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# Indonesian Learning Culture Based On Android

Ribka Kowi<sup>1</sup>, Tri Wahyu Widyaningsih, S.Kom.,MMSI<sup>2</sup>  
Tanri Abeng University, Informatics Engineering, Jakarta, Indonesia

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**Abstract—** Indonesia is the fourth country with the largest population in the world and rich of cultural heritage and local wisdom. However, the majority of Indonesian people are less caring, less knowing and minimum understanding about Indonesian culture because of the lack of facilities to provide information of Indonesian culture. On the other hand, Android development is increasingly rapid and free to develop. This is an opportunity that can be used to build a culture of learning systems to maintain the existence Indonesia culture in the eyes of Indonesian people.

This research aims to create a system of Indonesian Culture Learning android based mobile application that can be used as a medium of learning Indonesian culture. The methodology of this development is using SDLC which starting from planning, requirements analysis, system design, implementation, testing and maintenance. And using Android Studio as the main program, Photoshop and Microsoft Paint for image processing, and DIA to design UML.

Indonesian Learning Culture can display ten kinds of culture, that is: traditional house, traditional food, traditional clothes, traditional dance, traditional language, traditional music instruments, traditional song, tribe, handy craft and tourist attraction. Where each category shows an example of each of the provinces in Indonesia.

**Keyword—** *Android, Indonesian Culture, Mobile Application, SDLC.*

## I. OVERVIEW

Indonesia is an archipelago with diverse races and cultures starting from Sabang to Merauke. This is the only wealth can never be purchased by other countries. Society of Indonesia himself was very aware of all wealth owned, but do they know well the culture that exists in this beloved country? The answer is no, why? According to Amna Shifia and friends (2014:1) this is caused by the negative influence of the development of the current globalization has led to the development of the cultural influence of the nation of Indonesia. Besides that the lack of facilities provided by the government may also affect the waning values of cultural preservation.

And according to Dyina Shoful dan Heri Sismoro (2015:1) stated that the impact of globalization is also, lead to changes in lifestyle a more modern society. The effect is people will prefer to the new culture that may be considered more practical than the local culture. Besides that our young generation have also felt this changing of lifestyle, they who simply absorb foreign cultures that are considered more modern for example, an irreverent way of dressing and how to get along too freely adopted by teenagers causing a defiance of the existing norms.

According to Amna Shifia and friends (2014:1) they declare that another factor is the problem is the lack of public awareness of the importance role of the local culture. The local culture is the identity of the nation. As the nation's identity, the local culture should be kept maintained the authenticity or ownership so as not to be recognized by other countries. However, it does not cover the possibility of incoming foreign culture as long as it complies with the personality of the country because the country also need input-input from other countries that will have an effect on developments in his country [3].

Even so, the issue can be resolved by performing a good introduction through effective and efficient media, one of them using a mobile application that contains about the culture of Indonesia. The mobile application is the right solution to solve existing problems, as it can make it easier for everybody especially the young generation in the study of art and culture.

Indonesian young generation and the community are the target of creating this application. At certain of time like now days most of smartphone users are student ranging from elementary school until college. In addition, mobile applications can also be utilized as a means to introduce the culture and natural beauty to tourists Broad.

The objectives to be achieved are as follows:

1. Introducing Indonesian culture and arts in interesting ways.
2. Increasing Indonesian people's interest to learn Indonesian culture and arts.
3. Adding alternate media to learn about Indonesian culture besides books.

4. Created a media learning about Indonesia culture that can help the process of teaching and learning activities.

Based on the background that has been covered then the author are motivated to make Indonesia Culture based on android set on history, culture and the arts of Indonesia. This learning media also comes with questions and assessment exercise to test the knowledge of the users of the application. So it is expected to provide the solution of existing problems.

## II. RESEARCH METHODOLOGY

This method starts with collecting data, analyzing the data and interpret it. Descriptive methods in the implementation conducted through a survey techniques, case studies, analysis of behavior, the study of time and motion and analysis of the documentary”.

### 2.1 Data Collection Technique

This research used questionnaire technique to collect data from respondents. In addition spreading questionnaires in process of collecting data, researchers also take advantage of smart phones as a medium to access applications that have been created to expedite data collection process. The questionnaire will be used to assess the applications, while smartphone as a medium so that the respondent can see and assess the applications that already installed.

#### 2.1.1 Types of Data

The data collected in this study is qualitative and quantitative data, which are:

- Qualitative data is data about the development process of learning media in the form of criticism and suggestions from respondents
- Quantitative data is the core data in the study is data feasibility assessment developed learning media.

#### 2.1.2 Technique Analysis Data

Data and information that has been obtained and analysed, the data will be analysed in this study are as follows:

- Qualitative Data**  
Qualitative data in the form of criticism and suggestions provided by respondents will be analysed descriptively.
- Quantitative Data**  
The quantitative data obtained from questionnaires assessing the quality of products provided to the respondent. Data quality learning media in the form of qualitative data. To get a quality assessment media, the qualitative data were analyzed with the following steps:

Then search for the ideal score (ideal value) to determine the rating

**Table 1. Score scale**

Answer Scale	Score
Yes/Attractive/Fast/Good/Easy/Helpful/Agree	4
Quite interest/Fast enough/Quite easy/less agree	3
Unattractive/Less fast/Difficult/Neutral	2
No/Not attractive/Very Slow/Bad/ Very Disagree	1

scale and the total answer. To search for the ideal score of all items, use the following formula:

$$\text{Ideal value} = \text{Scale value} \times \text{Number of respondents}$$

Next will be determined the rating scale value and the intervals between 0 - 100 values.

**Table 2. Interval and Category**

Interval	Category
0% - 24,99%	Very Weak
25% - 49,99%	Weak
50% - 74,99%	Strong Enough
75% - 99,99%	Strong
100%	Very Strong

After that, to determine the number of answers from the respondents by percentage using the following formula:

$$p = \frac{f}{n} \times 100\%$$

Information:

p = Percentage

f = Frequency of each questionnaire

n = number of ideal score

### 1.2 Place And Research Time

Researchers conducted the study at Tanri Abeng University at Swadarma Raya St. No. 58, Ulujami – Pesanggrahan, South Jakarta. Research conducted in stages in November 2016.

The development of the system of learning the Indonesia culture based on android using System Development Lifecycle (SDLC) model. The SDLC model is a systematic approach to software and sequential, beginning from the stage of the System planning, analysis, design, implementation, testing and maintenance. Indonesia learning culture is concerned with activities such as:

After problem that occurred in community are found, researcher decide to solve that problem by creating a learning culture system that expected to resolve problem that occurs. This are the planning to create the system:

- ## 2. System Analysis

- Analysis Technology

- Information Analysis

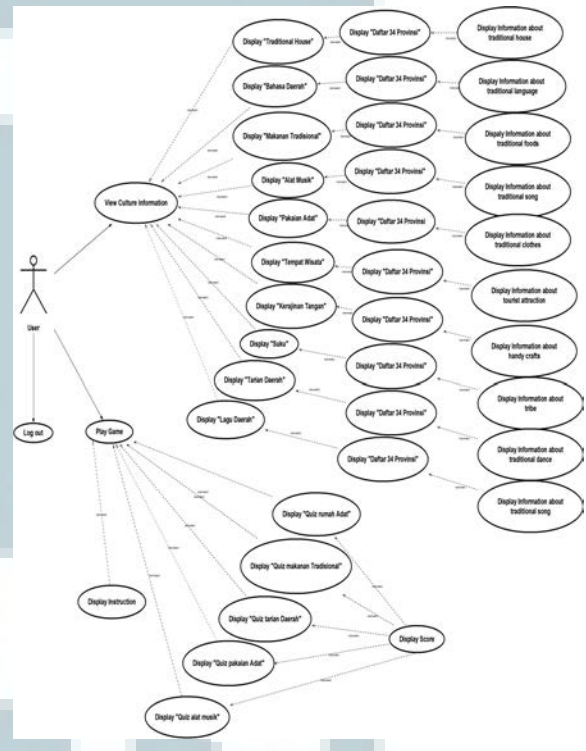
In this phase, researchers conducted data collection using Method Research Library that is by collecting as much information as possible from books, article and journals related to culture and Android development application to get the required information. Moreover,

- User Analysis

### 3. Design

a. UML Design.

At the design stage first thing to do is do a UML design to determine the workflow system to be created. This stage is the stage of designing a system that will be described in the form of the design of UML as follows:



**Figure 1.** Use case Diagram for User

Use case diagrams serve to illustrate the existing facilities within the learning system for the user. From Figure 1 Use Case Diagram for User explaining that the user gets the facility fully to open any material that is in the learning system and operate exercises are provided in the system, but the user cannot change the content of the materials and exercises since the system is still static. And of Figure 2 Use Case Diagram for Admin" explained that the admin also get the facility fully to process data and control system for the system to be updated.

## i. Actor Definition

## • Actor (User)

Explained about the facilities obtained by the user of the learning system of Indonesian culture. Users that is, those who have access rights to use all the facilities in the learning system that is open all cultural learning materials available, and can make or answer any exercises that exist in learning media.

## • Actor (Admin)

Explained about the facilities obtained by the admin of the system Indonesian culture learning system. Admin that is, those who have access rights to process all the data (the learning material culture) in the system, in addition to the admin can also updating the system and to edit the layout to make it more attractive.

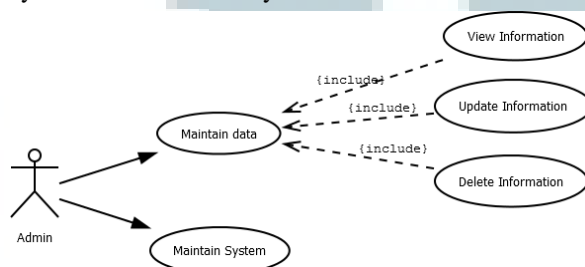


Figure 2. Use case Diagram for Admin

## ii. Usecase Definition

## • Use case (for User)

In this case there are three use cases that matter Indonesian Culture, exercises and exit.

## 1. Material Culture of Indonesia.

In this section, the user can open or view and study the material of Indonesia culture covering traditional home, traditional language, traditional food, traditional music instruments, traditional clothes, tourist attractions, crafts and traditional songs.

## 2. Exercises

In this section, the user can practice doing exercises by choosing the correct picture.

## 3. Exit

In this section, the user can log out of the system.

## • Use case (for Admin)

In this case there are two Use case, which is maintaining data (material) of Indonesia culture and maintaining the system and layout.

## 1. Data Maintenance (materials)

In this section, the admin can perform data maintenance (material) such as view, update and delete data. The data in here is about traditional home, traditional language, traditional food, traditional music instruments, traditional clothes, tourist attractions, crafts and traditional songs.

## 2. System Maintenance and Layout

Admin can perform system maintenance and layout is to update the system to be compatible in all Android smartphones and admin can edit the layout of the system to make it look attractive.

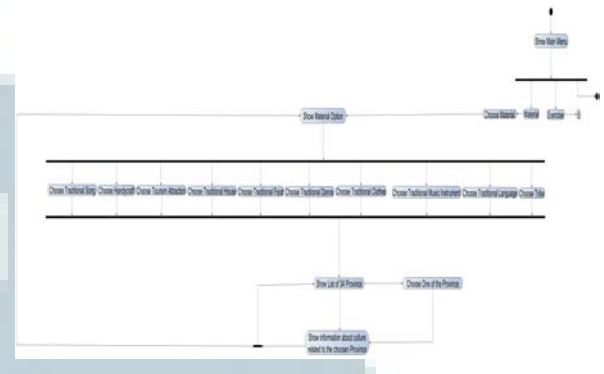


Figure 3. Diagram Activity for all system Material in Indonesian Culture Learnig

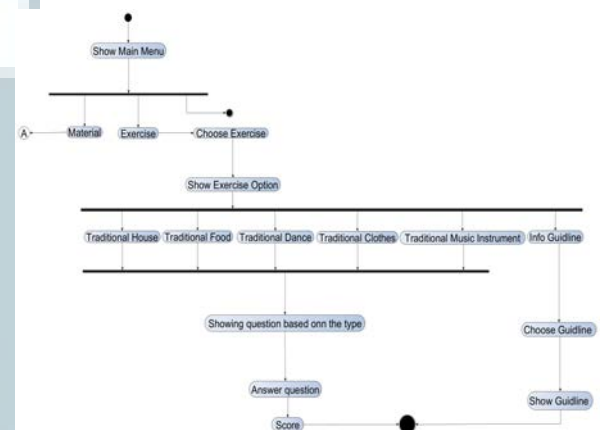


Figure 4. Diagram Activity for all system Exercise in Indonesian Culture Learnig

## i. Activity Diagram

In above Figure 3 Diagram Activity for all system Material in Indonesian Culture Learning and Figure 4 Diagram Activity for all system Exercise in Indonesian Culture Learning describes that when users enter into main menu page there is a menu option Learn, Quiz and Exit. Each option has a submenu option, except the exit menu that will directly take the user out of the system.

