

User Requirements Analysis For Digital Library Application Using *Quality Function Deployment*.

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Abstract

This study attempt to build Smart Digital Library to be used by the wider community wherever they are. The system is built in the form of Smart Digital Library portal which uses semantic similarity method (Semantic Similarity) to search journals, articles or books by title or author name. This method is also used to determine the recommended books to be read by visitors of Smart Digital Library based on testimony from a previous reader automatically. Steps being taken in the development of Smart Digital Library system is the analysis phase, design phase, testing and implementation phase. At this stage of the analysis using WebQual for the preparation of the instruments to be distributed to the respondents and the data obtained from the respondents will be processed using Quality Function Deployment. In the analysis phase has the purpose of identifying consumer needs and technical requirements. The analysis was performed to a digital library on the web digital library Gunadarma University, Bogor Institute of Agriculture, University of Indonesia, etc. The questionnaire was distributed to 200 respondents. The research methodology begins with the collection of user requirements and analyse it using QFD. Application design is funded by the government through a program of Featured Universities Research by the Directorate General of Higher Education (DIKTI). Conclusions from this research are identified which include the Consumer Requirements of digital library application. The elements of the consumers requirements consists of 13 elements and 25 elements of Engineering Characteristics digital library requirements. Therefore the design of digital library applications that will be built, is designed according to the findings by eliminating features that are not needed by restaurant based on QFD House of Quality.

Keywords: systems analysis, applications design, smart digital library, quality function deployment.

1. Introduction

The main activity of the digital library is a data search resources in the form of books, journals or articles that represented by the title of each of these resources. When the authors determine the choice of terminology which represents the title is very influenced by the background knowledge and ability. Differences in knowledge and ability results in choosing terminology for titles of books, journals and articles that represent the contents of these writings. The use of different terminology does not mean that the contents of books, journals or articles are very different. This is because the two terms are semantically similar (have the same meaning) although lexically different. Therefore, the search method classic library of digital resources (keyword matching search-based) will fail to find resources that are semantically similar but lexically different. This failure is characterized by the irrelevance of the search results. This is exacerbated by the fact that the submitted query does not fairly represent the resource that people wants to find. Usually done by doing query repeatedly by changing the form of selection query terminology. The search method of digital library resources that can be automatically enriched by exploiting the semantic heterogeneity is very important to identify the terminology and broaden the search results. Some search techniques have been developed, such as full text search, metadata search, and search with semantic networks. Based on observations made on several digital library sites, search by title has not been made using techniques that based on common semantics search, using common semantics technique search will results of the scope of data will be obtained



wider, if using keyword based technique, to get the information it must be made multiple times query, because of the book's title can be expressed in terms that were different despite having a similarity of meaning. Examples of search with the keyword "Programming" actually has in common with the word "Coding" or "Making Program Code". So the search by considering the semantic can save queries made with a lot of or extensive data coverage.

In addition to standard digital library research facility, this research also trying to add a new function which is actually a function already exists in the online book store that is book recommendations. People can not see a good book based on the title of the book, sometimes the titles do not talk about the contents of the book. Testimony is included in the opinion mining or sentiment analysis, which is a process of understanding, extract and process the textual data automatically to get the sentiment of information contained in an opinion sentence. Turney research in 2002, namely the opinion mining by using data contains consumer reviews data on a product. The method used in this study is the semantic orientations using pointwise Mutual Information (SO-PMI)[17]. Sentiment analysis is a combination of text mining and natural processing. Several methods that can be used to solve the problem of opinion mining is Naive Bayes classifier (NBC). NBC used to classify the opinions into positive opinions and negative opinions. Another method that can be used is KNN Clustering, NN, KMean, and Support Vector Machine (SVM) Clustering. Usually the book will be a best seller after people read later testified against the book. Testimonials will give rise to the interest to read the book if the result is well worth the testimony or recommend that the book is a good read. In general recommendation made by testimonials for books or other products in the online or digital media library is only done by selecting from a few words that represent the testimony of each user or reader. Such conditions can not give users flexibility in expressing his opinion on a book or any other product as testimonials that do generally, which is a sentence not a word choice. The difficulty in measuring the ranking of a book based on testimony is the diversity of representation at the time of making the testimony by users even though the meaning of the testimony has the same meaning.

