Competency Gap Evaluation Model for Computer Networks Profession: Bridging the Gap between Undergraduate Education and Industry Workforce Expectation

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Abstract

Computer Network is a very significant field of study for professional work in ICT industry (Crnkovic, 2003). A study of Kirida, et. al. (2008) has revealed that there was a problem in ICT professional in Computer Network, caused by the labor shortage in ICT, which has afflicted the economy progress. The finding also extended that the total skill deficiency in Thailand had risen up highly to 30% and 38% in 2004 and 2007 respectively. It was also noted that the labor shortage in Thailand industrial sector was more severe than other countries. One of the main problems in Computer Network Skill Deficiency is the shortage of candidates with the skills needed by the company.

To outcome these problems, it is important to find out what factors determine the gap competency of Computer Network professionals. This should help the appropriate skills which any candidate can promptly apply for the job. This should help to improve quality of the graduates in order that are suitable to the industry needs. This paper has defined a Competence Deficiency matrix of ICT focusing on Computer Network; based on National Quality Standard (NQS) and Thailand Quality Framework (TQF) of ICT study as defined by the Office of the Higher Education Commission (OHEC); as well 3 rounds of nationwide survey research of Computer Network academia. The Competence Deficiency matrix of ICT will be useful for ICT academia in improving quality of graduates accordingly.

This paper has defined a Competence Deficiency matrix of ICT focusing on Computer Network; based on EUCEIP Standard in IT & Computer Science Competency and Competency Model of Missouri University Research (2010) which studied in 3 sections; Foundational, Industry Related, and Occupation Competency. The industrial sector data are collected from 114 companies which covered 4 regions. Those companies are categorized into 5 groups; Industry Factory of small and medium enterprises (SMEs), Service Business & Hospital, Government Organization & Military-industrial complex, Education of University, and bank as well 3 rounds of nationwide survey research of Computer Network.

The Competence Deficiency matrix of ICT will be useful for the company quality assurance and the ability to complete the assigned work from the company. There are the four competency factors for measurement in ICT professional.
**Keywords:** Computer Network Competency Factors, Computer Network Competency Model, ICT Professional, Competence Deficiency matrix of ICT.

I. INTRODUCTION

At present the importance of computer network professional in Thailand is considerably significant in industrial field based on Economic Activities, Commerce Business and Service Business, Production, Construction, Land Transport and Travel Agent, and Hospital. Table 1 (Ministry of Information Communication Technology, National Statistical Office, 2010) [22] shows percentage of the organization which form in company business, have more employment in information technology and communication program, classified by economic activity (Table 1). The problem of educational institution on Computer Network is the difficulty of student perceptions. Chung’s research found that focusing on theory and technique without equipment was not interesting (Chung, 2007) [3]. Colin and et al. (Colin, 2009) [4] found that learners of this subject could not practice as taught or did not have sufficient time and did not have activities that related to instruction medium. In addition, David (2003) discovered that one of the problem was learners did not have prerequisite knowledge background necessary for the instruction.

Computer network instruction in Thailand’s universities, these days, plays an important role in industrial and trade sectors, government organizations, research, education, medicine, communication network system, entertainment business and etc. Association for Computing Machinery (ACM, 2005) [1] design-aided profession, development, analysis, qualification defining, result warranty, maintenance and appraisal of results that are greatly different from the use of ICT in terms of the study of the standard curriculum. To be widely accepted focusing on competence and knowledge base in profession and study of computer network is very important and crucial for ICT profession (Crnkovic, 2003). Computer network is one of the subjects that contained in several fields, such as computer science, computer engineering, information technology, and business computer curricula since it is crucial part of ICT system.