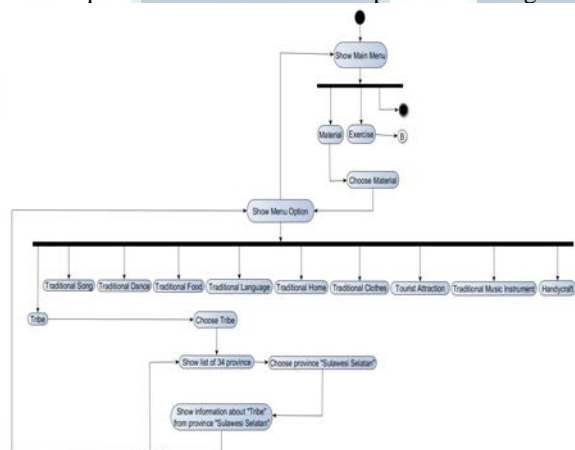


Here's a description from above picture of each option activity:

**Table 3.** Description about submenu learn and quiz

No.	Submenu Learn Option	Submenu Quiz Option
1.	Traditional Dance	Traditional House
2.	Tribe	Traditional Food
3.	Handy Craft	Traditional Dance
4.	Tourist Attraction	Traditional Music Instrument
5.	Traditional House	Traditional Clothes
6.	Traditional Language	Info
7.	Traditional Foods	
8.	Traditional Music Instrument	
9.	Traditional Clothes	
10.	Traditional Song	

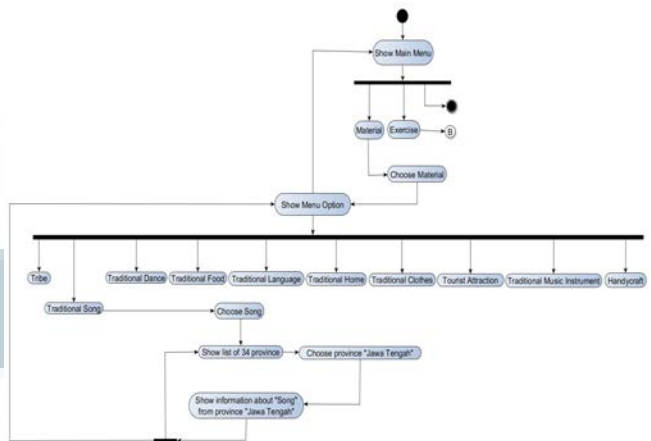
The explanation for the menu option Learning and



**Figure 5.** Diagram Activity for Tribe

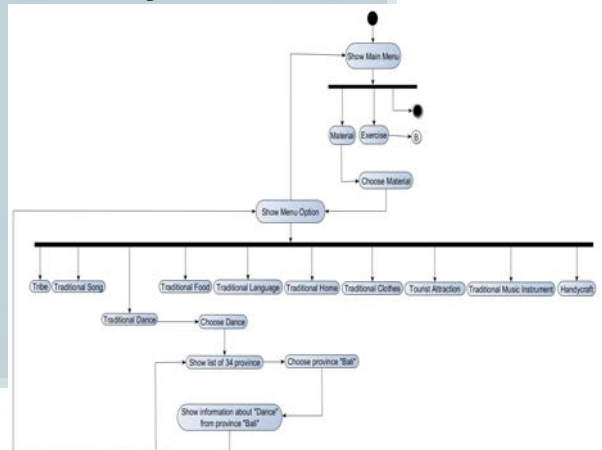
submenus:

In Figure 5 Diagram Activity for Tribe on the previous page explain that the activity begins when users are logged into the main menu page, the next activity is selecting option Learn, in the option Learn there are 10 submenu, then the user will choose a submenu Tribe which subsequently will be list menu of 34 provinces in Indonesia after that user will choose one of the provinces, and after that there will be information about the tribe of the provinces selected by the user. User can see other information about tribe from another province by choosing another province on list province.



**Figure 6.** Diagram Activity for Song

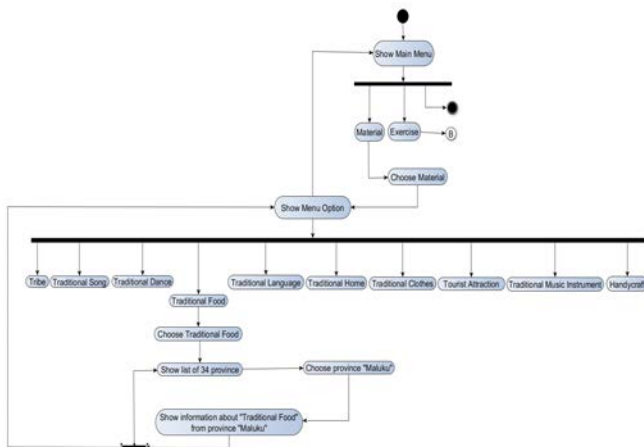
In Figure 6 Diagram Activity for Traditional Song activity on the previous page explain that the activity begins when users are logged into the main menu page, the next activity is selecting option Learn, in option Learn there are 10 sub menu, then the user will choose a submenu Traditional Song hereinafter will be list menu of 34 provinces in Indonesia after that user will



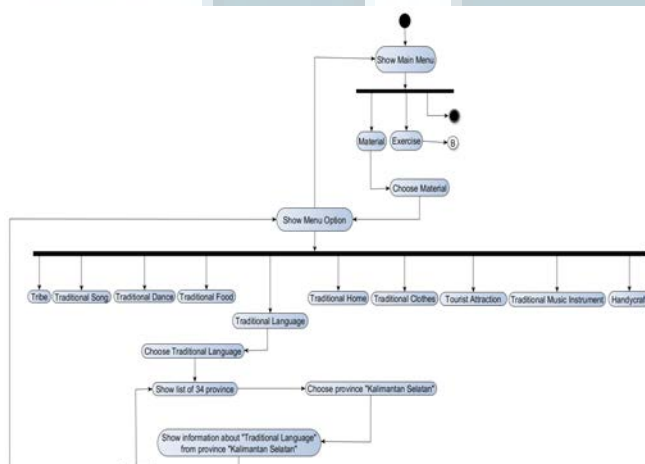
**Figure 7.** Diagram Activity for Traditional Dance

choose one of the provinces, and after that there will be information about the traditional song of the provinces selected by the user. User can see other information about song from another province by choosing another province on list province.

In Figure 7 Diagram Activity for Traditional Dance on the previous page explain that the activity begins when users are logged into the main menu page, the next activity is selecting option Learn, in option Learn there are 10 submenu, then the user will choose a submenu Traditional Dance which will further there list menu of 34 provinces in Indonesia after that user will choose one of the provinces, and after that there will be information about the traditional dance of the province selected by the user. User can see other information about traditional dance from another province by choosing another province on list province.

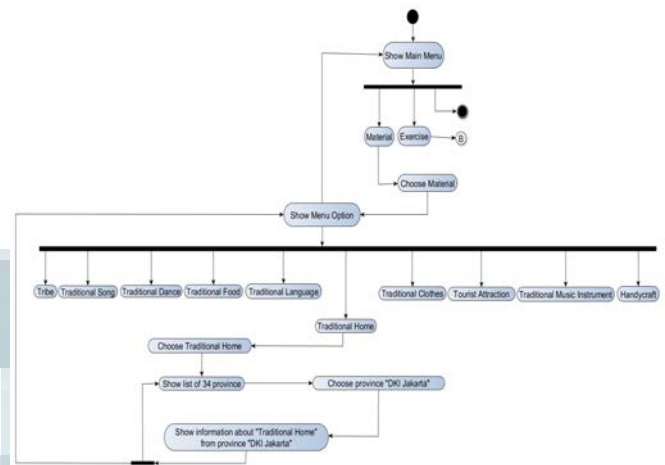


In Figure 8 Diagram Activity for Traditional Food on the previous page explain that the activity begins when users are logged into the main menu page, the next activity is selecting option Learn, in option Learn there are 10 submenu, then the user will choose a submenu Traditional Food that then there will be list menu of 34 provinces in Indonesia after that user will choose one of the provinces, and after that there will be information about the traditional food of the province selected by the user. User can see other information about traditional food from another province by choosing another province on list province.



**Figure 9.** Diagram Activity for Traditional Language

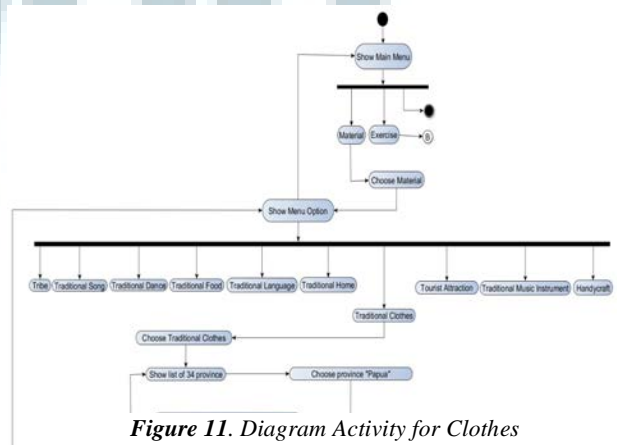
In Figure 9 Diagram Activity for Traditional Language on the previous page explain that the activity begins when users are logged into the main menu page, the next activity is selecting the "Learn, in option Learn there are 10 submenu, then the user will choose a submenu Traditional Language hereinafter there will be list menu of 34 provinces in Indonesia after that user will choose one of the provinces, and after that there will be information about the traditional language of the province selected by the user. User can see other information about traditional language from another province by choosing another province on list province.



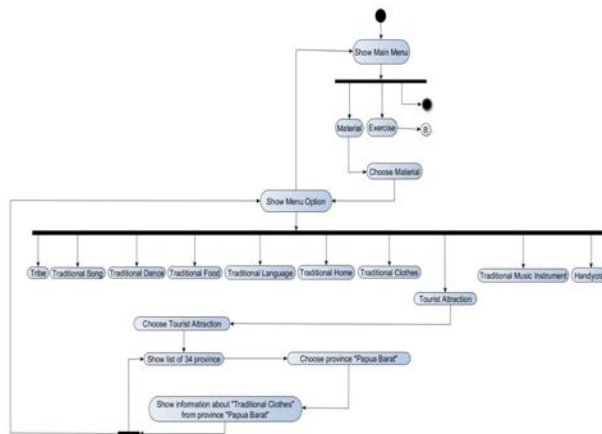
**Figure 10.** Diagram Activity for Traditional Home

In Figure 10 Diagram Activity for Traditional Home on the previous page explain that the activity begins when users are logged into the main menu page, the next activity is selecting option Learn, in option Learn there are 10 submenu, then the user will choose a submenu Traditional House that then there will be list menu of 34 provinces in Indonesia after that user will choose one of the provinces, and after that there will be information about the traditional house of the provinces selected by the user. User can see other information about traditional house from another province by choosing another province on list province.

In Figure 11 Diagram Activity for Traditional Clothes on the previous page explain that the activity begins when users are logged into the main menu page, the next activity is selecting option Learn, in option Learn there are 10 submenu, then the user will choose a submenu Traditional Clothes that then there will be list menu of 34 provinces in Indonesia after that user will choose one of the provinces, and after that there will be information about the traditional clothes of the provinces selected by the user. User can see other information about traditional house from another province by choosing another province on list province.



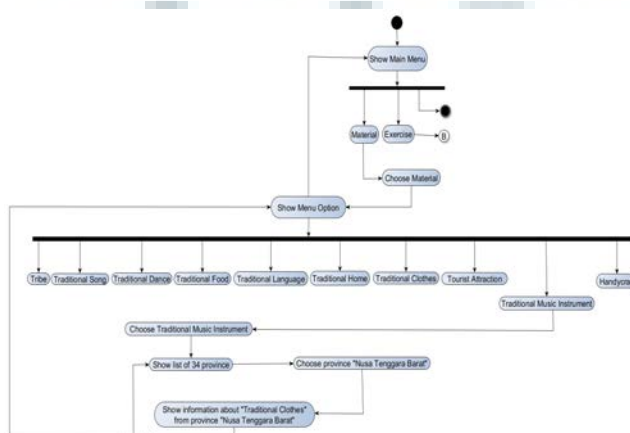
**Figure 11.** Diagram Activity for Clothes



**Figure 12.** Diagram Activity for Tourist Attraction

In Figure 12 Diagram Activity for Tourist Attraction on the previous page explain that the activity begins when users are logged into the main menu page, the next activity is selecting option Learn, in the Learn there are 10 submenu, then the user will choose a submenu Traditional Tourist Attraction which would then be no list menu of 34 provinces in Indonesia after that user will choose one of the provinces, and after that there will be information about the traditional tourist attraction of the province selected by the user. User can see other information about traditional house from another province by choosing another province on list province.

In Figure 13 Diagram Activity for Traditional Music Instrument on the previous page explain that the activity begins when users are logged into the main menu page, the next activity is selecting the option Learn, in option Learn there are 10 submenu, then the user will choose a submenu Traditional Music Instrument which would then be no list menu of 34 provinces in Indonesia after that user will choose one of



**Figure 13.** Diagram Activity for exercise Traditional Music Instrument

about traditional music instrument of the provinces

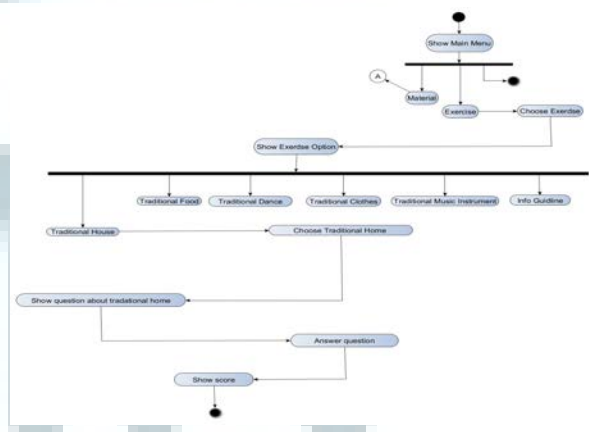


**Figure 14.** Diagram Activity for Handycraft

selected by the user. User can see other information about traditional house from another province by choosing another province on list province.

In Figure 14 Diagram Activity for Handy craft on the previous page explain that the activity begins when users are logged into the main menu page, the next activity is selecting option Learn, in the Learn there are 10 submenu, then the user will choose a submenu Traditional Handicraft hereinafter will be list menu of 34 provinces in Indonesia after that user will choose one of the provinces, and after that there will be information about the traditional handicrafts of the province selected by the user. User can see other information about traditional house from another province by choosing another province on list province.

