

Development of Key Performance Indicators of Municipality by Applying an Analytical Hierarchy Process: Case Study of Lower Northeastern Thailand, Group II

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Abstract

The purpose of this research was to develop key performance indicators (KPIs) in municipalities by applying a priority assessment in particular areas of lower Northeastern Thailand, Group II. Questionnaires were used to gather data from 200 municipality office administrations and 17 experienced professionals. To begin with the investigation of KPIs concerned the competency of municipality. The criteria of competency were categorized initially into 5 parts. All KPIs were analyzed by the Nominal Group Technique (NGT) and Affinity Diagram Technique (ADT). Grouped KPIs were then used to construct a questionnaire to provide both validity and reliability. For data analysis, confirmatory factor analysis using Bartlett's Test Sphericity technique was used. Professionals later evaluated the priority assessment with an Analytical Hierarchy Process (AHP). It found that all the 487 KPIs formerly used can be extracted into 38 KPIs. To beneficial contribution, it is cost saving and consistency to assess the competency in municipality office in Thailand.

Keywords: Key performance indicators, municipality, analytical hierarchy process

Introduction

Background

Centralized administration in Thailand provides limited effectiveness. This is because of the large population and area, the government policy and the bureaucratic system which make cost saving problematic. Municipality offices are organized to provide decentralization. This has been emphasized by every government to better meet the needs of the people. However, there are many problems at municipality offices. For instance, the authority of the municipality intercepts other domestic administration. Problems of conflict between civil officers and politicians, unrelated policy and plans with the real problem and people's requirement in the local area, ineffectiveness of policy implementation following the existing budget, and little participation of people in specific areas are highlighted as the main problems. In terms of participation, people are only able to join the election process, with no cooperation in the long term. Importantly, the current assessment of the competency of how municipality performs concerning cost saving and short time consume is ineffective. It is therefore necessary to implement beneficial and proper regulations or policies that are not too difficult.

From all the reasons stated above, there is a need for key performance indicators (KPIs) to assess the competency of each municipality office. An appropriate tool revealing suitable KPIs is very important and necessary. Quantitative measurements are interpreted easily based on a scientific approach for all stakeholders. As a result, an analytical hierarchy process is used to develop the KPIs in order to assess the competency of the municipality. It also provides a quantitative, safe, appropriate and advantageous contribution.

Objectives

To develop KPIs in municipalities by applying a priority assessment method in the lower part of Northeastern Thailand.

Scope

1) Municipality offices in Group II area of the lower Northeastern part of Thailand which include 4 provinces: Ubon Ratchathani, Amnat Charoen, Yasothon and Sisaket province.

2) The priority assessment contains of confirmatory factor analysis, an analytical hierarchy process, and Pareto concept.

3) A sample of 200 municipality administrations and 17 experienced professionals were interviewed by questionnaire.

Literature review

In the research by Phunikhom [1] it was stated that by gathering KPIs and grouping new KPIs via the Nominal group technique (NGT) and Affinity diagram technique (ADT) duplication could be reduced by 65 %. Moreover, Thummaseang [2] studied 50 involved KPIs to analyze the confirmation factor. The results showed that 26 proper KPIs were needed reducing the number of KPIs by 49.5 %.

Tiruschaya [3] has improved the criteria to evaluate the satisfaction of staff in Songkhla municipality in Songkhla province. It was used to improve the quality of living of all employees in this municipality. All staff participated to assess the priority of the present KPIs. It was able to obtain the deep context for further improvement.

Groarke [4] has studied how less developed areas in Italy can develop their local business effectively. The local policy was addressed by the professionals and then KPIs extracted to understand and reveal the local context. As a result, local business in this area improved economically and quickly.

Hua [5] has employed the Analytical Hierarchy Process (AHP) technique and questionnaire to develop a system for contractor selection in China and Taiwan. The questionnaire was developed and surveyed from 400 companies. It was found that the priority of each KPI helps to select a contractor effectively. An auction system was also developed for outsourcing contractors to fill in a particular form. All records were integrated and available for examination. In addition, Aunthaisong [6] developed a fundamental system for improvement of KPIs that caused economy and worth to find the waste and increase efficiency in work.

After reviewing all the research above, the researcher developed the framework shown in **Figure 1**.

