and 3) Communication Support System (CSS).

Each subsystem consists of the following modules:

IQA WS consists of 5 modules: 1) PM, 2) DM, 3) CM, 4) AM, and 5) RM.

ISS consists of 3 modules: 1) KMM, 2) FSM, and 3) DMM.

CSS consists of 3 modules: 1) IMM, 2) VCM, and 3) EMM.

Each of these modules plays an important role in developing the system. Each subsystem and module is consistent with the research of various authors [21-23]. This showed that the components of the virtual team campus on Cloud system consists of 3 subsystems and 11 modules can be developed to support the internal education quality assurance of Rajamangala University of Technology.

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