Ranking can also be done on the website of the hotel, resort, tourist attractions and others. Such websites usually provide features to provide recommendations on product reviews or just consumer reviews. As examples of websites that have the product review is www.amazon.com, www.download.com, www.yelp.com, Website yelp.com has a feature for users to give testimony to the product and then to a ranking done by giving a checklist on the asterisk, and its website amazon.com just to give you a checklist on the asterisk by it can not be known whether the product is the result of reading a book is good or bad. In this case it can be said that the lack of response or comment from the user, it could be when the user clicks or to cite a book, the book turned out to be not in accordance with what is expected or desired. Measurement rankings based on testimony can be done manually by a reviewer read testimonials. then classify it after that do the rankings, but this process requires substantial time, is expected to have a tool to automatically measure the rank of books or other products based on such testimony. Making a Smart Digital Library is expected to be very useful for readers to search information, where Smart Digital Library contains a title search based on common semantics (semantic similarity) and advice books are widely read by testimonials from readers of the book is done by looking at the similarities semantics.

Sample data for ranking the books based on testimonies by similarity semantic taken from a catalog of books on the website and also the physical book. For the analysis of digital library using the digital library websites Gunadarma University, Diponegoro University, University of Indonesia, Bogor Agriculture Institute and the Institute of Technology Surabaya. In some existing digital library on the websites of the digital library is still no automation on his widely read book recommendations based on testimonials from readers of the book is done by looking at the semantic similarity. So that needs to be developed Smart Digital Library using semantic similarity to his widely read book recommendations so that referrals can be more free in expressing their views through a series of words

forming testimony. Early stage to find out that the need for a recommendation based on testimony is by distributing questionnaires. Questionnaire deployment was conducted to see the user needs of the features that will be developed at this Smart Digital Library. Preparation of the questionnaire using WebQual and results of data processing using QFD.

2. Research objectives

Based on the issues raised, the purpose of this study is as follows:

1. To identify Consumer Requirements and Technical Requirements that are part of the Quality Function Deployment analysis as applied to Digital Library websites Gunadarma University, Diponegoro University, University of Indonesia, Bogor Agriculture Institute and the Institute of Technology Surabaya.
2. To find out what are the attributes that still require attention based on Quality Function Deployment analysis which has to be used and need to be eliminated in order to obtain a Digital Library applications that suit the needs of the user.

3. Literature review

3.1 Digital Library

Understanding digital libraries or Digital Library there are various opinions. Among that opinion is: as said by Hasibuan [1], a digital library or a digital library system is the concept of using the internet and information technology in library management. Meanwhile, according to Fahmi [2] says that the digital library is a system that consists of hardware (hardware) and software (software), strongly tipped electronic, management staff, users, organizations, working mechanism, as well as services by utilizing various types of information technology, Digital libraries can be grouped into several types as follows:

1. *Early digital libraries*
2. *Digital libraries of institutional publication*
3. *Digital libraries developments at national libraries*
4. *Digital libraries at Universities*
5. *Digital libraries of special materials*
6. *Digital libraries as research project*
7. *Digital libraries as Hybrid library project [3]*

Based on the definitions above that the digital library has basically 3 main characteristics as reviewed [4], namely:

1. Using technology that integrates the ability to create, find, and use information in various forms in a widespread network.
2. It has a collection that includes the data and metadata that mutual linking of data, both internal and external environment.
3. Is an activity to collect and organize digital resources developed together community service users to meet the information needs them. For the digital library is an integration of various institutions that select, collect, process, maintain, and provide information extends to various communities.

Some Reasons of the importance of digital libraries as follows:

1. *A digital Library bring information to the user*
 The digital library can be accessed anywhere. Digital libraries that deliver or bring the information to users whenever they need.
2. *Improved searching and manipulation of information*

The digital library offers a variety of ways of search and retrieval by providing electronic data bases making it easier for users to access information.