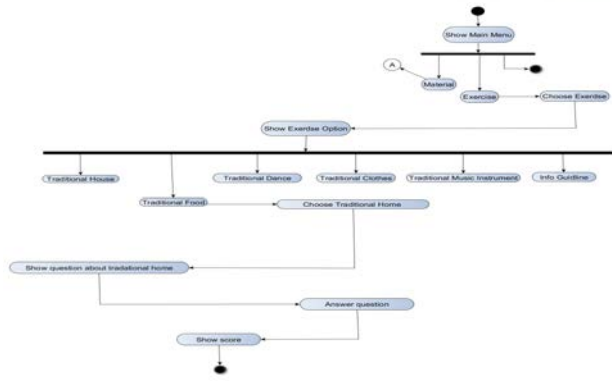
The explanation for the menu option Exercise and submenu:



**Figure 15.** Diagram Activity for exercise

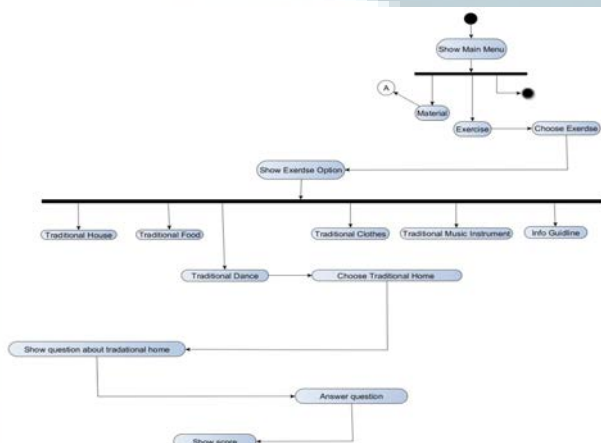
In Figure 15 Diagram Activity for exercise Traditional House on the previous picture explain that the activity begins when users are logged into the main menu page, the next activity is to choose Quiz, in option Quiz, there are 6 submenu, then the user will choose a submenu Traditional House which will then be there to see the question of traditional house existing

in Indonesia after that the user will answer questions consist of 10 questions along with an image that will appear randomly and after that there will be information about scores that user obtain.



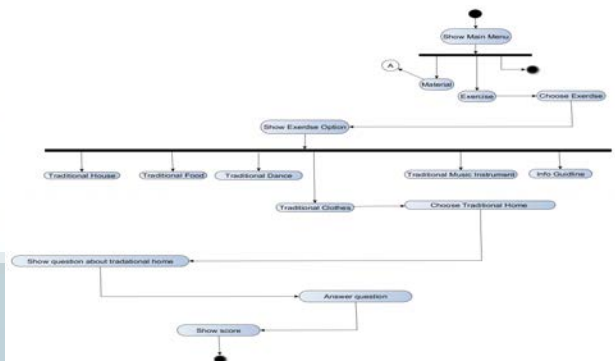
**Figure 16.** Diagram Activity for exercise Traditional Food

In Figure 16 Diagram Activity for exercise Traditional Food on the previous page explain that the activity begins when users are logged into the main menu page, the next activity is to choose Quiz, in option Quiz, there are 6 submenu, then the user will choose a submenu Traditional Food which in turn will be a display of questions about traditional food that is in Indonesia after that the user will answer questions consisting of 10 questions along with an image that will appear randomly and after that there will be information about scores that user obtain.



**Figure 17.** Diagram Activity for exercise Traditional Dance

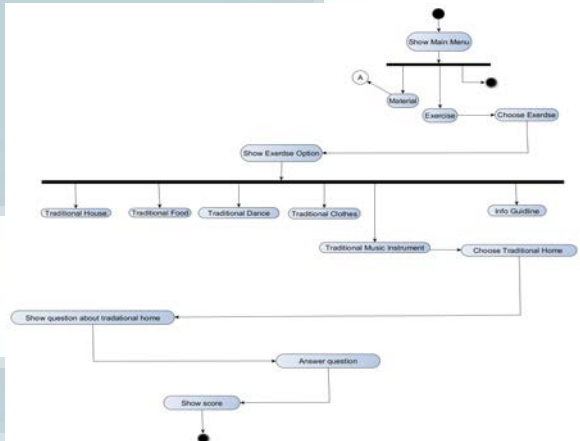
On Figure 17 Diagram Activity for exercise Traditional Dance on the previous page explain that the activity begins when users are logged into the main menu page, the next activity is to choose Quiz, in option Quiz, there are 6 submenu, then the user will choose a submenu Traditional Dance which in turn will be a display of questions about traditional dance that is



**Figure 18.** Diagram Activity for exercise Traditional Clothes

in Indonesia after that the user will answer questions consisting of 10 questions along with an image that will appear randomly and after that there will be information about scores that user obtain.

In Figure 18 Diagram Activity for exercise Traditional Clothes on the previous page explain that the activity begins when users are logged into the main menu page, the next activity is to choose Quiz, in option Quiz, there are 6 submenu, then the user will choose a submenu Traditional Clothes hereinafter will be display questions of traditional clothes that last in Indonesia after that the user will answer questions consisting of 10 questions along with an image that will appear randomly and after that there will be information about scores that user obtain.



**Figure 19.** Diagram Activity for exercise Traditional Music Instrument

In Figure 19 Diagram Activity for exercise Traditional Music Instrument on the previous page explain that the activity begins when users are logged into the main menu page, the next activity is choose option "Quiz", in option "Quiz", there is 6 submenu, then the user will choose a submenu Traditional Music Instrument after that system will display question about traditional music instrument in Indonesia after that the user will answer questions that consist of 10 questions along with an image that will appear randomly and after that there will be information about scores that user obtain.



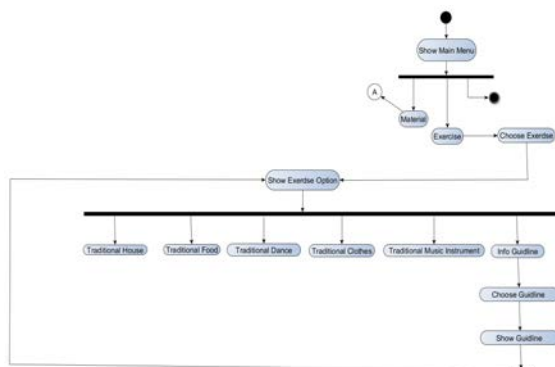


Figure 20. Diagram Activity for Info Guidelines

In Figure 20 Diagram Activity for Info Guidelines on the previous page explain that the activity begins when users are logged into the main menu page, the next activity is choose option "Quiz", in option "Quiz", there is 6 submenu, user will choose a submenu info then there will be a display information guidelines about how to answer the questions.

#### ii. Sequence diagram

In Figure 21 Sequence diagram for option "Belajar" on the next page explain that when the user choose option "Belajar" and the system will display 10 submenu option about culture. From 10 submenu user will choose for example option traditional house and the province is south Sumatera, the system will get data about traditional house from south Sumatera in the database after the system get valid data which is traditional house from south Sumatera, system will display the information to the user. For the other class it is also have the same sequential flow of system, which is user choose button "Belajar", the system will display submenu option about culture, user will choose the option about culture and the province, the system will get the information in database and the last is the system displaying the valid data to the user. Additional information for figure 21 sequence diagram for option "Belajar" on the figure is supposed to have 10 class about culture activity but because of all class have the same flow of sequential activity so the author only put 5 class which is MainActivity, TarianActivity, PakaianActivity, BahasaActivity, MakananActivity.

For Figure 22 Sequence diagram for quiz option on the next page explain that when the user choose button quiz, the system will display 5 submenu of quiz and info guidelines option. In the From 5 submenu of quiz user can choose one of it for example quiz about traditional foods, the system will display 10 random question about traditional foods from 34 province in Indonesia, after that the user will answer the 10 question and then the system will calculate the score and displayed the total score that the user achieve. And the other one is when user choose option info so the system will show the information guidelines about how to

answer the quiz. Additional information for figure 22 sequence diagram for quiz option on the figure is supposed to have 5 class about quiz option and 1 about info guidelines activity but because of all class of quiz option have the same flow of sequential activity so the author only put 3 class of quiz option which is Soal1, Soal3, and Soal4.

#### iii. Class Diagram

On the Figure 23 Class diagram for Indoculture system on the next page explain that on Indoculture system there is 11 class. Each of class shown their own specification and all class are connected inside the

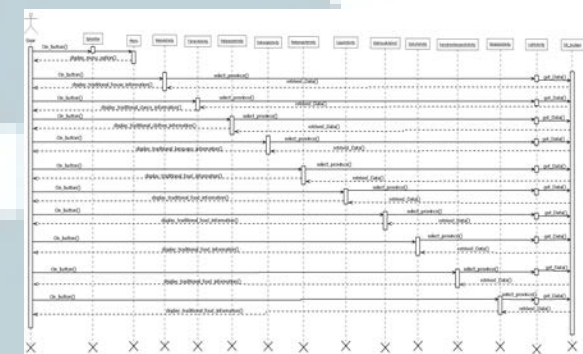


Figure 21. Sequence diagram for option "Belajar"

system. There is Db\_budaya class this class has a role as database class where the other 10 classes will be connected. The relationship between each of class and Db\_budaya class is one to many. Db\_budaya are able to create and upgrade database.

#### iv. Designing creative text, questions and answers

This stage is the stage where the researcher to

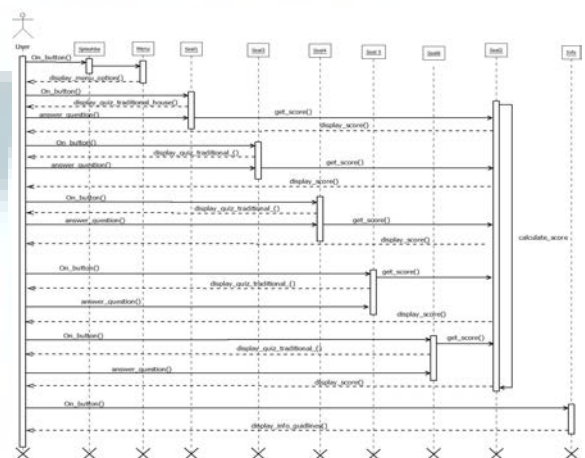


Figure 22. Sequence diagram for quiz option

review all the data that has been collected and then loaded in the format .docx (Microsoft Word document) using Microsoft word. Discussion answers will be posted in the form of image formats .png (portable

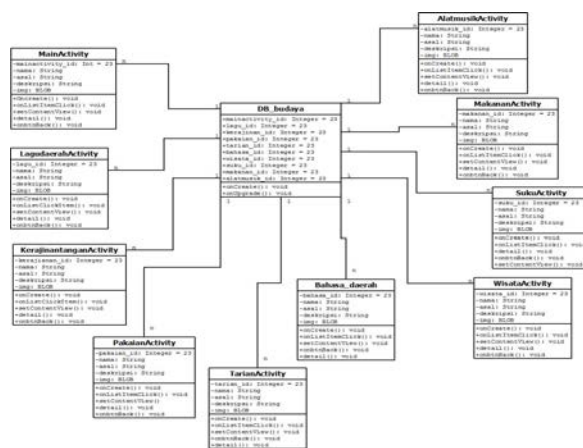


Figure 23. Class diagram for Indoculture system

network graphics) using Microsoft paint, while for manufacturing the direct question put in java.

- v. Manufacture and collection background, pictures and images of icons.

The collection of drawings done by doing a search on google and then collected into one folder. Then making a background and icon images created in the image formats .png (portable network graphics) using Photoshop.

#### 4. Implementation

- a. Creating the media.

In creating the media the author using Android Studio as IDE (Integrated Developing Media). All the components that have been prepared in the design phase are then assembled into a complete media in accordance with a design that was designed before. There are three activities in the manufacture of media that is making the interface, coding and testing.

- b. Validation I

At this stage the initial media validated by one media expert (lecturer) and a subject matter expert (lecturer). The result in the form of suggestions, comments, and feedback to the media that will be developed.

- c. Revision I

At this stage the media will be revised based on the insert and advice provided by subject matter experts (professors) and media experts (professors).

- d. Validation II

At this stage the media will be validated by the user is a student.

- e. Revision II

At this stage the media will be revised based on suggestions from users enter and learning media culture in this case as a matter experts. At this stage the

media will be revised and will be used in the implementation phase to the media.

#### 5. System Testing and Integration

At this stage is the stage of the trial applications that have been created so that researchers can ensure that there are no errors in the application and the results should be completely in accordance with what has previously drafted, by trying the application directly using a smartphone with Android OS. Here are the list and specification of some devices which are used as emulator and tester:

- Name : Asus Zenfone 5
- OS : Android Version 4.4.2 (KitKat)
- Name : Samsung Galaxy J1<sub>6</sub>
- OS : Android Version 5.1.1 (Lollipop)
- Name : Oppo F1s
- OS : Android Version 5.1 (Lollipop)
- Name : Xiaomi 3 Pro
- OS : Android Version 5.1 (Lollipop)

From application testing that performed on four types of smartphones with different versions of android and get satisfying results that the applications can be installed and run well on all these devices. However, there are some weaknesses that must be repaired, that is the consistency of a menu button, culture menu button position is inconsistent on the screen size of different devices. And also button back in application and back button on the device has a different function, so if pressing button back from device for example in list of province or in culture information it will not return to the previous layout but directly go to menu option.

- a. Field Trial




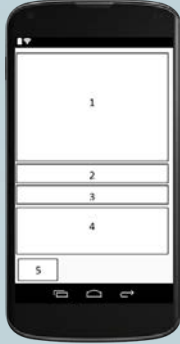
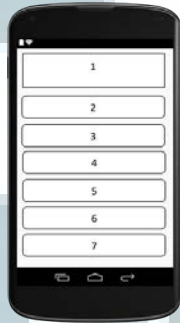
Phase field trials media learning culture will be conducted at Tanri Abeng University south Jakarta. In this phase also distributed a questionnaire to determine student assessment regarding the media that have been made.


