FACTOR ANALYSIS OF THE FUNCTIONAL REQUIREMENT OF SMES INFORMATION SYSTEMS

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Abstract—SMEs need information systems to develop business. With limited resources, different working structures make it impossible for SMEs to use enterprise-class information systems. The creation of new information systems for small enterprises is difficult due to cost, time and quality. In most cases, entrepreneurs fail to clearly identify requirements. The developers also fail to understand the respondents in terms of business details. The matter makes it more difficulty working with users’ requirements. The research objective is reforming the requirement elicitation in the requirement engineering process, from face to face interview and analysis, moving to e-survey interview and the statistical modeling by using the exploratory and the confirmatory factor analysis methodology. 221 SMEs companies in Thailand were participated in the survey. The first part of this study investigates the pattern of factors that influence the demand of functional requirements. The functional requirements for SMEs' information system results 4 influence factors. Easy access and Data interconnection has the highest influence at 0.963. Easy operation with Security has a second highest influence at 0.951. Knowledge Network Factor for self-study as a third rank at 0.829 and a Variety that can be customized prototype itself is the 4th rank at 0.754

Keyword— user requirement, SMEs, Small and medium enterprises, Information System, functional requirement, Factor analysis, Requirement elicitation

I. INTRODUCTION
At present, to compete with other SMEs in the same pier or a bigger enterprise business, SMEs business owners try to use modern knowledge to increase their competitiveness both in production and marketing, there for the using of IT system is a necessity. At the beginning, they may not require any IT system at all. When the business has grown bigger, the number of employee increased with more business units, this leads to more complexity in the data management, data analysis. From a business that only uses a simple IT system, then requires a more complex IT system to serve their business growth. However, SMEs business owner is the only one who has a knowledge in his or her business, the only decision maker for purchasing IT system and the only one who can provide IT system user requirement.

The SMEs working structure is a single layer structure or “Flat Organization”. In order to reduce processes, increase the working speed, reduce the operation cost, the employees have to be able to handle multiple tasks at the same point. This is different in a big enterprise which has multi-level of authorization, complex processes, and bigger number of employee, each business unit/employee has a specific task and responsibility vary to products or services. From this we can see a difference in the work flow process and working system of SMEs and enterprise business.
In Thailand, SMEs situation in 2016, the number of SMEs 2.766 million, or 98% of the total number of enterprises in the whole country. Small enterprises (SEs) accounting 99.26% or 2.733 million companies. The employment 10.7 million in SMEs, accounting for 80.44% of total registered employment. Creation of economic value 5.5 trillion baht or 41.1 percent of GDP. [1]

SMEs in Thailand face similar problems as many SMEs in other countries. Due to the global market competition. Factors Influencing SMEs are government policies and support, financial accessible, entrepreneurs knowledge, research and development knowledge transferring, specialist business services such as legal expert and consultant, Social behavior and culture, also the country’s infrastructure. [2] [3] Report from The Global Competitiveness Report 2015-2016 found that Thai SMEs have technology readiness problems in the Science, technology and innovation application, focus on labor as main factor, single ownership therefore entrepreneur has no time to develop business. Lack of business partnerships. Lack of advance information technology and lack of online e-commerce business. The ministry of commerce reported SMEs experience economic problems more than 70%, closing 25% on average. Each year, only 10% of SMEs are able to survive but facing the risk of long-term sustainable survival [4]

SMEs contribute up to 95-98% of the total number of business in the country [5], and has an impact on the growth of the country and GDP. At present, many SMEs have a need to develop their own potential by adopting IT system into their system. The existing IT system in the market is not suitable for the SMEs structure, due to the IT system development is still base on the enterprise business model. The quality problem of In software development life cycle (SDLC), the requirement engineering process (user requirement collection) is the most important one [6]. In addition, it is a difficult process. Requirement engineering is the part with highest risk in the system development. The system developers need to convert user’s requirement into a software program. The differences in education background and work experiences between requirement collector and user may cause a misunderstanding in the user requirement. This leads to a product that does not meet the user requirement. Many researchers propose the solutions to this problem. However, most of them are focusing on the software development for enterprise business. Admittedly, the software industry does not have enough professional who possess technical skill, experience and psychological skill [7]. This causes a problem in communication and requirement collection between the requirement collector and user. In addition, the users also do not understand their software requirement well enough to explain it in detail. These problems in software development process [6, 8-10] including the inconsistency of the user [7] result in a final software product that do not meet the user requirement.