3. *Improved facilities for information sharing*

With digital collections, libraries provide convenience facilities for sharing information between users and between libraries. The digital library also opens opportunities and paves the way for cooperation with other libraries.

4. *Timely access to information*

The digital library help users get the latest information. The digital library allows to easily access informasiberseri (periodical collection) with digital publishing.

5. *Improved use of information*

The digital library no longer restricted by time, place, language, and culture, so it's easier use of the information. Diverse information from various parts of the world with different languages and different cultures facilitate search.

6. *Improved collaboration*

Research at the University of California shows that the digital library facilities capable of improving cooperation among users. This process will improve the dissemination and use of information.

7. *Reduction of the digital divide*

The presence of the Internet in the world have raised their gab / gap among nations in the world in terms of infrastructure, facilities and resources. The presence of a digital library that can minimize the gap. [3].

Some of the gains of digitalization is one of them is the speed sourcing. Library library should integrate the concept pencarian. Sehubungan with that libraries should take notice 6 (six) of the agreement as reviewed by Tedd and Large [4], namely:

1. Technical interoperability (technical agreements), the similarity in the use of procedures and mechanisms of hardware, software, communication protocols, transport of data, procedures for storage and indexing, and others.
2. Semantic interoperability (semantic agreement), the standard use of the term in indexing and retrieval.
3. Political / human interoperability (political agreement): the decision to share together and cooperate.
4. Intercommunity interoperability (agreement among the community of users): an agreement to assemble between institutions and diverse disciplines.
5. Legal interoperability (legal agreement) legislation on access to digital collections, including the matter of intellectual property rights.
6. International interoperability (International Agreements) standard that allows international cooperation, the possibility of other state agencies have the specifications, procedures, technical and legal. [5].

3.2 Quality Function Deployment (QFD)

Quality Function Deployment (QFD) was first developed in Japan in 1966 by Dr. Yoji Akao. Definition of QFD itself according to Dr. Yoji Akao is a method for transforming a request from the user into a quality design for spreading 'function forming quality' and deploy methods for achieving the design quality into the system, component parts, and the specific elements in the manufacturing process. Quality Function Deployment (QFD) is a systematic approach that determines the demand or consumer demand then accurately translate these demands into technical, manufacturing, and production planning right. With QFD, the company's operations is driven by the 'voice of the customer' and not by management commands or opinion / wishes of the experts. The use of QFD

focuses on the major causes of satisfaction as well as customer dissatisfaction, making it a useful tool for competitive analysis of product quality by management.

Quality Function Deployment (QFD) is a method of planning and development of products/services in a structured way that allows the development team clearly define needs and expectations and to evaluate the ability of a product or service in a systematic way to meet the needs and expectations [6]. QFD is a structured process or mechanism for determining customer needs and translating those needs into relevant technical requirements, which each functional area and level of the organization can understand and act [7]. Quality Function Deployment (QFD) is a method of planning and development in a structured way that allows the development team clearly define customer needs and expectations, and evaluating the ability of a product or service in a systematic way to meet the needs and expectations [8]. QFD is used to improve understanding of the customer and to develop products, services and processes in a way that is more oriented to the customer [9].

Based on the above definition, it can be concluded that the practice of QFD is to design a process in response to customer needs. QFD translate what the customer needs into what is produced by the organization. QFD enables organizations to prioritize the needs of customers, finding innovative responses to those needs and improve processes to achieve maximum effectiveness. QFD is also a leading practice process improvements that can enable organizations to exceed customer expectations. By definition, QFD is a practice to design a process in response to customer needs. QFD translates what the customer needs to be what the resulting organization. QFD enables organizations to prioritize the needs of customers, finding innovative responses to those needs, and improve processes to achieve maximum effectiveness. QFD is also a leading practice process improvements that can enable organizations to exceed customer expectations. The purpose of QFD themselves as much as possible not only meet customer expectations, but also to go beyond customer expectations as a way to compete, so expect consumers do not resist and did not complain but instead want it.