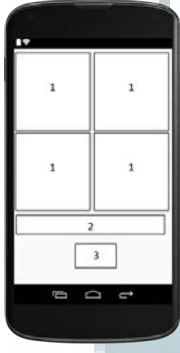

- b. When in need of revision phase III based on feedback and suggestions from students. But in this revision will consider the feedback and suggestions from the previous validator not to conflict with previous improvements.

#### 1. Maintenance

This stage is also necessary to perform maintenance such as updating android operating system on the application and update information about the culture and also updates features such as adding or removing features in applications Indoculture.

**Table 4. Design Output**

Layout	Description
	<p>Home Page :</p> <ol style="list-style-type: none"> <li>1. Containing name of the media which is “Indonesian Culture”.</li> <li>2. Button “Belajar” which will go to option menu page.</li> <li>3. Button “Quiz” which will go to option of exercise page.</li> <li>4. Button “Exit” which to close the system.</li> </ol> <p>Contain about the system maker.</p>
	<p>Option Menu :</p> <ol style="list-style-type: none"> <li>1. Button Traditional Home which will go to 34 Provinces page.</li> <li>2. Button Traditional Language which will go to 34 Provinces page.</li> <li>3. Button Traditional Food” which will go to 34 Provinces page.</li> <li>4. Button Traditional Music Instrument which will go to 34 Provinces page.</li> <li>5. Button Traditional Clothes which will go to 34 Provinces page.</li> <li>6. Button Local Attraction which will go to 34 Provinces page.</li> <li>7. Button Handy craft which will go to 34 Provinces page.</li> <li>8. Button Tribe which will go to 34 Provinces page.</li> <li>9. Button Traditional Dance which will go to 34 Provinces page.</li> <li>10. Button Traditional Song which will go to 34 Provinces page.</li> <li>11. Button “Back” which will go to home page.</li> </ol>
	<p>List Page :</p> <p>Containing list of 34 provinces in Indonesia. And the list is in sequential from Sumatera to Papua.</p>
	<p>Information Page :</p> <ol style="list-style-type: none"> <li>1. Contains images related to the type of culture.</li> <li>2. Contains the name of the image that appears.</li> <li>3. Contains information about the origin place.</li> <li>4. Contain a description of the image that appears. Button “Back” which will go to the list of 34 Provinces page.</li> </ol>
	<p>List Option for Exercise/Quiz :</p> <ol style="list-style-type: none"> <li>1. Contain the title of the quiz which is “Quiz Tebak Gambar”.</li> <li>2. Button Traditional Home which will go to traditional home quiz page.</li> <li>3. Button Traditional Food which will go to traditional foods quiz page.</li> <li>4. Button Traditional Dance which will go to traditional dance quiz page.</li> <li>5. Button Traditional Clothes which will go to traditional clothes quiz page.</li> <li>6. Button Traditional Music Instrument which will go to traditional music instrument quiz page.</li> <li>7. Button “Info” which will go the guidelines page.</li> </ol>

	<p>Page Info :</p> <ol style="list-style-type: none"> <li>1. Contain of title which is "Informasi".</li> <li>2. Contain of the guidelines about how to answer the quiz.</li> <li>3. Button "Exit" to close the page of info.</li> </ol>
	<p>Exercise/Quiz Page :</p> <ol style="list-style-type: none"> <li>1. Contain picture which will appear in random.</li> <li>2. Contains of question. Button "Next" which will go to the next questions.</li> </ol>
	<p>Result Page :</p> <ol style="list-style-type: none"> <li>1. Contains the information about score that you achieve.</li> <li>2. Button "Exit" to close the quiz page.</li> </ol>

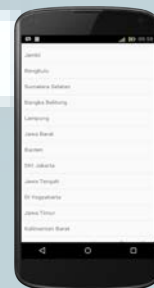
### 3.1.2 Submenu Learning Display

In the "Figure 3.2 Submenu Option on the Learning menu option" is the result of test systems on display submenu option on the button menu to learn where the contents of the display consists of a menu button Traditional House, Regional Languages, Traditional Food Traditional Musical Instruments, Traditional Clothes, Tourist Attraction, Crafts, Tribe, Regional Dance, and Traditional Song tenth button can work very well with no debug at all.

**Figure 3.2**  
Display  
Submenu Option  
on menu  
"Belajar"

### 3.1.3 Display List of 34 Province

In the "Figure 3.3 Display list of province" is the result of the test system in the list view button names every province in Indonesia. Where the contents of the display consists of 34 province in Indonesia from Aceh to Papua Province. 34 list this button can work very well with no debug at all.



**Figure 3.4** Display  
information about  
traditional house

### 3.1.4 Display Information about Traditional House

On "Figure 3.4 Display information about traditional house" is a system test results on the display traditional house information content selected by province. The display consists of a traditional house name, origin province, a description of the traditional house and the back button to return to the list of province. With results like these show that in addition to the display information has gone well and the back button can work very well with no debug at all.



**Figure 3.3** Display  
button list of 34  
Province

## III. ANALYSIS AND DISCUSSION

### ANALYSIS AND DISCUSSION

#### 3.1 Output of learning media

##### 3.1.1 Main Display



In the "Figure 3.1 Main Menu" is the result of system test on the start screen where the contents of display consists of the name of the system, information system maker and also the button "Learn" button "Quiz" and the button "Exit" third button can work very well without No debug at all.

**Figure 3.1** Main menu



### 3.1.5 Display Information about Traditional Clothes



**Figure 3.5**  
Display  
information about  
traditional clothes

On “Figure 3.5 Display information about traditional clothes” is a system test results on the display of information content of traditional clothes selected by province. The display consists of the name of traditional clothes, provincial origin, description of the traditional clothes and a back button to return to the list of province. With results like these show that in addition to the display information has gone well and the back button can work very well with no debug at all.

### 3.1.6 Display Information about Traditional Food



**Figure 3.6** Display  
information about  
traditional food

On “Figure 3.6 Display information about traditional food” is a system test results on the display traditional food information content selected by province. The display consists of the name of traditional food, provincial origin, description of the traditional food and the back button to return to the list of province. With results like these show that in addition to the display information has gone well and the back button can work very well with no debug at all.

### 3.1.7 Display Information about Traditional Musical Instrument



**Figure 3.7** Display  
information about  
traditional music  
instrument

On “Figure 3.7 Display information about traditional music instrument” is a system test results on the display of information content of traditional music instrument chosen by province. The display consists of the name of traditional music instrument, provincial origin, description of the traditional music instruments and a back button to return to the list of province. With results like these show that in addition to the display information has gone well and the back button can work very well with no debug at all.

### 3.1.8 Display Information about Tourist Attraction



**Figure 3.8** Display  
information about  
tourist attraction

On “Figure 3.8 Display information about tourist attraction” is a system test results on a display of traditional tourist attraction information content selected by province. The display consists of a traditional tourist attraction name, province of origin, the description of the traditional tourist attraction and a back button to return to the list of province. With results like

these show that in addition to the display information has gone well and the back button can work very well with no debug at all.

### 3.1.9 Display Information about Traditional Handy Craft



**Figure 3.9** Display  
information about  
handy craft

On “Figure 3.9 Display information about traditional handy craft” is a system test results on the display handy craft traditional information content selected by province. The display consists of a handy craft traditional name, provincial origin, description of the traditional handy craft and the back button to return to the list of province. With results like these show that in addition to the display information has gone well and the back button can work very well with no debug at all.

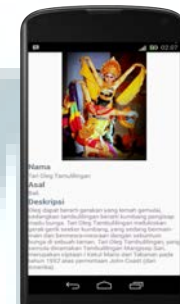
### 3.1.10 Display Information about Tribe



**Figure 3.10** Display  
information about  
tribe

On “Figure 3.10 Display information about tribe” is a system test results on the display of information content tribe chosen by province. The display consists of the name of tribe, province of origin, description of the tribe and the back button to return to the list of province. With results like these show that in addition to the display information has gone well and the back button can work very well with no debug at all.

### 3.1.11 Display Information about Traditional Dance



**Figure 3.11** Display  
information about  
traditional dance

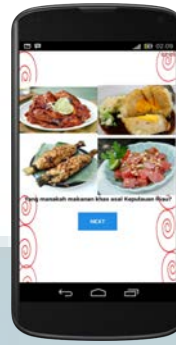
On “Figure 3.11 Display information about traditional dance” is a system test results on a traditional dance display information content selected by province. The display consists of the name of traditional dance, provincial origin, description of the traditional dance and a back button to return to the list of province. With results like these show that in addition to the display information has gone well and the back button can work very well with no debug at all.

### 3.1.12 Display Information about Traditional Song



**Figure 3.22** Display information about traditional song

On “Figure 3.12 Display information about traditional song” is a system test results on the display of information content of traditional song selected by province. The display consists of a traditional song name, provincial origin, description of the traditional song and the back button to return to the list of province. With results like these show that in addition to the display information has gone well and the back button can work very well with no debug at all.



**Figure 3.11** Display Quiz Traditional Food

On “Figure 3.12 Display Quiz Traditional Food” is a system test results on the display contents of a quiz about the traditional food you selected will appear randomly. The number of questions that will perform are as many as 10 questions. The display consists of a picture traditional food from various provinces in Indonesia, questions, and next button to go to the next question. With results like these show that in addition to the display information has gone well and the back button can work very well with no debug at all.

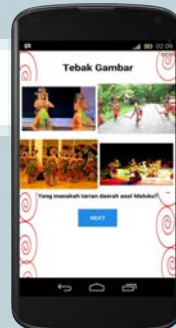
### 3.1.13 Display Submenu Quiz



**Figure 3.13** Display Submenu Quiz

On “Figure 3.13 Display Submenu Quiz” is the result of test systems on display submenu quiz on the button menu quiz in which the contents of the display consists of a menu button quiz Traditional House, Traditional Food, Traditional Dance, Traditional Clothes, Traditional Musical Instruments and Info the sixth button can work very well with no debug at all.

### 3.1.16 Display Quiz Traditional Dance



**Figure 3.13** Display Quiz Traditional Dance

On “Figure 3.13 Display Quiz Traditional Dance” is a system test results on a display of traditional dance quiz contents selected will appear randomly. The number of questions that will perform are as many as 10 questions. The display consists of images traditional dance from various provinces in Indonesia, questions, and next button to go to the next question. With results like these show that in addition to the display information has gone well and the back button can work very well with no debug at all.

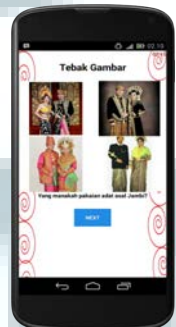
### 3.1.14 Display Quiz Traditional house



**Figure 3.14** Display Quiz Traditional house

On “Figure 3.14 Display Quiz Traditional house” is a system test results on the display contents of the traditional house quiz selected will appear randomly. The number of questions that will perform are as many as 10 questions. The display consists of a traditional picture house from various provinces in Indonesia, questions, and next button to go to the next question. With results like these show that in addition to the display information has gone well and the back button can work very well with no debug at all.

### 3.1.17 Display Quiz Traditional Clothes



**Figure 3.17** Display Quiz Traditional Clothes

On “Figure 3.17 Display Quiz Traditional Clothes” is a system test results on the display contents of a quiz about the traditional clothes chosen will appear randomly. The number of questions that will perform are as many as 10 questions. The display consists of images of traditional clothes of various provinces in Indonesia, questions, and next button to go to the next question. With results like these show that in addition to the display information has gone well and the back button can work very well with no debug at all.

### 3.1.15 Display Quiz Traditional Food

### 3.1.18 Display Quiz Traditional Music Instrument



**Figure 3.18** Display Quiz Traditional Music Instrument

On “Figure 3.18 Display Quiz Traditional Music Instrument” is a system test results on a display of traditional music quiz content of the selected instrument will appear randomly. The number of questions that will perform are as many as 10 questions. The display consists of images of traditional music instruments from various provinces in Indonesia, questions, and next button to go to the next question. With results like these show that in addition to the display information has gone well and the back button can work very well with no debug at all.

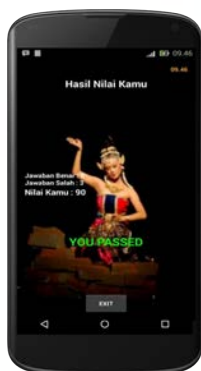
### 3.1.19 Display Info guidelines



**Figure 3.19** Display Info guidelines

On “Figure 3.19 Display Info guidelines” is a system test results on the display guidelines on how to answer the quiz. There exit button to go to the previous page. With results like these show that in addition to the display information has gone well and the back button can work very well with no debug at all.

### 3.1.20 Display Score



**Figure 3.20** Display Score

On “Figure 3.20 Display Score” is a system test results on the display score results have been achieved after answering the previous questions. The number of questions that will perform are as many as 10 questions. On this page will show the number of correct, wrong number and total value, if the value is less than 60 then the user fails to answer the questions correctly, if the value of 60 or more then the user has passed by answering questions correctly. With results like these show that in addition to the display information has gone well and the back button can work very well with no debug at all.

Qualitative data are get from the questionnaire which the testers were asked to provide comments and suggestions in order to determine the advantages and disadvantages of learning to the media on the further development of this learning media will become even better. In this case the testers were very enthusiastic to give criticism and suggestions were very good and helpful for researchers. Overall criticisms and suggestions can be found in the appendix.

### 3.2.2 Analysis Quantitative Data

Implementation phase is carried out by disseminating a questionnaire to 34 students from various majors and batch in Tanri Abeng University as testers to test and assess the learning media culture that has been installed on the smartphone. The questionnaire using Likert scale with four different alternative answers according to the characteristics of the question. Besides that testers were also asked to install learning media on their smartphone. Researcher share learning media by spread link where learning media has been uploaded which is google drive and testers must download and install the learning media on their smartphones. Tester assessment results can be seen in the Appendix. In the following is the details of results of the assessment result from testers.

