



Implementation of Analytic Network Process Method for Decision Support System on Library Services Quality Assurance Based on ISO 9001

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Abstract — This research proposes a model that combines Quality Management System (QMS) ISO 9001:2015 approach and Analytic Network Process method. Implementation of QMS is required to provide services oriented on customer needs that determination of Service aspect prioritization is required. The input data for Decision Support System of Library Services Quality Assurance which has been developed based on the seven principle of ISO 9001:2015 that is divided into twenty-two criteria. The input data obtained from the questionnaire related to the comparison of twenty-two criteria aspects of library services. The data is processed using ANP method to obtain priority of service aspect improvement. The process consist of : entering the criteria data into database of the system, create pairwise comparison matrix, calculate weight of the criteria, test the consistency ratio, calculate the supermatrix and rankings for each criteria that represent the priority aspects of service. Ranking from each aspect of the service is then displayed on system dashboard to simplify users to view the information. From the system which has been built found that the Procedure criteria gain highest rating thus need to prioritize for immediate evaluation and improvement action. In addition, this information system also found that Decision making based on evidence principle gain highest ranking among the seven principles of ISO 9001:2015 that made top priority in quality management of library services.

Keywords— Analytic Network Process; ISO 9001; Decision Support System; Library services; Quality Assurance

I. INTRODUCTION

In the service era, quality has become an unquestionable value for organisations. Thus the ability to respond to the varied needs and expectations of customers may be an important factor governing the very survival of the organisation. Whether in the public or in the private sector, libraries are service organisations and, as such, they exist in dynamic environments where users are increasingly demanding. This also poses challenges to the management of the library: a systematic approach is needed and one way to meet this challenge is to adopt a quality management system. ISO 9001 is one of the possible ways to manage quality in an organization, which is emphasizing the continuing improvement of services, or a process oriented. ISO 9001 is a generic standard which can be applied to all types of organisations within all sectors [1]. Moreover, the fact that the ISO 9001 standard has been widely used and adopted by more than one million organizations worldwide [2].

According to Arora [3], library is the heart of the academic setup. Therefore, the library's role is very important and to be a good library in terms of efficiently resources management. It is highly recommended to control their quality of services. ISO 9000, as international standard used by worldwide companies, is used to ensure that their quality assurance system is in place and effective. Conformances to ISO 9000 standards bring the guarantee that organization delivers qualified products and services [4]. Researchers used different methods to ensure quality of service to customers. Che Azlan Taib [5] used factor analysis and Cronbach's alpha. Danuta A Nitecki and Peter Hernon [6] adopted Gaps Model of Service Quality using SERVQUAL. Priority aspects of library services is multi-criteria decision problem. This paper proposed a three-level index system which consists of 7 cluster and 22 criteria.



Investigation showed that the criteria are interrelated. Analytical Network Process (ANP) is a method introduced by Professor Thomas L. Saaty can show the relationship between elements with a similar network structure, which analyzes the interdependence relationship between criteria and its influence on the final goal more accurately. Thus, model presented in this paper is based on ANP and ISO 9001 since this methodology can accommodate the complex interrelationship among factors affecting prioritizing service using seven principles of ISO as a cluster of library service quality management.

II. QUALITY ASSURANCE OF LIBRARY SERVICES BASED ON ISO 9001

A. QUALITY ASSURANCE OF LIBRARY SERVICES

Libraries are service organizations and as such. They exist in dynamic environments where supervision of the users seems to become evermore difficult to meet. Thus, the library, as a service provider, is not only focusing on the quality of service but also on the ability to move forward and adapt to the management of quality. It must meet the expectations of customers who govern the survival of an organization. To meet these challenges, it is recommended that the organization should apply certain quality management system or enforce on a quality assurance [5]. Organizations can use varied approaches to develop these efforts. Generally, quality assurance is known as a systematic method or process to monitor and evaluate a service or product. Quality assurance is also recognized as all those planned and systematic action, such as policies, action, attitudes, measuring tool for evaluation, and procedures that are necessary to provide adequate confidence that quality is being maintained and enhanced, and product or service meets the specified quality standard. The organization management plays the important role in deciding the quality assurance policies and objectives. Therefore, once this policy and objective are in place, it can be said that the quality assurance procedures have been implemented.