The main tool of QFD is a matrix [10], where the results achieved through the use of inter-departmental or functional teams to collect, Interpret, document and prioritize customer needs. The starting point (starting point) QFD is a customer and the wishes and needs of customers. In QFD this is called the "voice of the customer" (voice of the customer). QFD is the job of the team heard the voice of the customer. There are three main benefits obtained by the company when using QFD that is: 1. Reduce Costs: This can happen because the products are produced strictly according to customer needs and expectations of consumers so that there is no repetition of work and disposal of raw materials that do not conform to the specifications set by the consumer. Cost reduction can be achieved by a reduction in the purchase cost of raw materials, overheads or wage reduction and simplification of the production process. 2. Increase Revenue: With cost reductions, for the results that we receive will be increased. By QFD products or services produced will be better able to meet customer needs and expectations. 3. Reduce Production Time: QFD will make the product or service development team to focus on program development needs and expectations of consumers [8].

Other benefits derived from the application of this QFD also includes [11]:

- a. Focus on the customer (Customer focused) is to get input and feedback from customers regarding the needs and expectations of customers. This is important, because the performance of an organization can not be separated from customers.
- b. Efficient time (Time Efficient), by applying QFD, the development program will focus on the expectations and needs of customers.
- c. Orientation cooperation (Cooperations Oriented), QFD using a group-oriented approach. All decisions are based on consensus and the involvement of everyone in the discussion and decision-making.

- d. Orientation in the documentation (Documentation Oriented), QFD using data and documentation that shows the process of getting all the needs and expectations of customers. Data and documentation is used as information about the needs and expectations of customers are always repaired from time to time.

4.Methods

4.1 Research Design

This research is a case study, namely a depth and contextual analysis of the situation similar in other organizations, where the nature and definition of the problem that occurs is similar to that experienced in the current situation [12]. The data source preformance this study are derived from primary data and secondary data. In the analysis phase of the digital library web sites of data obtained from a digital library the University of Diponegoro (Diponegoro University), University of Indonesia (UI), Bogor Institute of Agriculture, etc.

4.2. Population, sample and sampling technique.

4.2.1. Population

The population is the entire group of people, events, things or objects of interest of researchers who want to investigate [12]. The population in this study is a digital library or digital library.

4.2.2. Sample

The sample is a portion of the population who want to study their characteristics and can be considered representative of the overall population [12]. The sample in this study is part of a digital library on the university digital library among which; library.gunadarma.ac.id, digilib.its.ac.id, digilib.unm.ac.id, digilib.uns.ac.id, digilib.unair.ac.id, digilib.ub.ac.id, digilib.unimed.ac.id, digilib.mercubuana.ac.id, lain-lain.

1.2.3. Sampling techniques

The sampling technique used in this study is simple random sampling. The sample size for this study is estimated at approximately 200 respondents by reason of the determination of the amount based on the opinions [13], that the sampling for the population that is not infinite and the unknown can be taken a sample of 100 people assuming normally distributed population. The total sample of 200 is reinforced by the opinions of Roscoe [12] which states that the number of samples is greater than 30 and less than 500 in most research is represented. Sampling was conducted using questionnaires distributed to users of digital libraries by simple random sampling. This study tries to analyze the quality of service Website Digital Library in order to determine the difference between the actual perception and ideal expectations as measured by the website users WebQual method approach. Instruments prepared by modifying and adding dimension to the three main dimensions, namely WebQual Information Quality, Service Interaction and Usability.

4.2.4. Data analysis methods

4.2.4.1. Descriptive analysis

Descriptive analysis was conducted to determine and be able to explain the characteristics of the variables examined in a situation or to understand the characteristics of organizations that follow certain common practices [12]. The purpose of this analysis is to give researchers a history or to

describe aspects that are relevant to the phenomenon of attention from the perspective of a person, organization, industry orientation, or other [12]. The descriptive analysis in this study is to describe the results of research on the design of smart digital library website which is the processing of the respondents using a questionnaire.

