Requirement Analysis of PACS and RIS Hospital Management Information System on Radiology Installation Based on Kano Method

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Abstract. Hospital management information systems are very helpful in carrying out services to customers. In this study, problems were found regarding the process of presenting the results of radiological image data that have not been facilitated throughout the patient's examination room. The slow results of radiological image data, especially for immediate results (CITO) in emergency department services have not been facilitated due to having to wait for the results printed. The results of reading radiological images (expertise) are waiting to be printed first. To solve this problem, a research was conducted focusing on the development of the Radiology Information System (RIS) information system model and Picture Archiving and Communication System (PACS). The development of this system is analysed using the KANO method to classify the expected system menu needs attributes. The test results get the percentage of better value higher than the worse that is 9.81 which means that it can be known attributes that greatly influence the increase in customer satisfaction if these attributes are not fulfilled, the disappointment level is very high, but the implementation stage is not optimal so that future research can present results better research.

1. Introduction

During the development of radiological image storage technology, the presence of a radiological image storage system makes it easier to provide data and can be used for disease diagnosis purposes. Therefore, in providing storage services and making it easier to access radiology images must receive major attention, especially to serve emergency services at night and holidays. The problem of the availability of radiological interpretation services in general is varied, depending on geographical location, time, and type of hospital (private or public). Professional hospital management skills require the support of information systems that are able to develop hospital performance. The existence of an accurate and reliable information system can improve service to customers, both to internal customers and external customers and other related environments [1].

The general hospital is to provide quality and affordable health services by the community in order to improve public health status (RI Minister of Health Decree No. 983/SK/XI/1992). Hospital services at radiology installations include X-rays, CT scans, ultrasound, X-RAY, Apron, X-Ray Mobile Unit, X-Ray Unit, MRI, PAT-CT [2]. In conducting radiology installation services, it is necessary to input
patient data (demographics) directly into the radiology machine (modality) so that this service becomes slow in the process of presenting the results of radiological image data. The speed of the results of the radiological image data is needed especially for immediate results (cito) in the emergency unit service while, services on holidays have not been facilitated where radiology specialists are not in the hospital. To achieve this goal, it is necessary to develop a PACS and RIS Information System in the Radiology installation to determine the attributes of priority system requirements that are built using the Kano method.

PACS (Picture Archiving and Communication System) is a filmless and computerized method, communicating and storing medical image data such as computed radiographic, digital radiographic, computed tomographic, ultrasound, fluoroscopic, magnetic resonance and X-ray photographs (Wong et al, 2009). For more than a century, the efficiency of radiological practice has been limited by film and film handling activities, with this PACS, allowing radiological images to be seen virtually anywhere on a server computer or ordinary personal computer [3].

Saud et. al (2013) reported the research that was conducted with qualitative methods, conducting in-depth interviews in accordance with the PIECES framework (performance, information, economic, control, efficiency and service). The informants in this study were the heads of outpatient installations, 2 staff members of the polyclinic, 1 staff member of the medical record, 1 staff member of registration, and 1 staff member of the hospital information system [4]. The results of the study show the needs of users for the development of the Makassar RSWS outpatient information system, namely the need for information systems that can facilitate data processing, facilitate access to desired reports through computers, and the need for information systems that can facilitate patient data search. The recommendations given in this study are related to user needs in the form of data management modules and reporting modules for outpatient care [4].

Sahfitri & Yulianingsih (2015) from Bina Darma University has conducted a research on the quality of academic information system services using the canoeing method Validity Test, this study produced service attributes used in the questionnaire as research instruments indicating that all statements in the service attributes used proved to be valid. It can be proved that of the 25 service attributes used show the validity value of the corrected item total correlation value on all research variables is greater than 0.159, so based on this, the questionnaire is said to be valid and can be used as a tool [5].

Susanto & Andriana (2016) from Informatics Engineering Study Program, Faculty of Engineering and Computer Science Indonesian Computer University, has conducted a research on the comparison of the waterfall model and prototype for the development of information systems and provides conclusions: Based on the analysis and comparison that has been done, it can be concluded that characteristics of both the Waterfall and Prototype software development models. The Prototype development model is more suitable for customized systems or software, meaning that software is created based on certain requests and needs (even situations or conditions) and is suitable for research tasks that have the purpose of implementing a particular method or algorithm in a case [6].

2. Methodology

This study aims to apply the canoe method in terms of identifying the very important needs of a hospital or organization in order to develop an information system. Therefore, in order to be known, what must be done is to investigate each list of needs that are made in detail. By understanding what requirements and information are needed and what will be provided in the development of hospital management information systems for radiology installation services at dharmais cancer hospitals. Based on the scope and purpose of the research, it is done by using experimental methods by manipulating conditions in accordance with the needs of the problems faced in the study. By manipulating this condition, the results of this study will produce relevant and easily accessible information that is useful for doctors, officers, radiographers and staff in obtaining information [7].