Table 1 Ministry of Information Communication Technology, National Statistical Office, 2010

<table>
<thead>
<tr>
<th>Economic Activities</th>
<th>Total</th>
<th>Commerce Business and Service Business</th>
<th>Production</th>
<th>Construction</th>
<th>Land Transport and Travel Agent</th>
<th>Hospital</th>
</tr>
</thead>
<tbody>
<tr>
<td>Staff number requirement</td>
<td>15,566</td>
<td>11,100</td>
<td>2,055</td>
<td>240</td>
<td>989</td>
<td>30</td>
</tr>
</tbody>
</table>

The purpose of developing Computer Network Competency Model is to improve competency model for computer network professional follow Thailand industry requirement and to study competency factor in computer network professional follow industry professional autonomy and also to indicate the gap competency of computer network profession of universities in Thailand. Normally, the main objectives of universities are to develop learners to possess knowledge in this filed, so the universities have provided standard instruction. The majority of them used ACM 2005 Standard. The university graduates should be able to conduct their profession efficiently.

This research explored industrial requirements cover 4 regions (The North, Central, South and East) and divided into 5 company groups. Those are groups of industry factory of small and medium enterprises (SMEs), group of Service Business & Hospital, government organization & military-industrial complex, group of education of University, and group of bank. It shows in outcome of study part.

II. MOTIVATION FOR THE STUDY

Requirement of computer network profession is reflected in Kirida et al.’s work (2008) that lack of skilled labor was a major obstacle to economic development. Thailand was in the second rank of labor lacking counting for 38% in 2007 and 30% in 2004.
next to Brazil. This can be seen that Thailand took longer period to recruit labor for production process at the rate of 5.2% compared with Korea’s which was 3.4% and Indonesia’s which was 1.6%. The reason why it took such a long period is because applicants did not possess qualifications as required by employers such as lack of English literacy at the rate of 90%, lack of information technology and ICT skill at 82%, calculation skill at 60%, creativity at 45% and leadership at 43%.

Table 2 Personal requirement classify by educational and experience (Ministry of Information Communication Technology, National Statistical Office, 2010)

<table>
<thead>
<tr>
<th>ICT Position</th>
<th>Educational Background and which more complex</th>
<th>Number of needed worker for work</th>
<th>Min</th>
<th>Max</th>
<th>Average Minimum Earned/Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total</td>
<td></td>
<td>12,042</td>
<td>9,600</td>
<td>128,000</td>
<td>1,800</td>
</tr>
<tr>
<td>ICT Engineer</td>
<td></td>
<td>302</td>
<td>7</td>
<td>70</td>
<td>94</td>
</tr>
<tr>
<td>Software Engineering Manager</td>
<td></td>
<td>302</td>
<td>23</td>
<td>240</td>
<td>23</td>
</tr>
<tr>
<td>System Analyst</td>
<td></td>
<td>220</td>
<td>30</td>
<td>350</td>
<td>30</td>
</tr>
<tr>
<td>Applications Software Developer</td>
<td></td>
<td>99</td>
<td>4</td>
<td>10</td>
<td>5</td>
</tr>
<tr>
<td>ICT Technical Specialist</td>
<td></td>
<td>124</td>
<td>40</td>
<td>100</td>
<td>70</td>
</tr>
<tr>
<td>ICT Support Engineer</td>
<td></td>
<td>81</td>
<td>50</td>
<td>100</td>
<td>50</td>
</tr>
<tr>
<td>ICT Support</td>
<td></td>
<td>30</td>
<td>20</td>
<td>50</td>
<td>30</td>
</tr>
<tr>
<td>ICT Support Specialist</td>
<td></td>
<td>8</td>
<td>20</td>
<td>30</td>
<td>10</td>
</tr>
<tr>
<td>Other</td>
<td></td>
<td>25</td>
<td>10</td>
<td>50</td>
<td>10</td>
</tr>
<tr>
<td>Average</td>
<td></td>
<td>132</td>
<td>40</td>
<td>100</td>
<td>70</td>
</tr>
</tbody>
</table>

Table 2 Work position which need the different level of cognitive and ability or skill in computer network. There are many position, system manager, information technical specialist, ICT safety specialist, and telecommunication engineer. The position requirement in year 2552 is 804, as 7.55% of all 10,641 positions. So Thailand has many ICT labor shortages who have cognitive knowledge in ICT and computer network competency.

III. RESEARCH QUESTIONS

1. What are factors which specify competency for computer network professional from industry requirements?
2. What are factors that set computer network competency for undergraduate curricula according to professional standard?
3. What is and what should computer network competency between currently applicant and applicant should be have?
4. What is the computer network competency of current applicant and what is expected competency?