**Table 3.2.2** Assessment Aspects and Number of values

No.	Assessment Aspects	Number of values
1.	System	467
2.	Display Media	105
3.	Displayed Information	370
Total		942
Percentage		67,28%

Based on assessment results in above table 3.2.2 from the testers of Tanri Abeng University and based on assessment from the aspect of the system, display media and information displayed researcher get a total value of 942 with the percentage 67.28% which, when seen from the table of category this value included in the strong enough category that means media learning culture is quite feasible to be used as Indonesian culture learning media.

## IV. CONCLUSION

Based on the results from research and discussion before, it can be concluded as follows:

1. Based on test results “Indonesian Culture Learning Media” can be installed and run properly on smartphones with Android version KitKat and Lollipop.
2. Features in the application can run properly in accordance with user’s needs which is to displays information about culture from 34 provinces in

## 3.2 Research Result (For functionality and Usability Testing Phase)

### 3.2.1 Analysis Qualitative Data



Indonesia such as traditional house, traditional clothes, traditional dance, traditional foods, traditional song, traditional music instrument, tourist attraction, traditional language, handy craft and tribes.

3. "Indonesian Culture Learning Media" can display 10 questions that comes with a picture that will appear randomly can run properly and also can displays the score results that user get after answering the questions in the learning media.
4. Based on the validation testing "Indonesian Culture Learning Media" by distributed a questionnaire to 34 students of Tanri Abeng University and get the average value 67.28% from the testers (students). Based on this assessment can be stated that "Indonesian Culture Learning Media" is quite decent to use as an Indonesia culture learning media.

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# Prototype of Gas Warning Monitoring Application Using Mobile Android Smartphone : A Case Study

Diki Hermawan<sup>1</sup>, Eko Budi Setiawan<sup>2</sup>

Program Studi Teknik Informatika, Universitas Komputer Indonesia, Bandung, Indonesia  
diki.hermawan04@gmail.com<sup>1</sup>, eko@email.unikom.ac.id<sup>2</sup>

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**Abstract**— This study aims to monitor gas leakage with case studies in a national company engaged in the production of polycarbonate for drinking water packaging. In the future this research will be referred to as the Company. The Company implements Sistem Manajemen Keselamatan dan Kesehatan Kerja or so-called System Management K3 (SMK3) to create a safety and health system by involving elements of management, labor, conditions and an integrated work environment in order to prevent and reduce accidents and occupational diseases. One of the causes of work accidents of the many causes that should be a concern is the danger that can be caused by the leaking gas LPG installation. Such hazards may cause explosions to fire that may threaten the safety of workers in companies using LPG gas for their production processes. The system in this study was designed to monitor and provide gas leak warnings to leaked LPG gas installations and promptly take prompt and automatic precautions. With the development of warning gas monitoring via android raspberry-based pi is expected to improve the security system and reduce the risk of work accident caused by LPG gas.

**Index Terms**— Gas Monitoring, Raspberry pi, MQ2, LPG, Android

## I. INTRODUCTION

Sistem Manajemen Keselamatan dan Kesehatan Kerja commonly referred to as SMK3, is now a very important concern because of the high number of work accident in Indonesia. SMK3 to build occupational safety and health system by involving management element, worker, condition and integrated work environment in order to prevent and reduce accidents and occupational diseases.

To meet the demands set by the government and its customers. The Company has followed its first audit in accordance with OHSAS 18001: 2007 standard, ILO-OSH: 2001 and Permenaker No 5 Year 1996 [1] on Occupational Safety and Health Management System. At the time of the first audit there were several findings, one of them in chemical warehouse in which there is gas installed to the production machine.

Findings submitted by the auditor to the team SMK3 in The Company is weakness of security system on Installation of gas in the warehouse, because in case

of leakage in the gas installation, it may be risky such as contamination of the product, the danger of gas being inhaled by the employee and the most dangerous is the explosion. For now the security system has not been maximal and can effectively control the danger of gas leakage. The current security system is still using the emergency button to be pressed by someone who knows if there has been a leak in the existing gas installations in the chemical warehouse, this can be risky for the safety of employees and the production process at The Company.

Along with the increasingly sophisticated technological developments over time, security systems must be improved so that leak monitoring of gas installations can be more effective and efficient [2]. Therefore, the monitoring of an object becomes more practical. To observe an object does not need to be done continuously, but simply put a sensor that leads to the desired object and then observe it through android smartphone [3]. For devices to be used as controllers and gas leak information givers in chemical warehouse using android smartphone. In one of the journals of the International Journal of Computing and Technology titled Android Base Home Automation Using Raspberry Pi writes that it is possible to set up a system to control and monitor using raspberry pi via android applications run on smartphones using android operating system [4]. Based on the research, to monitor gas leakage in this research can be done by using Android smartphone and Raspberry Pi.

Based on the above background, this research intends to make a leak detection device on gas-based raspberry pi installation connected to android application so that the SMK3 team can monitor the condition of the warehouse without having to repeatedly come to the site. The number of employees, especially SMK3 team that uses android smartphone can be used as a solution to monitor and control leakage on gas installations in chemical warehouse through android smartphone that they use. It is hoped that the construction of this system can increase and reduce the risk of work accident caused by LPG gas.

## II. LITERATURE REVIEW

### A. Internet Of Things

Internet of Things (IOT) is a computational concept that describes the future in which every physical object can connect to the internet and can identify itself between other devices [5]. The term "Internet of Things" became known in 1999 when it was first mentioned in a presentation by Kevin Ashton, confessor and executive director of the Auto-ID Center at MIT (Massachusetts Institute of Technology).

### B. Android

Android is a subset of software for mobile devices that includes middleware operating systems, and core applications released by Google. Android is a mobile operating system that adopts Linux operating system, but has been modified. Android was taken over by Google in 2005 from Android, Inc. as part of a strategy to populate the mobile operating system market. Google takes over all android work including the team that developed Android [6].

### C. Arduino Nano

Arduino is an electronic kit or an Open source electronic circuit board in which there is a main component, a microcontroller chip with Advanced Versatile RISC (AVR) type from an Atmel company. The microcontroller itself is a chip or integrated circuit (IC) that can be programmed using a computer. The purpose of embedding the program on a microcontroller is that the electronic circuit can read the input, process the input and then produce the output in accordance with the desired. So the microcontroller as the "brain" input, output and process on an electronic circuit.

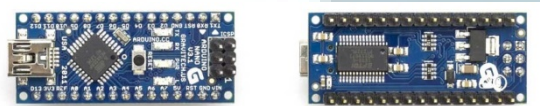


Fig 1. Board Arduino Nano

### D. Raspberry Pi

Raspberry Pi is a mini computer device the size of a credit card. Raspberry Pi has a Broadcom BCM2835 chip (SoC) system, which includes the ARM1176JZF-S 700 MHz processor (the firmware includes a number of "Turbo" modes) so users can try overclocking, up to 1 GHz, tanp, VideoCore IV GPU, and originally shipped with 256 megabytes RAM, then upgraded to 512MB. Includes built-in hard disk or solid-state drive, but uses the SD card for booting and long-term storage.

The operating system is embedded in an SD Flash Card, which makes it very easy to replace and exchange. The potential is remarkable, from the already or never explored, but has been tested as a multimedia player with good capabilities [7]. Raspberry pi has GPIO (general purpose input output). GPIO is a generic pin on a chip that can be controlled and programmed through software in both configurations as input pins and output pins.

### Raspberry Pi 3 GPIO Pin Layout

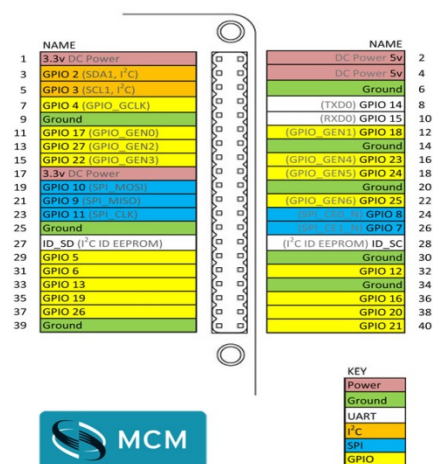


Fig 2. Board Arduino Nano

### E. Sensor MQ2

This sensor functions like a potentiometer, the resistance of this sensor varies proportional to the concentration of the detected gas. The change in resistance value of the sensor is then transferred to the ADC1 port of the microcontroller to be converted to PPM value. (Part Per Milion) The MQ-2 gas sensor has an output change in the resistance value, so in its use with the microcontroller ADC we need to add the load resistor so that the sensor readings can be worth the voltage. The change in voltage values is then converted to PPM (Part Per Milion).

### F. Web Service

Web Service is a software system designed to support interaction and interoperability between systems on a network. Web services are used as a facility that provides services (in the form of information or data) to other systems, so that they can interact with the system through the services provided. Web services store information data in JSON or XML format, so this data can Accessed by other systems despite different platforms, operating systems, and programming languages [8].

## III. RESULT

### A. Problem Analysis

Some of the most common problems with gas leak checking activities are :

1. Weak security system in existing gas installations in chemical warehouse, because the current security system only uses emergency button which is operated manually when gas leak occurs.
2. Inefficient time when monitoring the gas installations in chemical warehouse, because the team must check the condition of the warehouse at any time during working hours.

### B. System Architecture Analysis

The system to be built has several stages of input data obtained from the sensor MQ2, data processing input by raspberry pi 3, warning information that appears in android smartphone applications. As for the design of the system to be built can be seen in Figure 3 below.

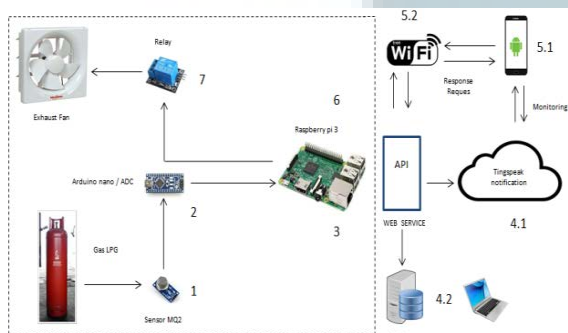


Fig 3. System Architecture

The following analysis of data flow and stages to explain the work process on the system design architecture above:

1. The MQ2 sensor detects the level of hydrocarbon gas in the air around the LPG gas cylinder installation, then the MQ2 sensor sends an analog signal to the arduino nano microcontroller based on the gas content detected by the MQ2 sensor. The gas detected is LPG type gas which consists of two gas mixtures, propane 30% and 70% butane. To differentiate LPG gas and other types of gas then on the sensor MQ2 there is a datasheet that determines the type of gas detected, here is the sensor datasheet to differentiate the type of gas:
  - Propane 200-500 ppm
  - Butane 300-5000 ppm
  - Methane 5000-20.000 ppm
  - Ethanol / alcohol 100-2000 ppm

The hydrocarbon gas that is sensed by the MQ2 sensor affects the value of the analogue resistance which can be converted to voltage. The sensor readings can be read by the ADC pin (analog to digital converter) on the arduino nano microcontroller.

2. Arduino nano works as an ADC (Analog to digital converter). This ADC is used as an analog to digital converter for the signal can be read by raspberry pi. For example, if the reference voltage is 5 volts, the input voltage is 3 volts, the input to reference ratio is 60%. So, if using an 8bit ADC with a maximum scale of 255, we get a digital signal of  $60\% \times 255 = 153$  in decimal form and converted to binary form 10011001.

$$\begin{aligned}\text{Signal} &= (\text{sample} / \text{max\_value}) * \text{reference\_voltage} \\ &= (153/255) * 5 \\ &= 3 \text{ Volts}\end{aligned}$$

3. Raspberry pi receives an imputed value of Arduino nano that has converted digital signals. Raspberry pi is programmed by using python language to process the value of imputation into information sent to android smartphone, if the specified gas value has reached the maximum limit that has been determined, automatically exhaust fan child is on. Besame with the command to fire the raspberry exhaust fan also sends information in the form of value to server tingspeak.com and server The Company.
4. The value sent by raspberry pi is stored on the server tingspeak and server The Company.
  - a. Data sent to tingspeak.com server by raspberry pi is data for notification if value in field = 1 means that there has been a mistake and if value in field = 0 means no leakage.
  - b. Data sent to the server The Company is the reading data from the MQ2 sensor periodically, whose results are stored on the server The Company and can be seen in web applications in the form of line charts and tables.
5. Applications on android smartphone in this research work in two stages:
  1. The application on the android Smartphone reads the value on the tingspeak.com server periodically if the value in field = 0 means no leakage on the gas installation, if the value in field = 1 means there has been a leak in the gas installation. Applications on android smartphone provide a notification if the value is read in the field = 1.
  - b. Applications on android smartphone can control GPIO on raspberry pi that serves to control the relay switch.
6. Raspberry pi receives commands from android smartphone to run a program that serves to disable the previously active relay switch to turn on the exhaust fan in the trigger by the MQ2 sensor. GPIO on raspberries to further control the relay..
7. The relay switch then receives the signal in the form of voltage supplied by GPIO on raspberry pi what if the value on the raspberry HIGH program then the relay is active and if the value on LOW program then switch is off.

Another explanation that can explain more details of the system workflow can be seen in figure 4 below.