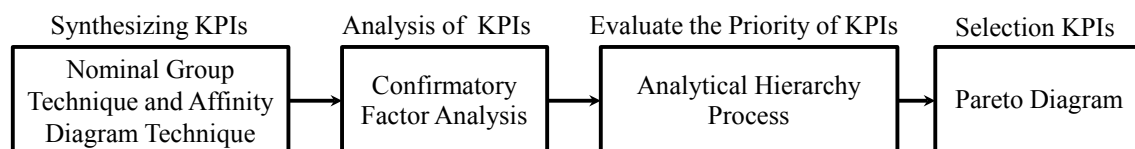


Figure 1 Conceptual framework.

Methods

Document research for investigation indicators

In this process, the previous studies are reviewed from scholar sources such as journals, proceedings, books, dissertations, research, and reports. Hard copies and online searching are mentioned to access from reliable sources and organization. KPIs are categorized into input factor, operation factor, output factor, and effectiveness measurement indicator. Moreover, the tools and methods are alternatively selected for priority assessment to minimize influential KPIs.

Synthesizing KPIs by nominal group technique and affinity diagram technique

The authors began by inviting experienced professionals for a focus group in order to synthesize the data by using the Nominal Group and Affinity Diagram Techniques. The NGT is a structured method for group brainstorming that encourages contributions from everyone. The ADT organizes a large number of ideas into their natural relationships. This method taps into a team's creativity and intuition.

Thanathitikorn [7] suggests that more than seventeen experienced professional is proper to minimize any errors. In addition, following the study of Punpatchivin [8], professionals should be selected by consideration of experience and academic qualification. Academics are independent and able to provide deep details. Interestingly, the proportion of professionals depends on the researcher. For the present study, the 17 professionals are categorized as 7 academics, 5 experienced workers in the private and public sector, and 5 people from municipality administration.

Starting with the representation of all KPIs investigated previously by researchers, the focus group undertook extensive discussion. The ADT was then used to minimize the KPIs. Additionally, the criteria of competency was determined on the primary and secondary criteria of all KPIs.

Analysis of KPIs

All KPIs obtained from the previous process are addressed and included in the questionnaire titled "The Study of Appropriateness of Indicators for Competency Assessment in Municipality". Two hundred workers from the municipality office responded to the questionnaire. Comrey and Lee [9] recommends that at least 200 key informants are needed. The questions for the respondents were in 2 main areas;

- 1) Content validity and congruence of KPIs, and
- 2) The possibility to investigate data.

5-point Likert scale from 1 to 5 is identified as shown in **Table 1**.

Table 1 Example of Questionnaire in Analyzing KPIs.

KPIs	Validity & Consistency					Able to implement				
	5	4	3	2	1	5	4	3	2	1
A1.1										
A1.2										
:										
E6.3										

From the two parts of the questionnaire, the total score is between 2 to 10. The score was adjusted using the SPSS Software with a maximum score of 1 and minimum of 0.2. Furthermore, the SPSS Software is used in confirmatory factor analysis. Singhchangchai [10] suggests the steps of this particular process as;

- Step 1 Select a factor using the research objectives
- Step 2 Examine the general assumption and then construct a correlation matrix
- Step 3 Extract a factor by Factor Extraction or Initial Factors
- Step 4 Select factor rotation
- Step 5 Indicate the factor score
- Step 6 Analyze using factor analysis
- Step 7 Select the factor (factor loading > 0.5)

Evaluate the priority of KPIs by an analytical hierarchy process

Factor analysis was employed to determine only the relevant factors to construct the questionnaire. Pairwise comparison on focus group of 17 professionals is argued. To weigh each priority an analytical hierarchy process was used so that, the questionnaire is composed of 1) Objectives, 2) Procedure to fill in

following the priority, and 3) Table on comparison of each indicator. The point weights are shown in **Table 2** and were further examined by Expert Choice software. It is known that priority weight score of each factor is important and is acceptable if it is not over 0.10 [11].

Table 2 Level of significant and point weight in analytic hierarchy process.

Level of significant	Point weight
Equal	1
Equal to Average	2
Average	3
Average to More than Average	4
More than Average	5
More than Average to More	6
More	7
More to Most	8
Most	9

Selection KPIs on Pareto concept

When all KPIs are investigated, each weight multiplies by a factor loading. The percentage of weight priority is used for comparison, rearranging them from high to low values. Using Pareto concept, the cumulative weight; lower 80 percent, is considered to select any KPIs again. As suggested by Singhapun [12], scaling at 80 percent is preferable in selecting KPIs following a priority assessment process.