4.2.4.2. *Quality Function Deployment analysis*

Quality function deployment (QFD) is an important tool in product planning and development. It helps improve customer satisfaction and shortening product development lifecycle. Due to the fact that QFD is a team tool and assists group process, geographically distributed team members pose a challenging issue on the common practice and usage of QFD [14]. Quality Function Deployment is defined as a structured methodology that is used in the design and development of products to establish specification needs and desires of consumers, and systematically evaluate the capabilities of the product or service to meet the needs and desires of consumers [15]. Quality Function Deployment using matrix-shaped House of Quality, which is used to describe the needs and expectations of consumers and the company's technical ability to design and produce goods or services according to customer desires. Data were collected both primary and secondary processed through the following stages [16]:

5. Discussion

5.1. Characteristics of respondents

Based on the results of the questionnaire obtained distribution is the Library's digital information search by author, showed that 93% of respondents said require a search feature based on the author's name, while the remaining 7% did not need these features.

From the results of the questionnaire, it was found that respondents who need a search feature information by year published the book as much as 80% of respondents, while the remaining 20% do not need these features.

Comparisons between respondents who need a search feature information based on semantic similarity more requiring as many as 83% of respondents stated need, while the remaining 17% did not require a search feature information based on semantic similarity.

From the results of the questionnaire, it was found that respondents who need a feature space to give testimony, many of which require as many as 67% , while the remaining 33% do not need these features.

Comparisons between respondents who require features that provide information on the rating guide so that users know a good book to read based on the ranking of results than if the data shows that more that require as many as 60% of respondents stated need, while the remaining 40% do not need these features.

5.2. Analysis of the Quality Function Deployment House of Quality

Analysis of the Quality Function Deployment House of Quality has been done and has been through the stages as described in the research methodology, which is the stage of determining the attributes of a product by compiling product attributes based on priority (measured by assigning weights interests) that reflect the things that expected by the consumer / user of the product.

Analysis of Quality Function Deployment with the House of Quality that has been done has been through stages, ie the stage of determining product attributes by arranging product attributes based on priority (measured by assigning weights interest) which reflects the things expected by consumer / user of the product. Phase Project Objective conducted with due regard to the comparison of data performance and relatives importance index (weight factor) of product attributes; then we will be able to see opportunities improvements that can be done and set it as a goal to be met in the product design modification project (project objective). The results of the three stages can be seen in Table 1.

The next stage after the calculations obtained from table 1 is the stage of Engineering Characteristics (Technical Parameters). The next stage is the stage of Interaction Matrix that is the core of QFD. This stage is done by connecting the product attributes with their technical parameters. Such relations may be evaluated for each cell matrix, what kind of relationships that happen: a strong-strong (strong), weak (weak) or nothing to do. Results of phase Interaction Matrix can be seen in Table 2. The purpose of QFD is to measure what variables need to be built because of flaws in the digital library were observed and the results of questionnaires QFD which the user states require that its value is below 1. Based on calculations of the Matrix Interaction phase, it can be seen that there is a technical characteristic that has a value of priority in under 1 to be developed for the needs of the user.

Table 1. Product attributes, product evaluation (process benchmarking) and the stage of the project objective

	Questionnaire	Target	Imp.rate	RII	Weight	Weight(%)
Digital Library for completeness catalog	4	5	1,25	5	6,25	8
Digital Library for Accurate Information	4	5	1,25	5	6,25	8
Digital Library for timely information	4	5	1,25	4	5	7
Digital Library for information by category in the catalog	4	5	1,25	4	5	7
Digital Library to search menu information (books / articles / journals)	4	5	1,25	5	6,25	8
Digital Library to search by author	2	5	2,5	2	5	7
Digital Library to search by year of publication	1	5	5	2	10	14
Digital Library to search for information (books / articles / journals) by keyword	4	5	1,25	4	5	7
Digital Library to search for information (books / articles / journals) based on common sense	1	5	5	1	5	7
Digital Library for space opinion / testimony	1	5	5	1	5	7
Digital Library for ranking information of the book based on testimony	1	5	5	1	5	7
Digital Library for ranking information of the book based on testimony Digital Library to download (books / articles / journals)	4	5	1,25	4	5	7
Digital Library to print (books / articles / journals)	4	5	1,25	4	5	7