The Kano model is a theory of product creation and customer satisfaction which was developed in the 1980s to classify user trends into five categories, namely: 1) One-dimensional: this attribute results in satisfaction if fulfilled and dissatisfaction if not fulfilled. 2) Attractive: this attribute if it is made
will satisfy the user, but does not result in dissatisfaction if it is not created, usually this attribute is a feature that is not previously expected by the user. 3) Must-be: this attribute does not have a dominant effect if it is fulfilled, but results in dissatisfaction if it is not fulfilled. Usually a basic feature in a product. 4) Indifferent: this attribute is a neutral attribute that does not affect customer satisfaction. We recommend avoiding features that have indifferent attributes. 5) Reverse: if this attribute exists, it causes dissatisfaction, if there is none, it will have an impact on satisfaction [7].

Basically, the Kano model consists of 3 but the consumer response always appears indifferent, questionable, and reverse categories. Indifferent, category where if the presence or absence of services will not affect consumer satisfaction. Reverse (decline), the degree of customer satisfaction is higher if the service goes on improperly compared to satisfaction with services that run better, questionable (doubtful) sometimes consumers are satisfied or not satisfied if the service is provided (Tan and Pawitra, 2001) as seen at Table 1 and Figure 1 below.

### Table 1. Kano Model [7]

| Dysfunctional questions | Very satisfied | Satisfied | Neutral | Not satisfied | Very dissatisfied |
|-------------------------|----------------|-----------|---------|---------------|------------------|
| Questions               |                |           |         |               |                  |
| Very satisfied          | Q              | A         | A       | A             | O                |
| Satisfied               | R              | I         | I       | I             | M                |
| Neutral                 | R              | I         | I       | I             | M                |
| Not satisfied           | R              | I         | I       | I             | M                |
| Very dissatisfied       | R              | R         | R       | R             | Q                |

M : must-be
O : one-dimensional
A : attractive
I : indifferent
R : reverse
Q : Questionable

![Figure 1. Consumer Response of Kano Model [7]](image)

### Table 2. Research Variable of Kano [7]

| Dimension       | Variable                                           | Item |
|-----------------|----------------------------------------------------|------|
| Reliability     | Ability to present data in graphical form          | 1    |
|                 | Ability to display radiological image data quickly | 2    |
| Responsiveness  | Appearance of action report data per officer       | 3    |
|                 | Appearance of action data with registration hours until service is performed | 4    |
| Assurance       | System with attractive interface                   | 5    |
3. Results And Discussion

Based on the system function in the analysis of user satisfaction using the Kano method was carried out. Evaluation of user satisfaction using the Kano method is divided into 4 parts, namely the identification of the personnel information system functionality, the creation and distribution of Kano questionnaires, analysis of questionnaire results, and priority actions based on the results of the questionnaire. The following Instrument variables - questionnaire variables that will be combined in the Kano evaluation table, for more details can be seen in Table 3 as follows:

| Dimension | Variable | Item |
|-----------|----------|------|
| System display tidiness | 6 |
| Ease of use of the system | 7 |
| Users can access anywhere | 8 |
| There is no interference when searching for expertise results. | 9 |
| The required communication is available | 10 |
| Comfortable in operating the system | 11 |
| Complete facilities to use information systems | 12 |
| Ability of users to use the system | 13 |
| Availability of devices in using information systems | 14 |

| Tabel 3. Kano Evaluation Category |
|-----------------------------------|
| **Disfunctional** | **Like** | **Must be** | **Netral** | **No Problem** | **Dislike** |
| Functional |  |  |  |  |  |
| Like | Q | A | A | A | O |
| Must be | R | I | I | I | M |
| Netral | R | I | I | I | M |
| No Problem | R | I | I | I | M |
| Don’t Like | R | R | R | R | Q |

A=Attractive, M=Must-Be, O=One-Dimensional, R=Reverse, Q=Questionable, I=Indifferent

The scale used is a Likert scale because behavior is a qualitative variable, where a more detailed scale is more clearly seen in Table 4 as follows:

| Table 4. Scale of Functional and Disfunctional Value Weighting |
|---------------------------------------------------------------|
| **Variable** | **Weight** |
|---------------------------------------------------------------|
| **Functional** | **Disfunctional** | **I really like** | 1 | 1 |
| **That should be the case** | 2 | 2 |
| **Netral** | 3 | 3 |
| **I can't accept it** | 4 | 4 |
| **I don't like it** | 5 | 5 |

Based on the assessment of respondents' answers with canoe diagrams, it is known that the interpretation is as follows:

a. One Dimensional.