Results and discussion

Findings from the literature review

The literature review of scholarly relevant sources shows the KPIs reflecting competency of working in municipality contains 487 items. Tools to investigate KPIs weighting are employed to be used in the priority assessment.

KPIs found from nominal group technique and affinity diagram technique

All KPIs investigated from previous stages are categorized by professionals. The primary criteria is split into 5 parts and named as A, B, C, D and E respectively. The secondary criteria and all KPIs from NGT and ADT, are shown in **Table 3**.

Table 3 Primary criteria, secondary criteria, and indicators from NGT & ADT

Primary criteria	No. of secondary criteria	No. of KPIs
A: Services in office	4	13
B: Public services	4	23
C: Organization management	4	19
D: Monetary and fiscal operation	4	17
E: Good governance	6	21

Analysis of KPIs

After preparing the questionnaire by grouping the extracted indicators, the authors ask the 200 municipality administrators to respond in appropriateness, congruence, and content validity of the KPIs for competency assessment of the municipality's operation. The collected data were analyzed by confirmatory factor analysis in particular Bartlett's Test of Sphericity. If the significance value is lower than 0.05 this means KPIs in each part are related together by indexing of the secondary criteria and KPIs as 1-digit and 2-digit respectively.

The **Figures 2 - 6** display the components in each indicator. The solid line shows secondary criteria and the dashed line shows those excluded in that component.

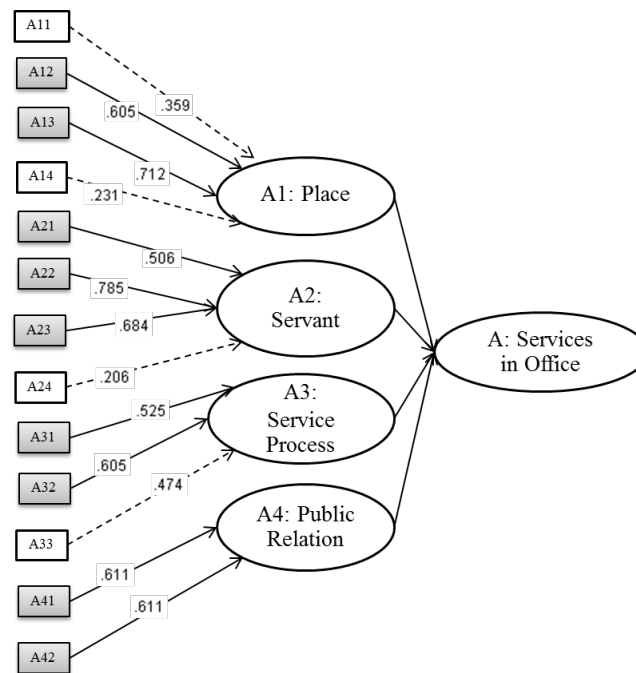


Figure 2 Results of the analysis of services in the office.

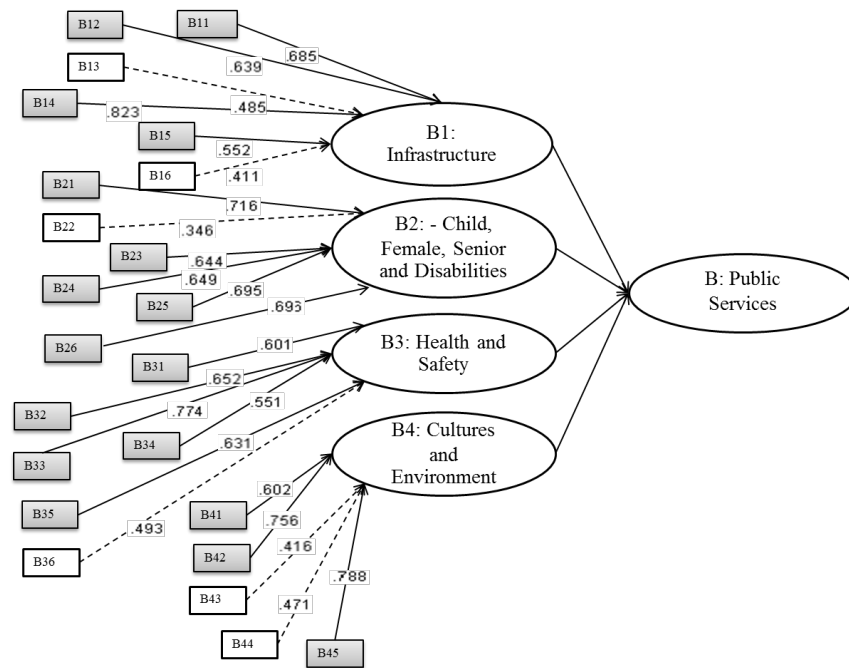


Figure 3 Results of analysis in public services.