The Interaction Matrix phase can be seen in the following :

	Completeness of catalog (Books / Articles / Journal)	Categorization of the Catalog	Accurate information	Information can be trusted	Timely information	Relevant information	Information is easy to understand	Detail information	Information has accuracy format	menu Search	Search by keyword	Search by title	Search by author	Search by year	Search Based on the similarity of meaning	Forum community space	Space Opinion / Testimonials	Ranked book based on testimony	Recommended books / articles / journals	The latest book information	Processing speed download (download)	View information by category	Menu for download (books / articles / journals)	Menu to print (books / articles / journals)	Navigation
Digital Library for completeness catalog	●	●																							
Digital Library for Accurate Information			●	●		●	△	△	△																
Digital Library for timely information					●																				
Digital Library for information by category in the catalog	●	●																							
Digital Library to search menu information (books / articles / journals)										●		●										△		△	
Digital Library to search by author													▽											▽	
Digital Library to search by year of publication														▽										▽	
Digital Library to search for information (books / articles / journals) by keyword											●														
Digital Library to search for information (books / articles / journals) based on common sense															▽									▽	
Digital Library for space opinion / testimony																△	▽		▽	▽				▽	
Digital Library for ranking information of the book based on testimony																		▽	▽	▽				▽	
Digital Library for ranking information of the book based on testimony Digital Library to download (books / articles / journals)																				△			▽	▽	
Digital Library to print (books / articles / journals)																							▽	▽	

Figure 2. Interaction Matrix

Results of Interaction Matrix phase can be seen in the following table 2.

Table 2. Interaction Matrix Result

No	Engineering Characteristics (Technical Parameters)	Sum Scores	Priority (%)
1	Completeness of catalog (Books / Articles /	135	12,78
2	Categorization of the Catalog	135	12,78
3	Accurate information	72	6,82
4	Information can be trusted	72	6,82
5	Timely information	63	5,97
6	Relevant information	72	6,82
7	Information is easy to understand	24	2,27
8	Detail information	24	2,27
9	Information has accuracy format	24	2,27
10	menu Search	72	6,82
11	Search by keyword	63	5,97
12	Search by title	72	6,82
13	Search by author	7	0,66
14	Search by year	14	1,33
15	Search Based on the similarity of meaning	7	0,66
16	Forum community space	21	1,99
17	Space Opinion / Testimonials	7	0,66
18	Ranked book based on testimony	7	0,66
19	Recommended books / articles / journals	7	0,66
20	The latest book information	7	0,66
21	Processing speed download (download)	21	1,99
22	View information by category	24	2,27
23	Menu for download (books / articles /	7	0,66
24	Menu to print (books / articles / journals)	7	0,66
25	Navigation	92	8,71

Based on the calculation of the Matrix Interaction phase, obtained the technical characteristics that have priority values below 1 to be developed for the needs of users, namely; Search by author, search by similarity of meaning, space Opinion / Testimonials, rating books based on testimony, Recommended Books / articles / journals, information is the latest book, Menu for download (books / articles / journals), Menu to print (books / articles / journal).

6. Conclusions

- 6.1. The results of data processing using the Quality Function Deployment method has identified Consumer requirements including the need for a digital library. element of consumer needs consist of feature information search by title, name pegarang, and year by considering the similarity of meaning / semantics, room features opinions / testimonials, features books rankings based on the testimony.
- 6.2. Based on the results of data processing at the Technical Requirements (House of Quality matrix calculation). Stage which is part of Quality Function Deployment analysis, found that there are some design features digital library is not important according to the respondents. Digital design library is designed to be built according to the findings by eliminating features that are not required by the user.

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