B. ISO 9001

The implementation of ISO 9001 quality standard in the business environment has become increasingly widespread and it has led to a growing number of commercial information services being managed according to this standard [1]. ISO 9001 is also slowly being adopted by the public sector and also here it is already possible to find libraries and information services that are adhering to its stipulations. ISO 9001 is generic, which means the same standard can be applied to a variety of organizations including libraries.

C. LIBRARY SERVICES BASED ON ISO 9001

Quality Management as a whole to put quality at the center of all activity and begin the process of changing to rearrange the mission, organizational culture and work practices in order to achieve continuous quality improvement. Quality Management of library services based on seven principles of ISO 9001 as follows:

1) CUSTOMER FOCUS

If a library no customers, then the library would have no meaning. Therefore, the library must understand what the needs of our customers and strive to be able to fulfill it. There are five laws of library science is used as the basis of the principles of customer focus as follows: First, the book is to be used. Second, there is every reader his book. Third, there are each book readers. Fourth, save time readers. Fifth, the library is a living organization.

2) LEADERSHIP

Library leaders must set the direction and unity of purpose of the library, create and maintain the internal environment for people to be fully involved in achieving the goals and objectives of the library has been determined. Leadership is reflected in the commitment of management or leadership and active participation they establish good communication and provide the necessary resources.

3) ENGAGEMENT OF PEOPLE

The involvement of human resources is the key to the achievement of the library. Good library management is the management of human resources, relying on human resources which are at the core of the library. Human resources need to be involved and trained to have skills that will be utilized in the interests of achieving the purpose of the library.

4) PROCESS APPROACH

The process is a combination of sequential methods, people, materials, machines and equipment in an environment to generate added value for customers. In order for the library activities are effective and can achieve the desired results, then the library needs to identify and manage a large number of activities that are related to each other.

5) IMPROVEMENT

Improvement of the overall performance of the library should be a permanent goal of the library. Repair is meant is a process that focuses on the ongoing effort to improve the effectiveness and efficiency of the library to meet the policy and objectives of the library.

Continuous Improvement requires consolidation measures in response and address the growing needs and expectations of customers, it also ensures a dynamic process that can inculcate the culture of quality in the library through quality management systems. To perform continuous performance improvement is risk-based thinking is needed to detect errors early so do the continual improvement of the processes carried out in the library. Therefore we need the participation and commitment of all the staff and management of the library for monitoring and process improvement.

6) EVIDENCE-BASED DECISION MAKING

An effective policy decisions based on the analysis of data and information to address the root causes. Therefore, the point of and collection of data and information for the benefit analysis should be done with discipline so that the quality of data and information collected can be guaranteed.

7) RELATIONSHIP MANAGEMENT

Libraries have to establish a good relationship and mutual benefit with the suppliers. Supplier is meant book publishers, bookstores, and vendor information.

III. INDEX SYSTEM

Based on the seven principles of ISO above, aspects of library services can be analyzed and clustered as follows:

TABLE I - ASPECTS OF LIBRARY SERVICES

GOAL	CLUSTERS	CRITERIA
PRIORITY ASPECTS OF LIBRARY SERVICES TO ENSURE QUALITY OF SERVICE	CUSTOMER FOCUS	REQUIREMENTS
		SERVICE TIME
		COST OF SERVICE
		PRODUCT SPECIFICATIONS TYPE OF SERVICE
		COMPLAINT HANDLING SUGGESTIONS AND FEEDBACK
		FACILITIES AND INFRASTRUCTURE LIBRARY
	LEADERSHIP	SERVICE ANNOUNCEMENTS
		THE VISION AND MISSION OF THE LIBRARY
		EMPOWERMENT LIBRARY STAFF
		DEVELOPMENT OF LIBRARY
	ENGAGEMENT OF PEOPLE	LIBRARIAN COMPETENCE
		LIBRARIAN BEHAVIOR
		MAIN TASKS AND FUNCTIONS OF LIBRARIAN
	PROCESS APPROACH	PROCEDURE
		SUPERVISION LIBRARY
	IMPROVEMENT	MEASURING TOOL FOR EVALUATION
		CONTINUAL IMPROVEMENT
	EVIDENCE-BASED DECISION MAKING	COLLECTION OF INFORMATION
		DATA ACCESS
		DATA ANALYSIS
RELATIONSHIP MANAGEMENT	SUPPLIERS OF BOOKS	
	RESOURCE OPTIMIZATION	

IV. ANALYTIC NETWORK PROCESS (ANP)

The Analytic Network Process (ANP) method is a mathematical theory that allows for a decision maker faced systematic feedback and factors are interrelated and generalizes on the supermatrix approach. It allows interactions and feedback within clusters (inner dependence) and between clusters (outer dependence) [9]. The feedback network can be seen as follows:

In the feedback network, the elements can be dependent or attached to components such as the network hierarchy but also can depend on each other elements. Furthermore, an element can depend on other elements that exist within a component. In Figure 1 described, a line of components C4 to C2 and C3 indicate a relationship between elements in the C4 components against the elements that exist in the C2 components or can be called also outer dependence. While the line rotation in the component shows a connection element in a component called the inner dependence. Priority of library services is a multi-criteria decision problem.