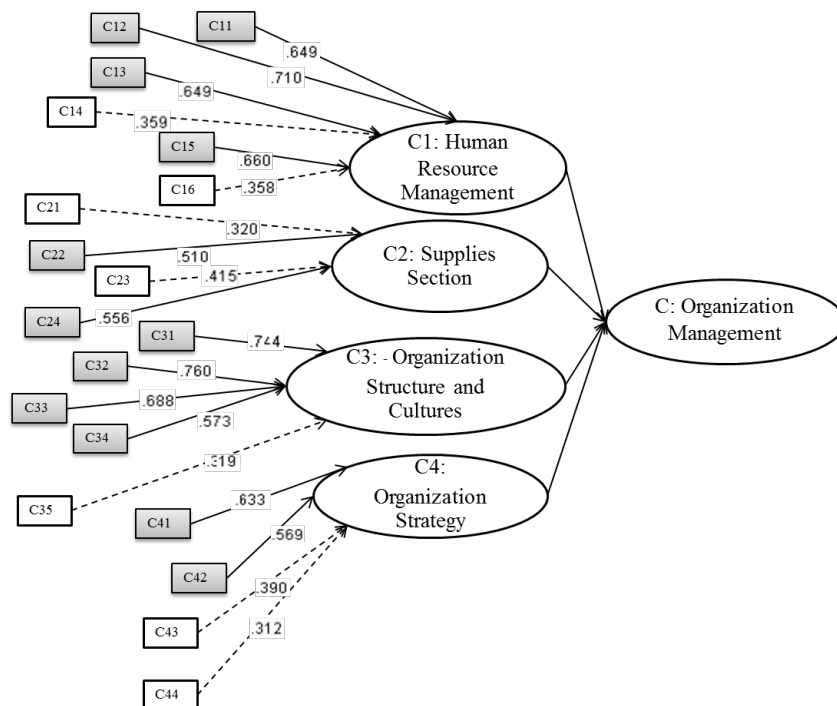


Figure 4 Results of analysis in organization management.

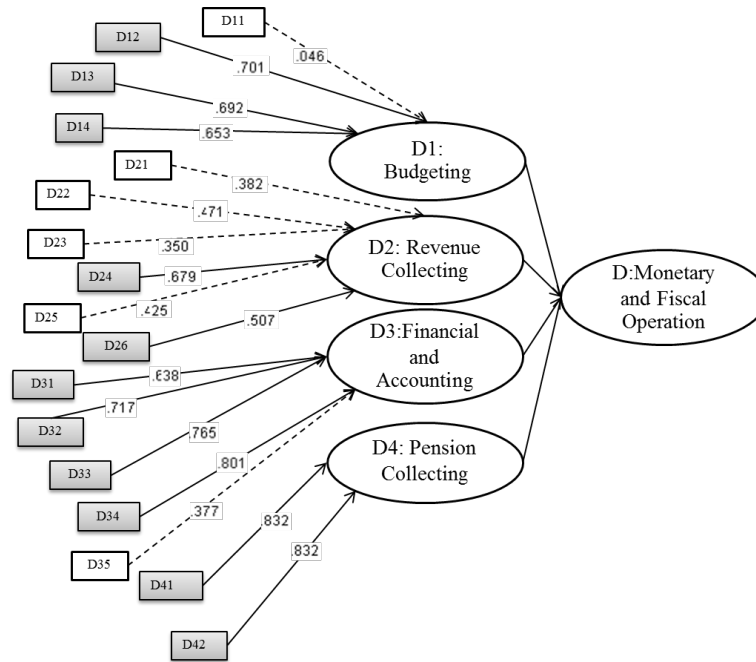


Figure 5 Results of analysis in monetary and fiscal operation.