IV. RESEARCH MODEL

![Research Model](image)

To have professional in computer network competency factors in the Figure 1 need to have two input of computer network professional standardize and industry requirement in computer network. And knowledge from education and internship to increase competency level are matched with standardize in computer network field.

V. OUTCOME OF STUDY

Outcome after Focus Group of computer specialists and educational technology had validated survey. There are 114 surveys on computer network industrial requirements cover 4 regions into 5 company groups. There are group of industry factory of small and medium enterprises (SMEs), group of Service Business & Hospital, government organization & military-industrial complex, group of education of University, and group of bank. The survey result is divided into following factors:

1. Skill and Operation
2. Behavior and Attitude
3. Specific Certified Professional
4. Opportunity for Position Progress

5.1 Factor of skill and operation

Figure 2, study found that job employ demand in section of skill and operation has overall mean 3.93 and when consider all 4 skill, found that System Analyze, Installation, Problem Solving and Maintaining equipment is in high level and the most requirement ( X = 3.99 ).
5.2 Factor of Behavior and Attitude

Figure 3, study found that respondents opinion for qualification in Computer Network Professional position toward Industry Requirements in part of Behavior and Attitude, are overall in high level, mean 4.18. Considering in each item indicated that the item Have good human relations with colleague and Ability to be a good team work are highest level with 4.27 of mean, the Understand IT System and have service mind is also high, mean 4.25. And Ability to people communicate, such as speaking and writing is in very level, mean 4.07, Understand IT System and have service mind is lowest mean 4.05.

5.3 Factor of Specific Certified Professional

Figure 4, study found that respondents have opinion level toward qualification of Computer Network position, in section of Professional Certificate, totally are in high level, mean 3.74. While the examining result in each item shown that the score on item Operator should have cognitive in job and Infrastructure Limitation for example, LAN, WAN, highest mean 4.05, the second is Operator should receive Professional Certificate in Computer network, such as Client-Server, and the last Operator should receive certificate for ability in Network System Management, such as NIC, Protocol, NOS, are 3.68, 3.59 and 3.53 respectively.

5.4 Factor of Opportunity for Position Progress

Figure 5, study found that respondents opinion on using technology preparedness measured by satisfying level, the overall mean score is 4.12. Consideration in each item found that the mean score of Set up new technology make working team have more knowledge and ability and satisfy is highest, 4.40. The mean score of satisfaction on the item, Set up new technology build up cooperate in team working, is 4.35. Set up new technology will pass on knowledge equipment, satisfy level mean 4.25. Item Set up new technology make easy maintain but may have personal violate copyright and item Using new technology cause more working time freedom (not limited by working hour and office) satisfy level mean 4.21. Item In your opinion overall set up new technology produce team working satisfaction, satisfy level mean 4.20. Item You expect that your organization as CCITT, ITUTS, ISO, ITIL, IAB, mean 3.86.

The means of the 3 rest items: Operator should have cognitive the difference between Infrastructure Topologies, as BusNet, Rinet, StarNet, Operator should receive Professional Certificate in Computer network, such as Client-Server, and the last Operator should receive certificate for ability in Network System Management, such as NIC, Protocol, NOS, are 3.68, 3.59 and 3.53 respectively.
technology, Organization support new technology learning and item. Using new technology about business information safety as Information Leakage, are same satisfy level mean 4.19. New technology creates trouble work in organization, satisfy level mean 4.17. Organization explain and try to understand that new technology replace some staff, and item. You believe that new technology is not suitable to conservative staff, satisfy level mean 4.15. New technology (in item 1) cause more efficiency organization, satisfy level mean 4.06. Organization often received new technology suggestion from salesman, satisfy level mean 4.04. Set up new technology make good communication in team working, satisfy level mean 3.97. Operators in your section like to use new technology in job, satisfy level mean 3.95. Using new technology makes higher business production because of co-operation working, satisfy level mean 3.94. New technology (in item 1) makes organization has good control system, satisfy level mean 3.80.