ANP method can show the relationship between elements with a similar network structure, which analyzes the interdependence relationship between criteria and its influence on the final goal more accurately [8]. Therefore, this paper selects ANP as study method.

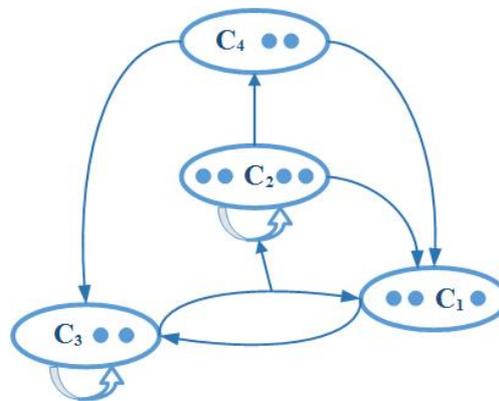


Fig. 1 The feedback network

There are eight stages in the decision making to selecting priorities of service quality aspects using ANP method. These stages can be seen in Figure 2.

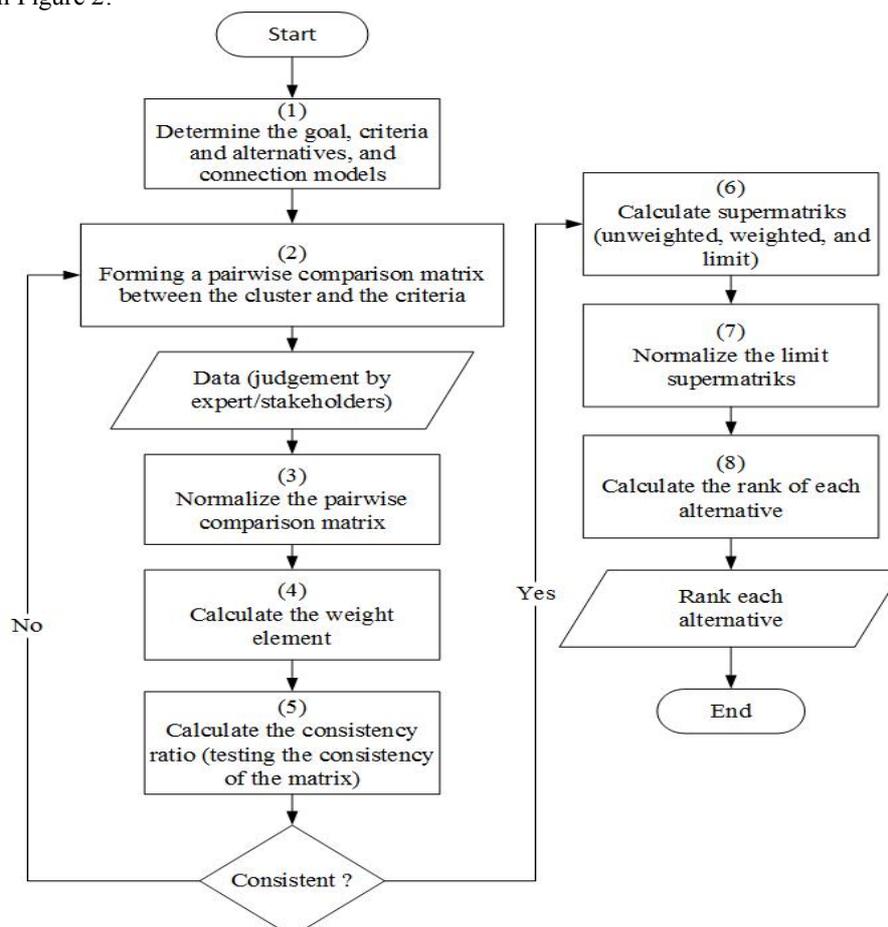


Fig. 2 The algorithm of ANP method

1. DETERMINE THE GOAL, CRITERIA AND ALTERNATIVES

Determining the desired goals or objectives, criteria referring to the control criterion, and determining an alternative option. If there are elements that have similar qualities then grouped into a same component, as shown in Figure 1.