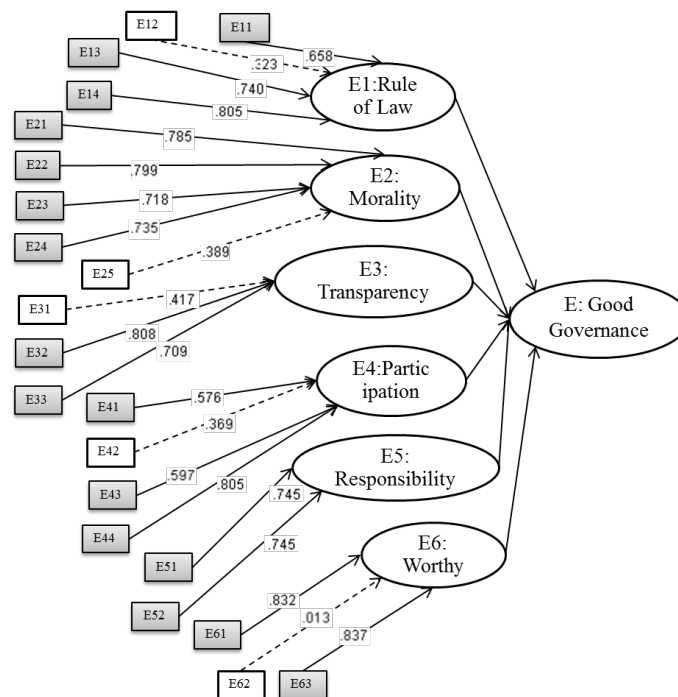


Figure 6 Results of analysis in good governance.

In summary, from **Figures 2 - 6**, there are a total of 93 KPIs revealed by 65 items. They were employed in the priority assessment process.

Priority assessment of KPIs by analytical hierarchy process

Obtaining the KPIs from the secondary criteria, the questionnaire was prepared for experienced professionals to discuss for weighting based on the priority assessment process. Pairwise comparison was used by first considering the primary criteria and then comparing with the secondary criteria. Expert Choice software was used. The Consistency Index is considered to be not over 0.1 and priority weight of the primary and secondary criteria are shown in **Table 4**.

Table 4 Priority weight of primary and secondary criteria by an analytical hierarchy process.

Primary criteria	Secondary criteria
A : Services in Office (0.18)	A1 - Place (0.17) A2 - Servant (0.32) A3 - Service Process (0.37) A4 - Public Relation (0.14)
B : Public Services (0.22)	B1 - Infrastructure (0.21) B2 - Child, Female, Senior and Disabilities (0.29) B3 - Health and Safety (0.28) B4 - Cultures and Environment (0.22)
C: Organization Management (0.19)	C1 - Human Resource Management (0.29) C2 - Supplies Section(0.21) C3 - Organization Structure and Cultures (0.24) C4 - Organization Strategy (0.26)
D : Monetary And Fiscal Operation (0.21)	D1 - Budgeting (0.30) D2 - Revenue Collecting (0.34) D3 - Financial and Accounting Management (0.28) D4 - Pension Collecting (0.08)
E : Good Governance (0.20)	E1 - Rule of Law (0.11) E2 - Morality (0.17) E3 - Transparency (0.24) E4 - Participation (0.23) E5 - Responsibility (0.15) E6 - Worthy (0.10)

Then, the professionals assessed the weight of each indicator for each group in the secondary criteria as shown in **Table 5**.

Table 5 Weight and cumulative weight on priority of KPIs by an Analytical Hierarchy Process.