Information system development with SDLC and traditional requirement engineering, for collecting data from each user, translating and executing programming, may not be appropriate for the situation of SMEs. The study of the SMEs’ information system model analyzes the relevant factors of “The demand of functional requirements model”, using the factor analysis. The results of this study show the starting point of SMEs information system requirement development pattern.

Meanwhile, the most common used technique of elicitation requirement is interview. [11] [12] [13] System analyst interview system owner and users to collect the user requirements. The needs must translate, diagnose, modelling, validate and transfer to explicit document. The requirement elicitation is a communication elaborative process which human
reaction perform significant role. A difference in domain knowledge between system analysts and system owner create communication obstacle, [13], especially in SMEs who has low literacy in information technology. Therefore, wrong identification take place in system requirement and convey to system failure.
The research is reforming the requirement elicitation in the requirement engineering process, from face to face interview moving to the statistical procedure by using the exploratory and the confirmatory factor analysis methodology. Tools used in the research is an electronic questionnaire (e-survey). The electronic questionnaire has less human interact between interviewer and respondent which is opposite to current face to face elicitation process.

In order to solve the differences of domain knowledge in communication problem, the factor analysis techniques are used to replace the System analyst's analysis process after collecting the user requirements. The System analyst's process consists of translation, diagnostic, modelling, validate and transfer to document.

The study is to identify demand for system functionality in SMEs firms. To understand and able to explain the causal relationship between variables in term of equation by using Exploratory factor analysis and Confirmatory Factor Analysis technique.

II. METHODOLOGY

Sample group that being used in this research are management, business owner who has the authority to decide on the selecting and purchasing of the organization information system, or has an IS system related experience in the organization. By which the organization must be SMEs that complied with the Thailand ministry of commerce’s criteria. The answer obtained from the questionnaires of 266 companies. From the filtering of the duplicated and skipped answer has found 45 sets that need to be discarded due to quality, thus 221 sets remain.

Tools used in the research is an electronic questionnaire (e-survey) by using google document created an electronic questionnaire and send the link to the sample group, the data is updated in real time and stored in the google document system. The electronic questionnaire has less human interact between interviewer and respondent which is opposite to current face to face elicitation process.

The factor analysis is used to examine the pattern of complex and multidimensional relationship for large numbers of functional variables. Factor analysis increase knowledge of the variable structure and interrelationship by summarize into a smaller set of factors or component. [14]The 1st Order Confirmatory Factor Analysis confirm the relationship of the observed variables from the EFA. Then create a model to show the relationship of the variables. The 2nd order Confirmatory Factor Analysis calculates to measure the size influence the needs of Functionality in SMEs' information systems.

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However, the low computer technology literacy in SMEs 'entrepreneur, affect to the questionnaires. Three questionnaires have been developed and adjust for using simple wording of technical functional and non-functional requirement.

A. Data collection

This research sent the questionnaire to the business owners who has been selected to join the SMEs development program of the department of business development under the ministry of commerce of Thailand who pass the criteria of being a business owner for at least 3 years, their business is still running, want to develop their business further,
being a member of the federation of Thai SMEs. Sending electronic questionnaire to the target group (500 business owners who passed the criteria) during 14 July 2016-30 September 2016

B. Data Analysis,
Data collection by using electronic questionnaire. Verify data, data filtering and correction. Using evaluation methods with SPSS program IBM version 23 for Windows, a program for statistics analysis. Present in tables and explanations. Using Exploratory Factor Analysis to categorize variables [14-20]

Modeling of demand requirement using Amos IBM version 23[14, 19-23] Analysis using the 1st Order Confirmatory Factor Analysis to confirm the consistent pattern of the model data with empirical data. Apply the 2nd order Confirmatory Factor Analysis [16, 24] to measure the influence of Functionality demand pattern of the SMEs’ information systems

III RESULT OF THE RESEARCH
A. data analysis by basic statistics
Part 1 : Demographic attribute of the SMEs business owner( SMEs entrepreneur). From the survey of 221 SMEs entrepreneurs, 54% are male, 43% aged between 31 to 40 years old, 50% have master’s degree, 66% are business owner.