2. FORMING A PAIRWISE COMPARISON MATRIX

ANP method assumes that the decision maker must make a comparison between the interests of all elements for each level in the form of pairs. If there are n elements then the comparison is a comparison matrix $n \times n$. Therefore, the number of votes needed to create the matrix is $\frac{n(n-1)}{2}$. Scale used in the assessment is 1-9. The comparison is transformed into the form of a matrix A . Value α_{ij} represents the relative importance of the elements in row i of the element in the column j (i.e., $\alpha_{ij} = \frac{w_i}{w_j}$). Data obtained in the pairwise comparison matrix formulated as follows:

$$A = \begin{bmatrix} \frac{w_1}{w_1} & \frac{w_1}{w_2} & \dots & \frac{w_1}{w_n} \\ \frac{w_2}{w_1} & \frac{w_2}{w_2} & \dots & \frac{w_2}{w_n} \\ \frac{w_3}{w_1} & \frac{w_3}{w_2} & \dots & \frac{w_3}{w_n} \\ \vdots & \dots & \dots & \vdots \\ \frac{w_n}{w_1} & \frac{w_n}{w_2} & \dots & \frac{w_n}{w_n} \end{bmatrix} = \begin{bmatrix} 1 & \alpha_{12} & \dots & \alpha_{1n} \\ \alpha_{21} & 1 & \dots & \alpha_{2n} \\ \vdots & \dots & \dots & \vdots \\ \alpha_{n1} & \alpha_{n2} & \dots & 1 \end{bmatrix}$$

3. NORMALIZE THE PAIRWISE COMPARISON MATRIX

After the formation of the cluster comparison matrix is completed, then proceed with normalizing the comparison matrix by dividing each value in the column with a total value of each column so that the sum of each column is 1.

4. CALCULATE THE WEIGHT ELEMENT

Weighting element is calculated through two processes. First, calculate the vector row, row vector is calculated by calculating the total value of each row of the matrix that has been previously normalized. Second, calculate the value of eigenvectors. Eigenvectors calculated by dividing the value of the row vector with the number of elements

5. TEST THE CONSISTENCY RATIO (CR)

There are three stages in measuring the consistency of a pairwise comparison matrix. First, calculate the largest eigenvalue (λ_{max}). The largest eigenvalue calculated by multiplying the value of eigenvectors with pairwise comparison matrix, then the result of multiplying the amount calculated for each row. After that, perform the calculations to obtain eigenvalues. The eigenvalues calculated by dividing the total number of each row with eigenvector. After eigenvalues obtained, then perform calculations to get the total of eigenvalues, then divide the total by the number of elements. In this condition, the largest eigenvalue has been obtained. Second, calculate the consistency index by performing formula $(\lambda_{max} - n)/(n-1)$, where n is the number of elements. The last one is calculate the consistency ratio by dividing the value of consistency index with Random Index (RI). The value of RI varies greatly adjust the size of the matrix used. The random index value can be seen in Table II [7].

6. CALCULATE THE SUPERMATRIX

Supermatrix compiled using eigenvectors value of the results of pairwise comparisons between clusters, criteria and alternatives. Supermatrix formation consists of three types. The first is unweighted supermatrix, this supermatriks formed using eigenvectors value of pairwise comparison matrix between the criteria by entering eigenvectors into columns suitable matrix. Second one is weighted supermatrix, this supermatriks formed by multiplying each column value in unweighted supermatrix by the value of each column of the cluster matrix. Matrix cluster is a matrix formed of eigenvectors of the comparison of the cluster. The last one is limit supermatriks, this supermatrix formed by multiplying the value of each column of supermatriks weighted with itself, until the value of a column on each row to be a convergent.

7. NORMALIZE THE LIMIT SUPERMATRIKS

After calculating the limit supermatrix completed, then proceed with normalizing the limit supermatrix by dividing each value in the column with a total value of each column so that the sum of each column is 1.