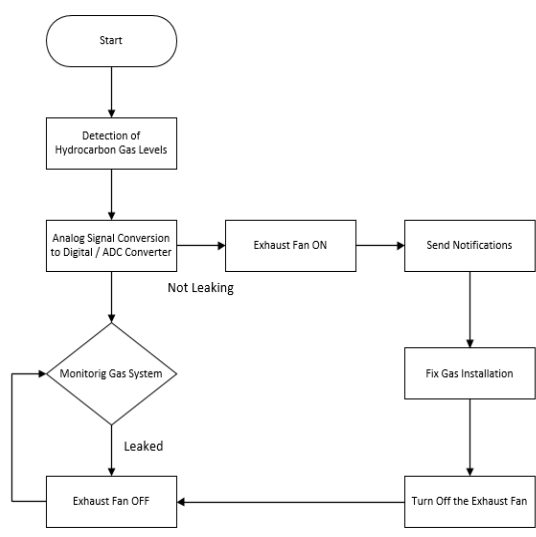


Fig 4. System Data Flow Analysis

### C. Web Service Analysis

In the development of this web service based RESTfull API with JSON-based data exchange, web service development is built into two parts: webservice for android device and web service for web application, both web service is connected to one database. The webservice is accessed by web apps and android apps and then reconfigures on the device with JSON format.

### D. Hardware Analysis

Hardware analysis is an analysis process that emphasizes more on the aspect of hardware utilization needed for research Prototype Warning Monitoring Gas Via Android Based Raspberry pi in Chemical Warehouse The Company.

#### D.1. Mini PC Raspberry Pi3 Analysis

Instead of PCs in this study used a mini PC that is Raspberry pi 3. Raspberry pi or often abbreviated Raspi, is a single board computer SBC (single-board circuit) the size of a credit card. Raspberry pi has a processor, RAM and hardware port like most computers that can be connected to monitors, keyboard and mouse. In addition raspberry pi also dilengkapi with GPIO (General-Purpose input / output) which serves to control the relay that works as a switch. Relay is one component part of the system to be built. Raspberry pi is a good choice to use as a web server as a liaison between the android smartphone device and microcontroller that is suitable for the system to be built on the research being conducted.

TABLE I. Specification Raspberry Pi3

Specification of Board Raspberry Pi 3	
SoC	Broadcom BCM2837
CPU	4x ARM Cortex-A53, 1.2GHz
GPU	Broadcom VideoCore IV
RAM	1GB LPDDR2 (900 MHz)
Networking	10/100 Ethernet, 2.4GHz 802.11n wireless
Bluetooth	Bluetooth 4.1 Classic, Low Energy
Storage	MicroSD
GPIO	40-pin header, populated
Port	HDMI, 3.5mm analogue audio-video jack, 4xUSB 2.0, Ethernet, Camera serial interface (CSI). Display Serial Interface (DSI)

Raspberry pi can be activated by using a micro USB cable with a voltage of 5V and a minimum current of 700 mA. With 700 mA current limits on micro USB and GPIO pins. Any good input / output digital pins have logic high 3.3VDC and low logic 0 VDC. If the resistance is less than 3.3V on any pin it can cause damage.

#### D.2. Microcontroller Arduino Nano Analysis

The microcontroller board used in this experiment is an arduino nano board. Arduino nano is a microcontroller board based on ATmega328p with a very small size. Arduino nano is used as ADC (analog to digital converter). This ADC works to convert analog signals that send MQ2 sensors into digital signals to be read by raspberries pi. By using arduino nano to facilitate the process of assembling a series of electronics microcontroller than assemble ATmega328 from scratch in breadboard.

TABLE II. Specification Raspberry Pi3

Specification of Arduino Nano	
Chip microcontroller	Atmega328p
Voltage Operation	5V
Input Voltage	7V-12V
Digital I/O pin	14 pieces, 6 of which provide PWM
Analog input pin	6 pieces
Arus DC per pin I/O	40 Ma
Memori Flash	32 KB, 0.5 KB is used for bootloader
SRAM	2KB
EEPROM	1KB
Clock speed	16 Mhz
Dimension	45 mm x 18 mm
Weight	5 g



### D.3. Sensor MQ2 Analysis

For LPG gas sensor used MQ2 sensor. MQ2 is an electronic component for detecting hydrocarbon gas levels such as iso butane (C<sub>4</sub>H<sub>10</sub> or isobutane), propane (C<sub>3</sub>H<sub>8</sub> or propane), methane (CH<sub>4</sub> or methane), ethanol (ethanol alcohol, CH<sub>3</sub>CH<sub>2</sub>OH), hydrogen (H<sub>2</sub> or hydrogen), smoke, and LPG (liquid petroleum gas). This gas sensor can be used to detect gas leakage at home and factory, in this research MQ2 is used to detect leakage of LPG.

By using MQ2 hydrocarbon Gas Sensor, the researchers can detect the levels of hirdokarbon gas in the air by connecting the MQ2 sensor to the Arduino nano microcontroller. Thus the researcher can make electronic devices to determine the action based on readable data, such as sending notification on the smartphone android warning sign of danger when gas leak is detected.

The output of this sensor is analogue resistance which can easily be converted to voltage by adding one ordinary resistor can also use potentiometer so threshold detection sensitivity can be adjusted as needed. By converting this impedance into voltage, the sensor reading result can be read by ADC pin (analog to digital converter) on arduino nano microcontroller. This MQ2 gas sensor can be installed close to the gas installation so that when LPG gas leak occurs, this sensor can easily detect it. The description of how the sensor works can be seen on the Figure 5.

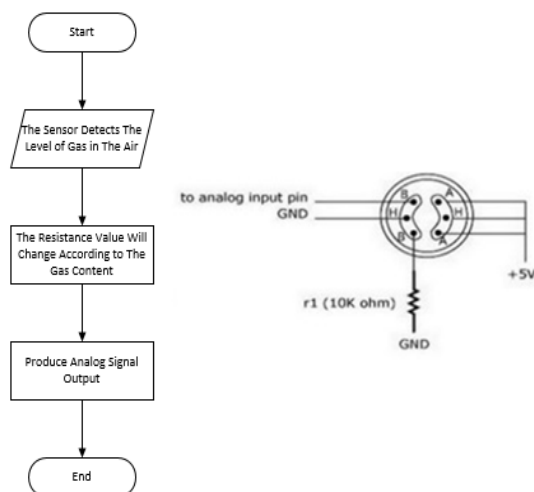


Fig 5. How Sensors Works

### D.4. Relay Switch Analysis

This research uses a switch as an electrical voltage relay. A relay is an electromechanical component that acts as a switch operated by an electric voltage. The relay consists of two parts namely the Coil electromagnet and a set of switch contacts. Relays use electromagnetic principle to drive the Switch Contacts so that with a small electric current (low power) can conduct higher voltage electricity. For example, with

Relays using 5V and 50mA Electromagnets capable of moving Armature Relay (which serves as a switch) to conduct 220V.

### E. Functional Needs Analysis

This section discusses the use case diagrams of mobile applications, class diagrams and relational schemes of the table structure on the web backend.

#### E.1. Use Case Diagram Mobile Application

Use Case Diagram is a diagram showing the functionality of a system or class and how the system interacts with the outside world and describes the system functionally visible to the user. From the identification of actors involved above then Use Case Diagram can be described as follows in Figure 6.

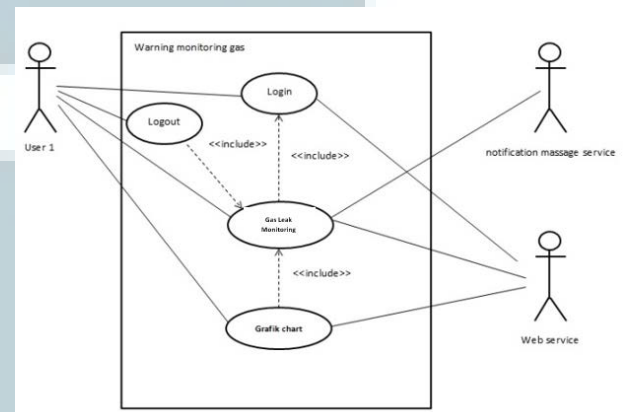


Fig 6. Use Case Diagram

#### E.2. Class Diagram Aplikasi Mobile

Class Diagram is a structural diagram that modeled a set of classes, interfaces, conditions and relationships. The class diagram is depicted with a box that is essentially divided into three parts, namely class name, attribute, and operation. For the class diagram in this study are as follows in Figure 7:

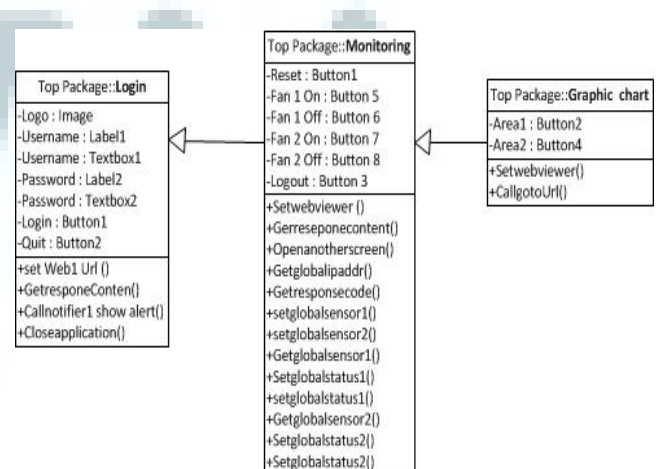


Fig 7. Class Diagram

### E.3. Table Structure Database

The table structure describes the detail of the table containing fields, data types, data lengths, and other information. Figure 8 is a description of each of these tables databases.



Fig 8. Table Structure Database

## F. Implementation and System Testing

Stage Implementation and system testing is a design translation phase based on the results of analysis into a particular programming language and application of software built in the real environment.

### F.1. Hardware Implementation

The hardware used to implement the system can be seen in the table III and Figure 9 below.

TABLE II. Spesification Hardware Implementation

Hardware	Spesification
Processor	Intel Core i3
Mini PC	Raspberry Pi 3
Mikrokontroler ADC	Arduino Nano
Relay	2 channels
Sensor	MQ2
Fan Voltage	5 Volt

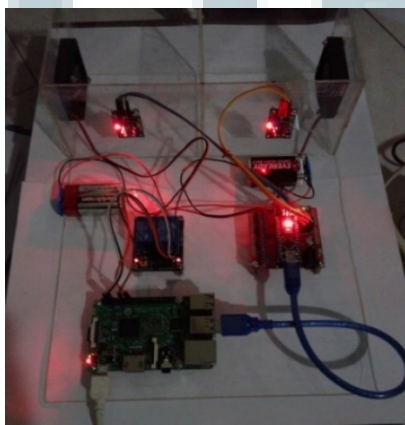


Fig 9. Hardware Implementation

### F.2. Raspberry Implementation

In Raspberry pi can be seen the value generated by the MQ2 sensor sample results. Visible on the image the value changes when there is a leak in the gas..

MQ2 sensor sample results when no leaks can be seen in the Figure 10.

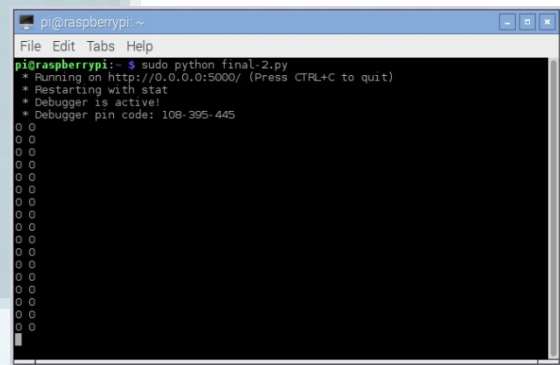


Fig 10. Sensor Value Without Gas Leakage

MQ2 sensor sample results when have leaks can be seen in the figure 11.

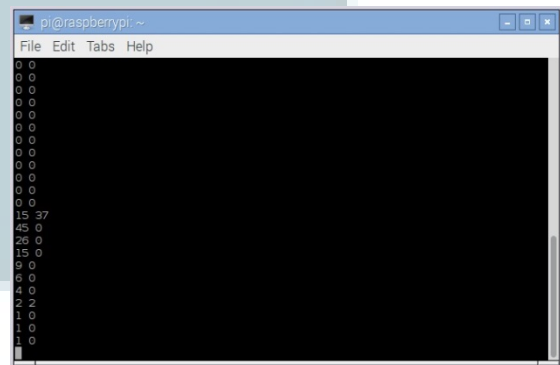


Fig 11. Sensor Value With Gas Leakage

### F.3. Mobile Android Implementation

Here is an implementation of several interfaces of the android mobile platform system that can be built.

#### F.3.1 Login Page Interface

In login page interface, user fill in Username and Password on the login page to be able to enter Warning Monitoring Gas Application. The appearance can be seen in the Figure 12.



Fig 12. Login Page Interface

### F.3.2. Chart Page Interface

Chart Charts On this page Users can see images of Graphic Chart from MQ2 sensor that detects gas leak in warehouse.

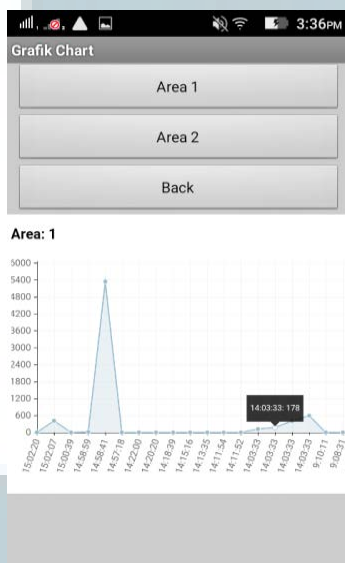


Fig 13. Chart Page Interface

### F.4. Website Implementation

Chart graph display on server can be seen through web application. In this web application can be seen graphs, historical tables, and time tables of events.