An attribute included in the category is very important to prioritize the development of hospital management information systems on radiology installation services at the dharmais cancer hospital that will be made. The factors included in this category are as follows: 1) Data Clearance. 2) Tidiness of the system display. 3) Completeness of Patient data. 4) The complete name of the officer. 4) Data search.
b. Attractive
An attribute that belongs to the category needs to be maintained because the level of satisfaction will be very high with increasing attribute performance will not cause a decrease in satisfaction level. Factors included in this category are: 1.) Display summary in graphical form. 2) Appearance of radiology action report data. 3) Appearance of radiological image data. 4) Appearance of expertise data. 5) Teleradiology data display. 6) Tidiness of system display.

c. Must be or basic needs.
An attribute that is in the category is still considered necessary because being a user is not satisfied if the performance of the attribute is low. But user satisfaction will not increase far above neutral even though the performance of these attributes is high. Must be is a weak statement of satisfaction but more positive than neutral. The factors included in this category are: 1) Providing action report data according to the executor's name. 2) Display of case reports on radiological measures. 3) Appearance of tool or modality usage data. 4) Users can access the system anywhere. 5) Completeness of case report data.

d. Indifferent.
An attribute that is in the category of less attention so that the presence or absence of attributes will not affect the increase or decrease in the level of satisfaction.

Based on the respondents' answers by matching the category of canoe method, the number of each attribute can be known. Furthermore, to determine canoe categories for each attribute by using the blot h formula as below [8]:

a. If (One dimensional + attractive + musbe) > (indifferent + reserve + questionable) then the grade is obtained from the maximum of (onedimensional, attractive, must be).

b. If (One dimensional + attractive + musbe) < (indifferent + reserve + questionable) then the grade is obtained from the maximum of (onedimensional + attractive + must be).

Better value identifies how much customer satisfaction increases if we provide features (A & O), worse identifying how much decrease in user satisfaction if we don't provide features (O & M). As for the formula for calculating better and worse, it can be seen in the following formula [9][10]:

\[
Better = \frac{A+O}{A+O+M+I}
\]

\[
Worse = \frac{O+M}{A+O+M+I}
\]

The results of recapitulation of better and worse values based on respondents' answers can be seen in Table 5 as follows:

| No | A | M | O | I | Q | R | Better | Worse |
|----|---|---|---|---|---|---|--------|-------|
| 1  | 6 | 1 | 7 | 0 | 0 | 0 | 0.92   | 0.57  |
| 2  | 2 | 4 | 6 | 2 | 0 | 0 | 0.57   | 0.71  |
| 3  | 10| 2 | 0 | 2 | 0 | 0 | 0.71   | 0.71  |
| 4  | 8 | 2 | 2 | 0 | 1 | 0.76 | 0.23  |
| 5  | 3 | 1 | 9 | 0 | 0 | 0.85 | 0.78  |
| 6  | 5 | 1 | 4 | 4 | 0 | 0 | 0.64   | 0.35  |
| 7  | 4 | 0 | 7 | 3 | 0 | 0 | 0.78   | 0.50  |
| 8  | 6 | 2 | 2 | 3 | 0 | 0 | 0.61   | 0.30  |
| 9  | 1 | 2 | 3 | 8 | 0 | 0 | 0.28   | 0.35  |
| 10 | 2 | 1 | 5 | 6 | 1 | 0.87 | 0.42  |
| 11 | 0 | 11| 3 | 0 | 0 | 0 | 0.21   | 1.00  |
| 12 | 0 | 4 | 6 | 4 | 0 | 0 | 0.42   | 2.50  |
| 13 | 0 | 4 | 6 | 4 | 0 | 0 | 0.42   | 0.71  |
Based on the assessment of better and worse, it can be known that the attributes that greatly affect the increase in customer satisfaction if the attribute is not fulfilled, the level of disappointment is very high, namely the worse value = 9.81. By paying attention to the interests or expectations of users towards the needs of PACS and RIS hospital information systems on radiology installations, the attributes that need to exist are: display summary in graphical form, appearance of radiology action report data, appearance of radiological image data, appearance of expertise data and teleradiology data display.

4. Conclusion
The conclusions that can be drawn based on the analysis results of the pacs information system and the dharmais cancer hospital risk are as follows:

a. In determining the needs of the development attributes of PACS and RIS management information systems using the canoe method.

b. The need by the user for the information system of information and risk can be known and can be used as a hospital morning rifensi in optimizing the hospital information system.

c. To be a guideline for hospital management in order to increase information quality to easily produce expertise

d. With PACS and RIS facilities processing X-ray image data can increase optimal service at radiology installations.

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