Part 2 : Firm attribute. The largest group which contribute to 45 % of the answerer have been running the business for over 10 years in which 38 % of them are service business, 30% are food & beverage, the 2nd largest group is professional service contribute to 15% of the answerer, 24% have business revenue per year more than 50 MThb, 67% have fixed asset value less than 30 MThb, 50% have number of employee less than 15 persons.

B. Exploratory factor analysis
Testing Hypothesis with Bartlett's Test of Sphericity
H0: Variables are not correlated.
H1: Variables are interrelated.

Based on Kaiser-Meyer-Olkin data used to measure the suitability of the data. 0.941 concludes that the available data is appropriate to use the Factor analysis technique. From the test statistic, Sig value = 0.000 which is less than 0.5, thus rejecting H0. Variables are related. It is appropriate to use Factor analysis. By examining Extraction Communality, the variable “The use of cloud systems to replace the creation of hardware & security within the company.”, has the lowest value at 0.507 and the variable “connects to the other desired system by users” got the highest value is 0.838.

Factor analysis is conduct by use Extraction Method: Principal Component Analysis. Rotation Method: Varimax with Kaiser Normalization. From Eigenvalues, greater than 1, there should be 4 factors. Factor 1 can describe the maximum number of data at 55.057, with 4 factors representing 71.034.

C. Validating the measurement model (CFA)
The First Order Confirmatory factor to confirm the components analyzed by the EFA by drawing data from the EFA drawing the structural model, perform statistical validation with AMOS.

Research hypotheses
H0: Structural relationship model the demand for system functionality generated is consistent with empirical data.

The results of the validation with the Maximum Likelihood method showed that the data was p <0.05. When adjusting the FIT model, p = 0.000, the fitness index was checked for goodness of fit.

The validation results of the consistent model, it was found that, compared to the measure of consistency, RMSEA 0.074, GFI 0.912, AGFI 0.868, CFI 0.961, Chisq/df 2.199 , all values achieved criteria. The analysis confirms the suitability of the model relative to the empirical data.

The Second Order Confirmatory factor to determine whether the sub-factor is under the same large element. And to determine which sub-elements are
less important. The results of the suitability check, Consistent model, it was found that, compared to the criterion of consistency, \( p = 0.000 \), the value obtained from the analysis was less than 0.05. However the results can pass the criteria of fitness index (RMSEA 0.072, GFI 0.909, AGFI 0.866, CFI 0.962, Chisq/df 2.153) With all those index and CR. as well as AVE. calculation are above the standard level. Therefore, we can confirm the suitability of the model compared to the empirical data and confirm the sub-factor is under the same large element.

Fig. 1 The 1st order confirmatory factor analysis

Fig. 2 The 2nd order confirmatory factor analysis

<table>
<thead>
<tr>
<th>2nd Construct</th>
<th>Item</th>
<th>Factor Loading</th>
<th>CR (Above 0.6)</th>
<th>AVE (Above 0.5)</th>
</tr>
</thead>
<tbody>
<tr>
<td>the demand for system functionality</td>
<td>Easy operation with security</td>
<td>Y11</td>
<td>0.951</td>
<td>0.931</td>
</tr>
<tr>
<td></td>
<td>Accessible</td>
<td>Y12</td>
<td>0.963</td>
<td>0.871</td>
</tr>
<tr>
<td></td>
<td>Variety and connection with trial system</td>
<td>Y13</td>
<td>0.754</td>
<td>0.700</td>
</tr>
<tr>
<td></td>
<td>Knowledge network</td>
<td>Y14</td>
<td>0.829</td>
<td>0.809</td>
</tr>
<tr>
<td>Factor Y11</td>
<td>Easy to understand language without IT knowledge</td>
<td>x2205</td>
<td>0.823</td>
<td>0.871</td>
</tr>
<tr>
<td></td>
<td>Users can access at anytime, anywhere by anyone</td>
<td>x2208</td>
<td>0.740</td>
<td>0.700</td>
</tr>
<tr>
<td></td>
<td>System modification not affect normal operation</td>
<td>x2211</td>
<td>0.700</td>
<td>0.700</td>
</tr>
<tr>
<td></td>
<td>system security</td>
<td>x2219</td>
<td>0.809</td>
<td>0.809</td>
</tr>
<tr>
<td>Factor Y12</td>
<td>Every business can access easily</td>
<td>x2213</td>
<td>0.692</td>
<td>0.860</td>
</tr>
<tr>
<td></td>
<td>Low cost of use</td>
<td>x2215</td>
<td>0.729</td>
<td>0.875</td>
</tr>
<tr>
<td></td>
<td>Transfer knowledge forward to employees</td>
<td>x2217</td>
<td>0.875</td>
<td>0.875</td>
</tr>
<tr>
<td></td>
<td>Migrate old data</td>
<td>x2218</td>
<td>0.885</td>
<td>0.885</td>
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<tr>
<td>Factor Y13</td>
<td>There are a variety of functionalities</td>
<td>x2201</td>
<td>0.842</td>
<td>0.893</td>
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<tr>
<td></td>
<td>connecting to other applications by yourself</td>
<td>x2202</td>
<td>0.921</td>
<td>0.921</td>
</tr>
<tr>
<td></td>
<td>has a prototype system for trial</td>
<td>x2203</td>
<td>0.806</td>
<td>0.806</td>
</tr>
<tr>
<td>Factor Y14</td>
<td>builds a collaborative network for user</td>
<td>x2220</td>
<td>0.718</td>
<td>0.811</td>
</tr>
<tr>
<td></td>
<td>contains the information warehouse for self-study</td>
<td>x2221</td>
<td>0.691</td>
<td>0.691</td>
</tr>
<tr>
<td></td>
<td>There are face-to-face consultants</td>
<td>x2222</td>
<td>0.854</td>
<td>0.854</td>
</tr>
</tbody>
</table>
Summary of the sub-factor under the category the demand for system functionality with the influence weight as following