No.	KPIs	Weight on priority (%)	Cumulative weight on priority (%)
1	A 3.2 Working Process Reduction	3.93	3.93
2	D 2.4 Increase Rate of Taxpayers	3.71	7.64
3	A 2.1 Service staff qualification	3.51	11.15
4	C 4.1 Religion nourishment	3.46	14.61
5	D 2.6 Tax collectionratio	3.43	18.04
6	E 3.2 Monitoring by the citizens	2.78	20.82
7	A 3.1 Service procedure	2.73	23.55
8	C 1.5 Human resource management strategy	2.37	25.92
9	B 1.1 Road and footpath construction	2.36	28.28
10	D 1.4 Income and expense accounts	2.21	30.49
11	B 2.3 Older person care	2.17	32.66
12	D 1.3 Disbursement control	2.14	34.80
13	E 5.1 Mission responsibility	2.10	36.90
14	C 2.4 Office supplies control	2.07	38.97
15	C 1.2 Human resource development	2.04	41.01
16	B 4.2 Art and culture promotion	2.03	43.04
17	E 3.3 Monitoring by other agencies	2.02	45.06
18	B 2.4 Disadvantaged aid	1.98	47.04
19	D 1.2 Documents control	1.95	48.99
20	B 4.5 Environmental conservation	1.94	50.93
21	E 4.1 Public participation	1.93	52.86
22	C 2.2 Office supplies checking	1.92	54.78
23	A 2.3 Service staff quantity	1.90	56.68
24	D 3.2 Completeness of taxation	1.88	58.56
25	C 3.3 Learning organization creating	1.82	60.38
26	A 4.2 Complaint receive system	1.76	62.14
27	B 3.2 Sports promotion	1.72	63.86
28	B 3.4 Public health information promotion	1.72	65.58
29	D 3.3 Ability of taxation	1.71	67.29
30	D 3.1 Taxpayers information	1.71	69.00
31	A 1.3 Facilities for visitors	1.68	70.68
32	B 3.5 Public disaster prevention and mitigation	1.66	72.34
33	C 3.2 Organization standard	1.64	73.98
34	B 1.5 Water resource management	1.62	75.60
35	C 4.2 Organization problem analysis	1.48	77.08
36	E 4.3 Public suggestion management	1.38	78.46
37	A 1.2 Facilities for the public	1.38	79.84
38	E 2.1 Moral principles standard	1.36	81.20
39	E 4.4 Citizens activity promotion	1.29	82.49
40	B 2.6 Vocation promotion	1.28	83.77
41	E 2.2 Moral activity	1.22	84.99
42	E 6.3 Personnel cost	1.12	86.11
43	E 5.2 Policy responsibility	0.91	87.02
44	E 6.1 Procurement budget	0.88	87.90
45	E 1.1 Local regulation	0.88	88.78
46	B 4.1 Religion nourishment	0.87	89.65
47	D 4.1 Public fund management	0.84	90.49

No.	KPIs	Weight on priority (%)	Cumulative weight on priority (%)
48	D 4.2 Public fund accounting	0.84	91.33
49	C 3.1 Organization structure	0.82	92.15
50	A 4.1 Public relations system	0.76	92.91
51	E 1.4 Performance monitoring	0.70	93.61
52	E 1.3 Personnel regulation	0.62	94.23
53	D 3.4 Tax accounting	0.59	94.82
54	C 1.1 Human resource development planning	0.55	95.37
55	C 1.3 Workforce planning	0.55	95.92
56	B 3.3 Public health activity	0.55	96.47
57	E 2.3 Transparency of budget allocation	0.54	97.01
58	B 2.5 Woman development	0.51	97.52
59	B 3.1 Sports administration	0.49	98.01
60	B 2.1 Child and youth development planning	0.45	98.46
61	B 1.4 Water drain system planning	0.37	98.83
62	A 2.2 Service standards	0.35	99.18
63	B 1.2 Road and footpath maintenance	0.28	99.46
64	E 2.4 Decision styles of executives	0.27	99.73
65	C 3.4 Organization's Culture	0.27	100.00

Results in selection of KPIs on priority process by Pareto concept

All KPIs were weighted, then each weight multiplied by the weight of the primary and secondary criteria. Priority weights were compared for all 65 KPIs in percentage. The weights were rearranged from high to low and cumulative weights are shown in **Table 5**. **Figure 7** shows the relationship between the weight and cumulative weight on the priority of KPIs following the Pareto concept.