8. CALCULATE RANK OF EACH ALTERNATIVE

The final stage of implementation of the ANP method is rank on each criterion by calculating the final weight of each of these criteria. There are three kinds of weights calculated that raw weight, normal weight and ideal weight. Weight of raw calculated by summing each row supermatriks limit that has been normalized, normal weight is calculated by dividing the value of the weight of raw with a number of criteria, and the ideal weight is calculated by dividing the value of normal weight with highest values of normal weight, so that the highest weight of ideal weight is 1.

TABLE II - RANDOM INDEX

MATRIX SISE	INDEX
1	0
2	0
3	0.5247
4	0.8816
5	1.1086
6	1.2479
7	1.3417
8	1.4057
9	1.4499
10	1.4854
11	1.514
12	1.5365
13	1.5551
14	1.5713
15	1.5838
16	1.5978
17	1.6086
18	1.6181
19	1.6265
20	1.6341
21	1.6409
22	1.647
23	1.6526
24	1.6577
25	1.6624
26	1.6667
27	1.6706
28	1.6743
29	1.6777
30	1.6809
31	1.6839
32	1.6867
33	1.6893
34	1.6917
35	1.694
36	1.6962
37	1.6982
38	1.7002
39	1.702

The data used in this study was obtained from the Central Library of Islamic University of Indonesia in Yogyakarta through questionnaires. In this research, the weight of the procedure is 0.1440 (14.40%), this suggests that the procedure is the most ideal criteria and must be prioritized to ensure the quality of library services and provide excellent service to library users. The data access criteria with weights 0.1330 (13.30%) came second after the procedure library. Detailed research results can be seen in Table III and Table IV.

TABLE III - GLOBAL AND LOCAL WEIGHT

CLUSTER	CLUSTER WEIGHT (GLOBAL)	CRITERIA	CRITERIA WEIGHT (LOKAL)
Customer Focus	15.75%	Requirements	0.53%
		Service time	1.85%
		Cost of service	0.30%
		Product specifications type of service	2.48%
		Complaint handling suggestions and feedback	4.85%
		Facilities and infrastructure library	5.74%
Leadership	7.85%	Service announcements	0.59%
		The vision and mission of the library	2.17%
		Empowerment of library staff	2.93%
		Development of library	2.16%
Engagement of People	6.56%	Executive competence	2.70%
		Executive behavior	1.71%
		Main tasks and functions of people	2.15%
Process Approach	20.63%	Procedure	14.40%
		Supervision library	6.23%
Improvement	13.30%	Measuring tool for evaluation	3.45%
		Continual improvement	9.85%
Evidence-based Decision Making	31.82%	Collection of information	9.13%
		Data access	13.30%
		Data analysis	9.40%
Relationship Management	4.08%	Suppliers of books	0.66%
		Resource optimization	3.42%

TABLE IV - THE RANKING OF EACH ELEMENTS

CRITERIA	WEIGHT	PERCENTAGE	RANKING
Procedure	0.14405	14.40%	1
Data access	0.13297	13.30%	2
Continual improvement	0.09851	9.85%	3
Data analysis	0.09401	9.40%	4
Collection of information	0.09125	9.13%	5
Supervision library	0.06226	6.23%	6
Facilities and infrastructure library	0.05744	5.74%	7
Complaint handling suggestions and feedback	0.04847	4.85%	8
Measuring tool for evaluation	0.03452	3.45%	9
Resource optimization	0.0342	3.42%	10
Empowerment of library staff	0.02932	2.93%	11
Executive competence	0.02702	2.70%	12
Product specifications type of service	0.02479	2.48%	13
The vision and mission of the library	0.02166	2.17%	14

Development of library	0.02158	2.16%	15
Main tasks and functions of people	0.02145	2.15%	16
Service time	0.01849	1.85%	17
Executive behavior	0.01714	1.71%	18
Suppliers of books	0.00664	0.66%	19
Service announcements	0.00592	0.59%	20
Requirements	0.0053	0.53%	21
Cost of service	0.00301	0.30%	22

V. CONCLUSION

Analytic Network Process (ANP) method can be applied to a decision support system in determining the priorities of library services with seven clusters using ISO 9001 principles are customer focus, leadership, involvement of personnel, process approach, improvement, evidence-based decision making, and relationship management. The proposed model indicates that different assessment criteria related to library services based on ISO 9001 can be consolidated with the ANP approach. The results of the analysis using method ANP indicates that the procedure is a criterion must be prioritized in order to ensure the quality of library services. The results also showed that of the seven principles iso, evidence-based decision making is the quality management principles in the library that should be prioritized.

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