Factor Easy operation with security contains variables sub-factor with no.1 rank: Easy to understand language without IT knowledge with influence 0.823, the 2nd is variable system security, influence 0.809. The 3rd is System modification not affect normal operation with weight 0.790. Follow by Users can access at anytime, anywhere by anyone weight 0.749

Factor Accessible consist of variable no.1 Migrate old data influence 0.885. Follow by no.2 with Transfer knowledge forward to employees. 0.875. No.3 is variable Low cost of use 0.729. follow by Every business can access easily weight 0.605.

Factor Varity and connection with trial system. The highest variable is connecting to other applications by yourself, influence 0.921. No.2 with the variety of functionalities weight 0.842. The Last one is a prototype system for trial 0.806

Factor the Knowledge network. The highest is face-to-face consultants got 0.884. No.2 is to builds a collaborative network for user weight at 0.718. Follow by contains the information warehouse for self-study weight 0.691

Summary of new models created After checking, found that. There is a consistent fit of model versus empirical data. The functional requirements model in the SMEs software system consists of Accessible. The first rank influence is 0.963, the second factor is the Easy operation with security influence is 0.951. Knowledge network is influenced by 0.829 and the last one is Varity and connection with trial system (users can adjust by themselves) got influence 0.754

IV. CONCLUSIONS

Most requirement engineering research is done by those in the field of computer engineering, but in this study, researching on aspects of the SMEs user. That resulted new variables in terms of Varity and connection with trial system. and Knowledge network. Results also show that users like to do tasks themselves due to speed of work and cost which is the main challenges for all SMEs. However, all variables are controlled variables. Excluding Social factors, external uncontrollable factor.

However, three questionnaires have been developed and adjust by using simple wording of technical functional and non-functional requirement. This evidence shows the low computer technology literacy in SMEs 'entrepreneur and confirm the communication obstacle between business owner and developer. The human interacts by face to face interview could not solve this obstacle, therefore this study examines new method of elicitation by using "the electronic questionnaires". This tool is able to gather the demand of new information system without developer resource.

The System analysis process consists of translation, diagnostic, modelling, validate and transfer to document. In order to solve the differences of domain knowledge in communication problem which lead to wrong requirement identification. The study using the factor analysis techniques to replace the System analysis process. Test results show grouping of the main factor and sub-factor with the scale of influence. According to SMEs' simple way of work and similar in operation, the EFA CFA results could help the software developer to shorten the analysis procedure by using this statistical modeling as SMEs’ standard functional requirement.

The research results using e-questionnaires and statistical analysis methodology help SMEs and developer to connect anywhere and anytime, shorten time of the interview and increase the quality of the analysis process to prepare the requirement document. The knowledge of the pattern of complex and multidimensional relationship of the functional requirement are determined by the size of the influence. Therefore, the researcher proposes the
results as a standard functional requirement knowledge for SMEs’ information system

V. REFERENCES