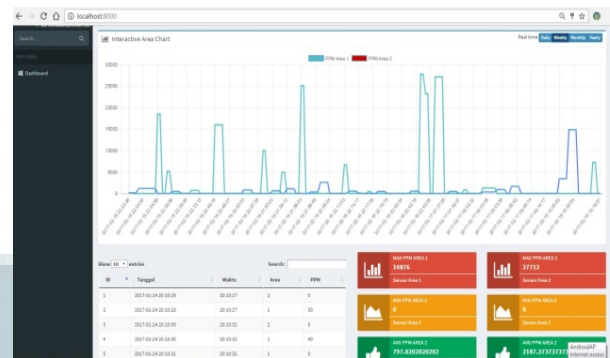


Fig 14. Chart Page Interface on Web Server

## G. System Testing

This software testing uses two stages, the first stage is alpha testing that focuses on software functionality built with black box testing methods. The second stage is beta testing that focuses on user assessment of the software built, data collection methods in the form of interviews to parties who involved in the system. Alpha testing is a test of functionality against software built. Alpha testing is done by users who use software that has been built previously and accompanied by the builder. The builder notes the mistakes and problems felt by the user. Alpha testing is divided into three stages, namely test scenario, case and test results, and test conclusions.

### G.1. Gas Leak Monitoring Testing

Table III below is the result of blackbox testing of gas leakage with this application.

TABLE III. Gas Leak Monitoring Testing

Test Cases	Test Scenarios	Expected Results	Test Result
Gas leak monitoring (status "safe", "alert") and notification	User gets status information ("safe", "alert")	Displays status ("safe", "alert")	[√] Succeed [ ] Failed
	User Gets notification in case of gas leak	Displays notifications of text and vibration	[√] Succeed [ ] Failed
	Users press the button ON button to turn on the Exhaust Fan no 1	Exhaust fan no 1 is on	[√] Succeed [ ] Failed
	Users press the OFF button to turn off exhaust fan no 1	Exhaust fan 1 is off	[√] Succeed [ ] Failed

Test Cases	Test Scenarios	Expected Results	Test Result
	Users press the ON button to turn on the exhaust fan no 2	Exhaust fan 2 is on	[√] Succeed [ ] Failed
	Users press the button OFF button to turn off exhaust fan no 2	Exhaust fan 2 is off	[√] Succeed [ ] Failed

Figure 15 below shows an example of test scenario implementation result that the user gets the status of safe or alert information. On this page the user can see the status of the gas condition in case of leak it appear notification in the form of a warning that there has been a leak.

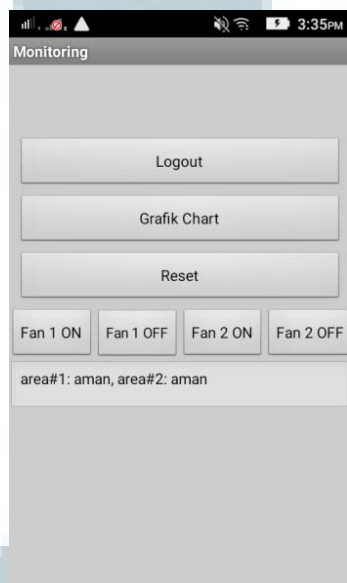


Fig 15. Monitoring Page Interface

## G.2. Blackbox Testing Conclusion

Based on the results of blackbox testing that has been done can be drawn the conclusion that the process still allows an error, but the system functionality can produce output, validation and error handling process is expected.

## IV. CONCLUSION

Based on the results obtained from research conducted this study, it can be concluded :

1. Security system for leakage on gas LPG installation in chemical warehouse at The Company in this research can be improved
2. Time to monitor gas installation condition in chemical at The Company in this research becomes more efficient

Furthermore, this monitoring system can be developed in all aspects of safety not only used for gas leakage only but can be developed to monitor all security systems in The Company, for example wastewater disposal security systems, security systems on production machines and so on so that all systems can be centralized and easy to monitor.

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# Designing Information Product (IP) Maps On the Process of Data Processing and Academic Information

Diana Effendi<sup>1</sup>

<sup>1</sup>Informatics Management Department, Universitas Komputer Indonesia, Bandung, Indonesia  
diana.effendi@email.unikom.ac.id

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**Abstract—** Information Product Approach (IP Approach) is an information management approach. It can be used to manage product information and data quality analysis. IP-Map can be used by organizations to facilitate the management of knowledge in collecting, storing, maintaining, and using the data in an organized. The process of data management of academic activities in X University has not yet used the IP approach. X University has not given attention to the management of information quality of its. During this time X University just concern to system applications used to support the automation of data management in the process of academic activities. IP-Map that made in this paper can be used as a basis for analyzing the quality of data and information. By the IP-MAP, X University is expected to know which parts of the process that need improvement in the quality of data and information management.

**Kata kunci :** IP Approach, IP-Map, information quality, data quality.

## I. INTRODUCTION

The Information owned by an organization should be managed as a product. Capital is no longer the only major resource that must be owned companies. But, the information that was the main resource that must be owned. Data were processed incorrectly, can produce false information, and of course difficult to expect the correct decision if built on bad information. So, the data needs to be managed properly. Managing data is not just how to provide and sort through the data, but also how to have data that is accurate and free of errors, and how to do it. For this reason, the information possessed by the organization must be managed as a product in various ways. In this perception, the focus is product information, not the system that produced the product.[1][2][3]

Information management approach as a product called (IP Approach). IP approach is a very different

approach to information management approach that has been done by the organization, known as by product approach. Organizations that use the by product approach, place the application as the end product of the information system, not information itself. In table 1 below, described some of the things that distinguishes between IP approach to by-product approach.

Tabel 1. Differences Between IP Approach And By-Product Approach

	IP Approach	By-Product Approach
What is managed?	Information; product information life cycle.	Hardware and software; system life cycle
How to manage?	Integrated, cross-functional approach that cover the entire parts of the organization.	Stove-pipe systems, the control of individual components, costs control.
Why should manage it?	Provide high quality information to the users of the information.	implement a high quality hardware and software system
What are the success criteria?	Provide quality information throughout the product lifecycle, No Garbage In Garbage Out (GIGO).	The system worked well, and no bugs.
Who is managing it?	CIO, Information product manager.	CEO, IT director, the database administrator.

X University is an educational institution that organizes higher education in Bandung, Indonesia, and has been using information technology as the core of its business, as well as facilities and infrastructure to provide services to students, faculty and the entire staff as well as support the implementation of activities in all units. The importance of the use of information technology in the implementation of each activity, requires X University to perform data and information management appropriately.

In previous research [5], measurement of data and information quality has been done to the process of academic data management, which includes student registration process, guardianship, value. The process involves several existing entities, namely X Center (UC), Academic Administration and Students Affair (BAAK), and Department (major). The result of measurement of the quality of information done by using CALDEA and EVAMECAL method shows that the quality of data and information of X University for the process of information management (IMP) of academic activity has not reached the definition level with the ML-IQV value of 6.33. It said a data and quality information for the processing of information (IMP), if ML-IQV reaches a value of more than 90.

Low levels of quality information that is because the X University has not given his full attention to the quality of the information it holds. X University more attention in the development of systems, such as IT infrastructure and applications of information systems. X University has not considered the information is as a product, which must be managed.

In this paper, the IP approach will be to manage the quality of data and information on the IMP academic activities. In the last part, will be described IP-Map of academic activities carried X UNIVERSITY today. IP-Map that can then be used as a guide to improve the quality of data and information management X University in the future.

It is important in the management of information as a product requires a paradigm shift in the organization of the information itself. The main principle in the IP approach in this regard, ie : [1] [3]

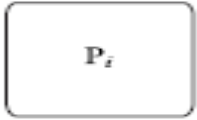


1. Understanding the needs of users of information.
2. Managing the information as a product, resulting from the production process is well-defined.
3. Managing information as a product that has a life cycle.
4. Pointing information product manager to manage product information.

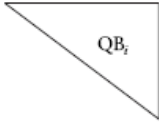



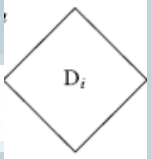

The Four Principle is the key to maintaining the quality of the information. To implement IP approach, organizations not only need a philosophical understanding, but also require models, device support, and techniques of IP approach. *Product Map* (IP-Map) provides a set of tools to implement the IP approach, and support the continuity of data quality. IP-Map is a toolkit that is used to manage the information product and the analysis of data quality.

IP-Map is a toolkit that is used to process the product of the information and analysis of quality data. IP-Map is a systematic representation of a process for making or creating a product of the information using a standard set of symbols and rules. It should be understood that the standards development process in the manufacture of IP-Map is still being developed, and will continue to evolve. Standard Group is a committee of academics and practitioners of data quality, has created a standard in the manufacture of IP-Map. [2]

In IP-Map, known definition that is commonly used by IP-Map user organizations. This definition is the data elements and products of the information. Data element is the smallest unit of data that has meaning in the context of the operational environment. Data elements can include attributes of an entity, a field within a record or form [2][3][4]. Examples of data elements that student registration number, name, date of birth, etc. While the product of information (information product) is a collection of instances of data elements that meet the specific needs of the use of data [2][3][4]. The data requirements for example for reporting or decision-making process. Examples of product information are transcripts, study results card, etc.

Tabel 2. IP-Map Basic Symbols [2][3]

Construct Description	Construct Item
<b>Function or process block :</b> Task that describes any transformations, manipulations, or calculations performed (i.e., What should be done ? Example :Create purchase order, Update database)	
<b>Source (raw input data) block :</b> This block is used to represent the source of each raw (input) data that must be available in order to produce the information product expected by the consumer.	
<b>Customer (output) block :</b> This block is used to represent the consumer of the information product. The consumer of the information product. The consumer specifies in this block data elements that constitute	

the “finished” information product.		acrossing business unit boundaries and therefore assign accountability to the appropriate business unit.	
<b>Data quality Block :</b> This block is used to represent the checks for data quality on those data items that are essential in producing a “defect-free” information product. Therefore, associated with this block is a list of data quality checks that are being performed on the specified component data items.		<b>Information system boundary block :</b> This block is used to reflect the changes to the raw input data items as they move from one information system to another type of information system ( Example : Paper to Electronic). These system changes could be intra or inter-business units.	
<b>Data storage block :</b> This block is used to represent the capture of data items in storage files or database so that they can be available for further processing.		There are circumstances where the raw input data items or component data items go through both a business boundary and a system boundary change. The combined business-information system boundary block is defined for this purpose.	
<b>Decision block :</b> In some complex information manufacturing systems, depending on the value of some particular data item(s), it may be necessary to direct the data items to a different set of blocks down stream for further processing. In such cases, a decision block is used to capture the different conditions to be evaluated and the corresponding procedures for handling the incoming data items based on the evaluation.			
<b>Business boundary block :</b> The business boundary block is used to specify the movement of the information product (or raw/component data) across departmental or organizational boundaries. The role of the business boundary block in the IP-Map is to highlight the data quality problems that might arise when			

There is a similarity between the IP-Map with Data Flow Diagrams (DFD). But, IP-Map is not merely describing the flow of data as well as DFD. IP-Map provides information on collector information, maintainer information, and users of information. Information about the level of participation and the role of stakeholders in the process of producing the information to be written. Similarly, the information on the infrastructure of a system, organizational infrastructure, and certain functions in the organization. IP-Map combines the information in the dimensions of data quality. Dimensions of data quality, timeliness especially can be combined into a number of blocks of IP-Map.

## II. IP-MAP CONSTRUCTION PROCEDURE

Standard Group proposed procedures to establish IP-Map. The stages are contained in the IP-Map construction procedure is as follows [2]:

**Stage 1 :** Selecting IP to be mapped. Select the data elements are dominant in the IP. There are several ways to get this data element. The first way, the data

elements obtained by examining and decomposing IP. The second way, if the IP could not be identified or described clearly, it is done bottom-up approach to select one or more data elements are critical of the IP. A set of data elements can be further used or disposed of during the IP-Map was developed

- Stage 2** : Identification of parties responsible for creating, collecting, enter data, maintain data, and who will use the data.
- Stage 3** : Describing between data elements, transformation, and connectivity between the data stream.
- Stage 4** : Identify the functional roles. Identification of individual involvement and responsibilities of each.

The information obtained from each stage are combined in IP-Map. Usually performed in the following order:

1. Drawing workflow
2. Drawing data flow
3. Drawing system infrastructure
4. Drawing infrastructure and roles within the organization.

Furthermore, collection of the IP that can be used to manage information.

### III. RESULTS AND DISCUSSION

Based On IP Approach Principle described in section 1, X University need to do the following :

1. Understanding the needs of users of information. X University need to understand the needs of users of information in the process of data management academic activities. User information in academic activities in X University identified as students, faculty trustee, Vice Rector III, Chief BAAK, Chairman Prodi. While the product of the information needed by the users of such information is the Student Registration Statements, the Trust List Students, Student Study Cards (KSM), Card Study Results (KHS), the Academic Progress Report, Student Transcript.
2. Managing the information as a product, resulting from the production process is well-defined. The process of academic activities has been well defined by X University. Academic activities started from the student registration process, followed by the trusteeship process and taking courses, and ends with the evaluation process that was marked by the release of study result card and Academic Progress Report. Parties X University

Center, BAAK, and Prodi have databases that are connected, so that the data owned by the three entities is consistent.

3. Managing information as a product that has a life cycle.

Information must be managed as a product that has a life cycle. Starting from the information created or collected and managed, stored in a storage area (file or database), henceforth be given to those in need. X University has been doing these activities, but did not give great attention to the quality of the information being managed. X University more attention to the development of applications for data management automatically in supporting the implementation of academic activities, regardless of the quality of the data itself.

4. Pointing information product manager to manage product information.

X University has not had a team that handles the management of the quality of information separately. As described in previous research, quality management of information made by a team that also serves as a guarantor of the curriculum team. Therefore, X University need to form a special team to handle the product quality information, and appoint a person in charge of the team.

#### III.1 DEVELOPMENT IP-MAP DATA ACADEMIC PROCESSING

Academic data management process, including the process of student registration, trusteeship, and processing of students' academic value data. The process that occurs involves some existing entity that X University Center, BAAK, and Prodi-study programs. Network architecture that is in X University is divided into multiple networks according to existing study programs, which are connected together on the computer network of data centers in X University Center. The network is also integrated with BAAK. The permissions of each study program is governed by an administrator who manage all of the existing network in X University.