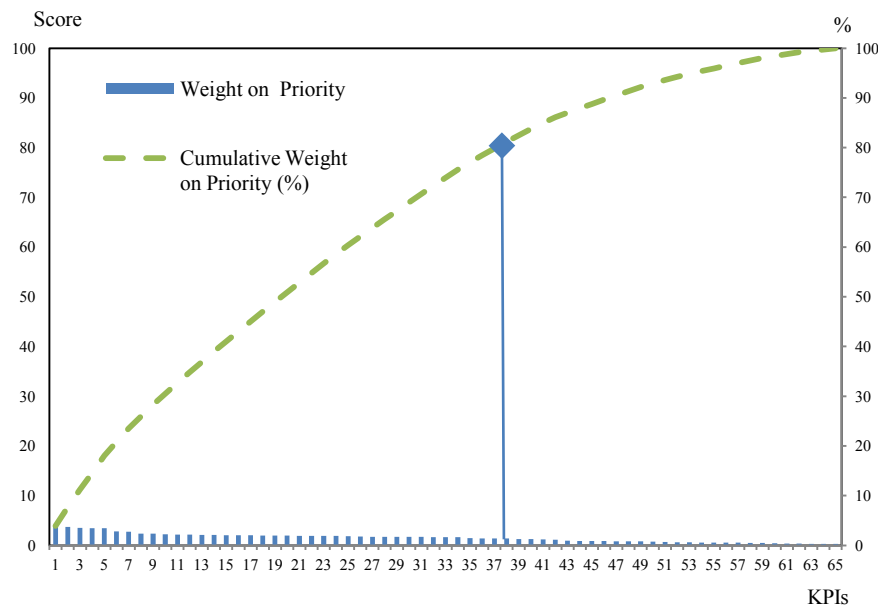


Figure 7 Selection of KPIs from the Pareto concept.

From **Figure 7**, it found that the first 80 percent priority KPIs are numbers 1 to 38. These KPIs are used to assess the competency of the municipality.

Discussion

This research used the priority order method beginning with the NGT and ADT for gathering and grouping KPIs that could reduce the duplicated KPIs from 487 to 93 (reduction 80 %). This result is similar to the research by Phumikhom [1] which reduced the KPIs to 65 %. Furthermore, after analysis of the confirmation factor, the researcher cut some KPIs that were not the factor off. This was similar to the research of Thummaseang [2]. The result left proper KPIs that can be used for efficiency analysis. However, in performance analysis of local government operation for potential improvement, the priority order is necessary. Then the researcher specified the weight of KPIs by the AHP method and use Pareto concept for cutting the less important KPIs out. This resulted in efficiency and economic analysis of the performance which is similar to the result in Unthaisong [6] research.

Conclusions and suggestions

Conclusions

The present study begins with an investigation of particular indicators related with competency assessment at municipalities. Moreover, the relevant tools and methods in decision and priority assessment are mentioned. From reviewing many scholar sources, the criteria of competency can be classified into 5 parts. The symbols for each criteria are Service in Office (A), Public Services (B), Organization Management (C), Monetary and Fiscal Operation (D), and Good Governance (E). All data were analyzed by the NGT and ADT. There are 93 KPIs which are able to prepare a questionnaire. The questionnaire was then evaluated by 200 administrators in the municipality office. The respondents considered appropriateness, congruence, and content validity. Confirmatory factor analysis by Bartlett's Test of Sphericity found that there are 65 KPIs revealing competency from a total of 93 KPIs. Next, experienced professionals were invited to evaluate the priority weight of the KPIs following an analytical hierarchy process. After taking Pairwise Comparisons, and using the Expert Choice software program a comparison of primary criteria, secondary criteria and indicators respectively was achieved.

To multiply each weight indicator with a primary and secondary factor loading, it is able to compare the weight on priority for all 65 KPIs. The priority weight and cumulative weight on priority were employed for analysis following the Pareto concept. It found that only 38 KPIs are needed to assess competency of performance by a municipality.

Suggestion

With data collection in the same place and cultures, problems due to generalization with other municipality offices may occur. In fact, all KPIs reviewed from scholar sources which do not vary on different geography and culture. It implies that the findings in the present research are applicable in different contexts. By particular study, it can conclude the strength of it as the following given.

- 1) Multi-stages used in this study confirms the appropriateness and worthy of extracted KPIs.
- 2) This study is able to solve the problem in pair comparison of a hierarchical data or AHP. In fact, in general decision making, it is not in the form of hierarchy.
- 3) To compare the priority of each criteria based on the effects so that it comes close to a human decision.
- 4) All KPIs are from target respondents and are therefore objective.
- 5) Multi-stages in the analytical procedure are useful for further implementation.

Additionally, this study has found some recommendation as described below.

- 1) Using both questionnaire and interview to compare the priority of each criteria may cause confusion for respondents giving incorrect answers.
- 2) In weighting, the respondents may not familiar with the given scale so that the error can be traced.
- 3) To gather data effectively, the respondents must be a person who is involved in the decision process within the organization. Because of experience in a particular responsibility reflects on the KPIs

used for decision. It helps to develop KPIs in the future. Also, the assessment tool will be improved gradually.

4) The sufficiency sample size provides consistency and advantaged contribution.

5) In real practice, to analyze using the AHP does not reveal a hierarchical structure. This is because each level of the component may relate with the higher or lower hierarchy. It is limited for AHP. However, the Analytic Network Process (ANP) should be used because ANP concerns the relationship among hierarchy, and is very helpful to eliminate the particular problem as well.

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