The information in table 3 and figure 6 there are 5 company groups, Industry Factory of small and medium enterprises (SMEs), Service Business & Hospital, Government Organization & Military-industrial complex, Education of University, and bank and 4 Competence Deficiency factors, Skill and Operation, Behavior and Attitude, Specific Certified Professional and Opportunity for Position Progress. After analyzed with Competence Deficiency factors, It found that Skill and Operation is the most important for Factory of small and medium enterprises (SMEs), Service Business & Hospital and Group of Education of University. While Government Organization & Military Industrial Complex requirement on the factor of Behavior and Attitude.

![Figure 5 Opportunity for Position Progress](image)

**Figure 5 Opportunity for Position Progress**

![Table 3 The survey result of Competence Deficiency Matrix of ICT with 5 company groups](image)

**Table 3 The survey result of Competence Deficiency Matrix of ICT with 5 company groups**

<table>
<thead>
<tr>
<th>Competence Deficiency Matrix of ICT</th>
<th>Industry Factory (SMEs)</th>
<th>Service Business &amp; Hospital</th>
<th>Government Organization &amp; Military-industrial complex</th>
<th>University Education</th>
<th>Bank</th>
</tr>
</thead>
<tbody>
<tr>
<td>Skill and Operation</td>
<td>4.06</td>
<td>4.09</td>
<td>4.07</td>
<td>4.06</td>
<td>4.05</td>
</tr>
<tr>
<td>Specific Certified Professional</td>
<td>4.09</td>
<td>4.06</td>
<td>4.07</td>
<td>4.06</td>
<td>4.05</td>
</tr>
<tr>
<td>Opportunity for Position Progress</td>
<td>3.90</td>
<td>3.92</td>
<td>4.08</td>
<td>3.98</td>
<td>3.95</td>
</tr>
<tr>
<td>Behavior and Attitude</td>
<td>3.90</td>
<td>3.92</td>
<td>4.08</td>
<td>3.98</td>
<td>3.95</td>
</tr>
</tbody>
</table>

![Figure 6 The graph present survey result of Competence Deficiency Matrix of ICT with 5 company groups](image)

**Figure 6 The graph present survey result of Competence Deficiency Matrix of ICT with 5 company groups**

**VI. DISCUSSION**

To explain the Gap Analysis of ICT professionals in Computer Network, there are 2 models; Technical Model and Conceptual Model. The technical Model will consist of terminology in Ontology that present the gap relation among Education Institution, Industry Requirement and EUCIP standardize. The researcher will have presentation by visualization program but now it is processing. By function of relation are in below:
Education Component = {Component#1, Component#2, Component#3,…}
EUCIP Component (Network Amin.) = {EUCIP#1, EUCIP#2, EUCIP#3,…}
Diff(Eduction, EUCIP) = {d1, d2, d3,…}

The Conceptual Model will present about one sampling data model such as selected one university and one industry requirement specification of Network Administration Position. Business Engineering will be one curriculum of Network Course that will contain of many sections and it will have Key Competency that matched with EUCIP standard. And one of Job Specification in Network Administration for a factory requirement will present about the Networks Skill and qualification and also it will have Key Competency. Then these both Key Competency factors are matched to be Gap Analysis. But now this process is in doing, it will show in future work.

VII. CONCLUSION

To outcome in ICT professionals in Computer Network total skill deficiency labor shortage problems in Thailand had risen up highly to 38% in 2007, it is important to find out what factors determine the competency of Computer Network professionals. This paper has defined a Competence Deficiency matrix of ICT focusing on Computer Network; based on EUCIP Standard and Competency Model of Missouri University Research (2010). The survey of industrial sectors are collected from 114 companies which covered 4 regions categorized into 5 company groups which required 4 Computer Network competency skill factors, skill and operation, behavior and attitude, specific certified professional and opportunity for position progress. And Competency factors have related with industry requirement that can classified into 2 groups. Group 1 is Skill and Operation Factors are required for Factory of small and medium enterprises (SMEs), Education of University and Service Business & Hospital. Group 2 is Behavior and Attitude Factors are required for Bank and Government Organization & Military-industrial complex.

REFERENCES