##### a. IP-Map of Student Registration

Student registration process produces information in the form of Student Registration Report that Given to the BAAK head and Vice Rector III, as well as the Student Trusteeship list given to every faculty trustee.



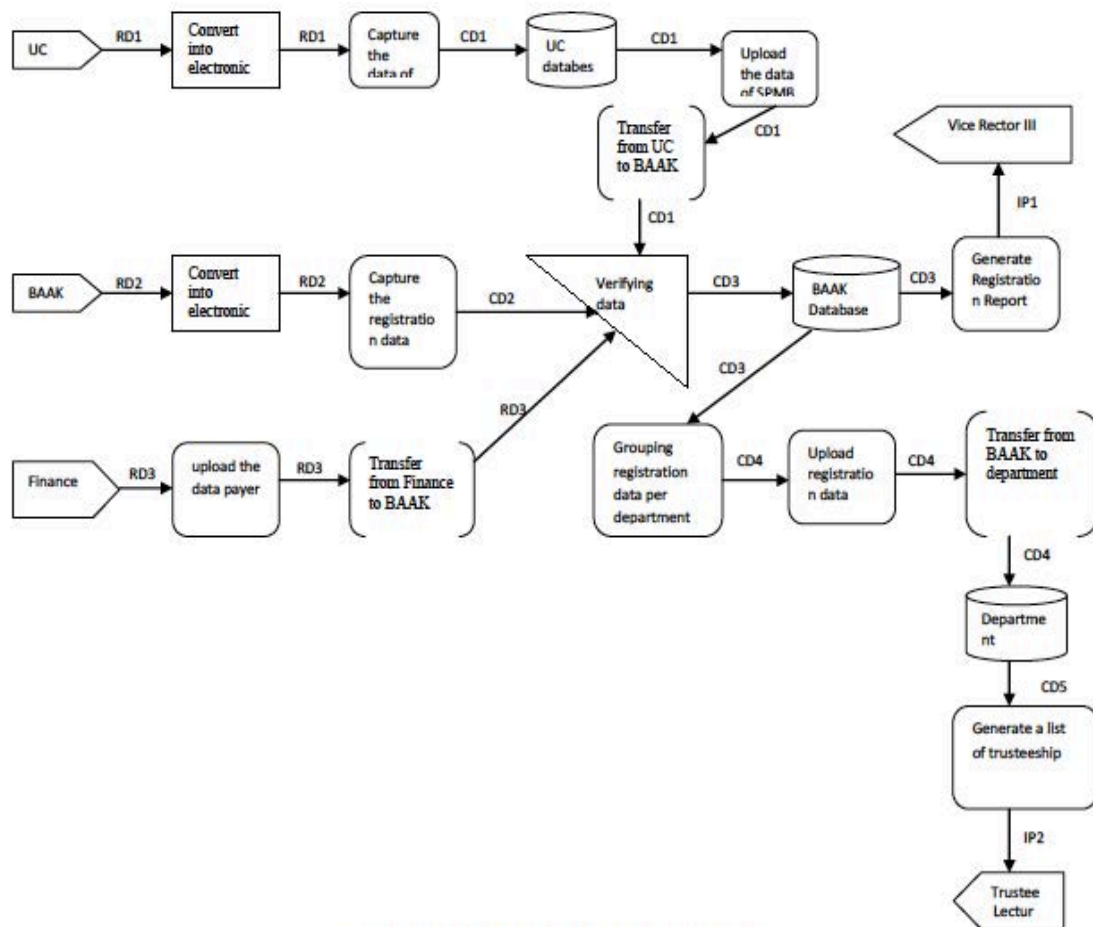


Image 1. IP-Map of Student Registration

RD1	: The SPMB Result of SPMB Committee
RD2	: Student registration data
RD3	: College payment data from banks
CD1	: SPMB result data
CD2	: Registration data
CD3	: Valid registration
CD4	: Student registration data per department
CD5	: Student registration data of the department
IP1	: Student registration report
IP2	: Trusteeship list of students

### b. IP-Map Of Student Trusteeship

Student trusteeship process produces information product such as KSM that given to students and faculty trustee as proof of taking the course. Management of information products for students trusteeship process can be drawn in the IP-Map in image 2.

Image 2:

RD4 : data of trusteeship  
RD5 : data of taking courses  
CD6 : data of trusteeship  
CD7 : data of taking courses  
CD8 : data of taking courses that validated by  
trusteeship data and registration data  
IP3 : Student Study Cards (KSM)

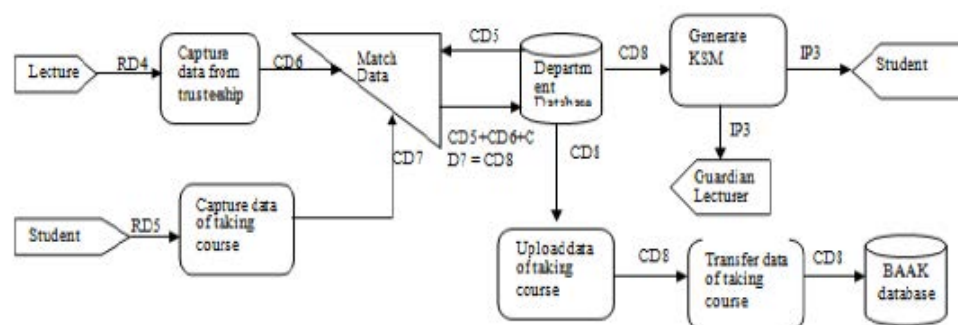


Image 2. IP-Map of Student Trusteeship

### c. IP-Map of Student Value Management

The Management process of Student Value produce information product such as KHS which given to students and faculty trustee, and Report of Academic Progress given to the Vice Rector III. Data of student value is also used by BAAK to make transcripts of students. Management of product information for the student evaluation process can be drawn in the IP-Map in Image 3.

Image 3.

RD6 : Students value data per class

CD8 : Students value data

CD9 : Student value data validated

CD10 : Final Students Value Data per student

CD11 : Final Students Value

IP4 : Study Result Card (KHS)

IP5 : Transcripts

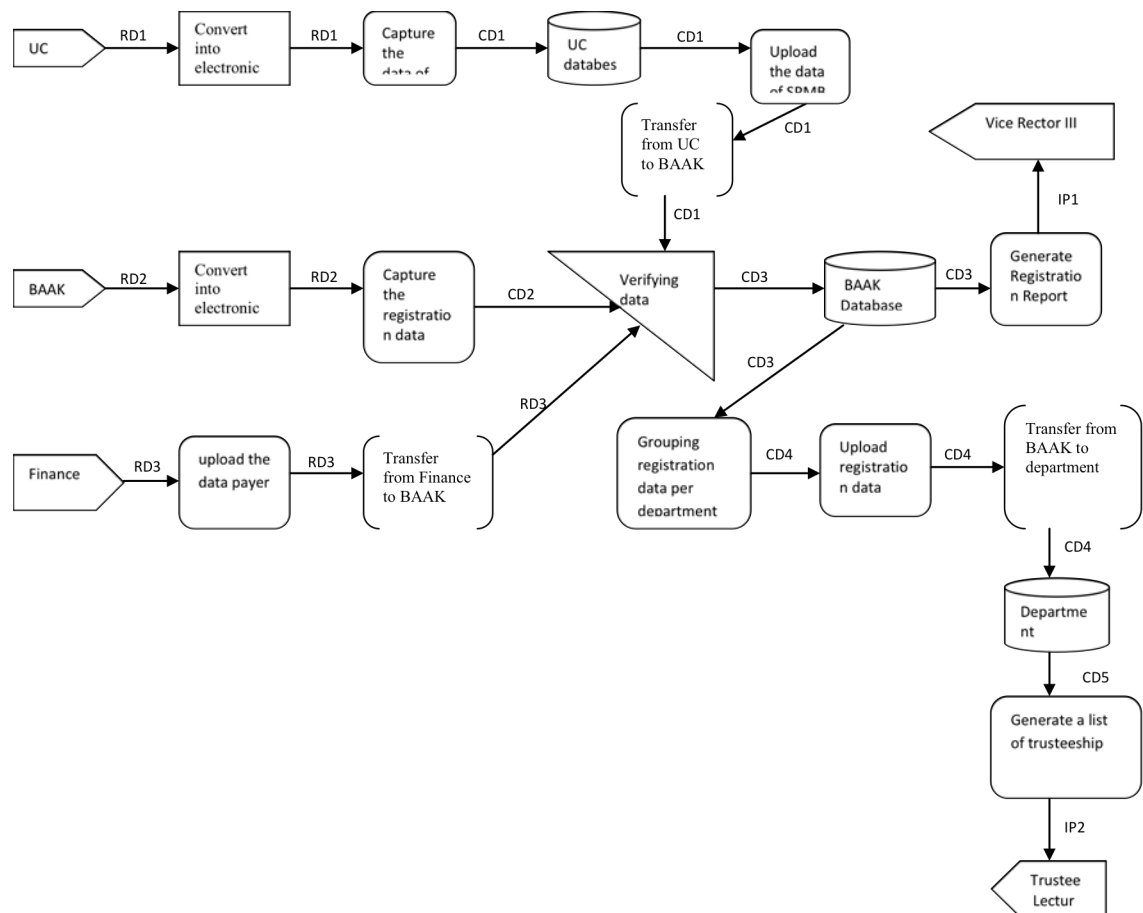


Image 3. IP-Map of Student Value Management

#### IV. CONCLUSION

During this time, X University only give attention to the application system used to support the automation of data in the process of academic activities. IP-Map made in this paper can be used as a basis for analyzing the quality of data and information. By looking at the IP-Map is expected X University parties can know which part of the process that need improvement in the quality of data and information management.

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# Simulation of Digital Radio Mondiale (DRM) Coverage Prediction – A study case with Radio Republik Indonesia (RRI)

Nabila Husna Shabrina

Department of Electrical Engineering, Universitas Multimedia Nusantara, Tangerang, Indonesia  
nabila.husna@umn.ac.id

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**Abstract**— In this paper, DRM is applied for simulating coverage prediction in Radio Republik Indonesia (RRI). The proposed method is developed by simulating high frequency propagation from RRI Pro 3 transmitter with VOACAP online software. The simulation is undertaken in some different conditions. The variation of antenna type and transmitter power are observed in the simulation. The time of propagation also discussed to predict the coverage. The result shows that the variation of parameter influences the coverage result of DRM propagation in HF band. Changing the antenna type and time of propagation will make impact in the range of coverage while adding power transmitter gives insignificantly effect to the range of coverage.

**Keywords**—DRM, Prediction Coverage, VOACAP

## I. INTRODUCTION

Countries around the world are now in the process for migrating from analogue to digital radio broadcasting. Digitalization provides advantages such as allows such features as automatic tuning, offers credible single frequency network and uses more efficient spectrum [1]. DRM is a digital radio standard designed by DRM Consortium for Low Frequency (LF), Medium Frequency (MF), and High Frequency (HF) bands [2][3]. DRM system is designed to provides a high quality digital replacement for current analogue radio system. It can be used both in Analogue Modulation and Frequency Modulation bands. DRM standard developed by an international consortium consist of broadcaster, network providers, manufactures, broadcasting unions and research institute. It specifically designed to allow new digital transmission to co-exist with the current analogue systems [4]. It also provides many advantages such as excellent audio quality, wide coverage, and significant energy cost saving.

Average radio today can only receive some 35-40 local FM stations. DRM itself has the potential to bring every radio a vast selection of new content because it is ideally suited to long range broadcasting so everyone can stay tuned to the same station as they cross regional and national boundaries and move from one country to another [4]. DRM is very portable and mobile. It can be taking anyplace to listen to what we want, when we want and where we want. Innovation in DRM brings short wave and medium wave broadcast can be heard in FM-like sound quality with excellent reception.

Radio Republik Indonesia (RRI), as state-owned radio of Indonesia joined DRM consortium in 2015. It possibly made Indonesia as the next county to apply DRM. Therefore, in this paper, DRM coverage simulation is investigated with HF propagation prediction model using VOACAP software. The coverage result variation as a response of changing simulation's parameters such as antenna type and transmitter power are analyzed. The propagation time also discussed to see the consequence on the coverage result.

## II. DRM STANDARD

### A. Frequency Bands

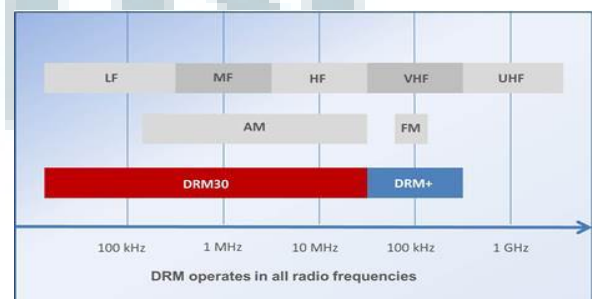


Fig. 1 DRM modes [3].



DRM system is a flexible digital sound broadcasting which available in frequency below 30 MHz [5]. Frequency bands for both DRM30 and DRM+ modes can be seen in Fig. 1. DRM standard describes several different operating modes which can be divided into two groups as follows [3]:

- DRM30 modes, designed for utilizing AM bands below 30 MHz
- DRM+ modes, designed for utilizing FM broadcast band from 30 MHz to 300 MHz

### B. Coverage Concepts for DRM

Planning for DRM coverage is build based on two concepts [5]:

- Minimum usable field strength

Minimum usable field strength describes the requirement field strength for the receiver to a given level of performance. In DRM, it can be defined as bit error rate (BER). The BER is used as parameter whether the DRM signal can be reconstructing or not.

- Protection ratio

Protection ratio is the minimum values that the wanted signal levels must exceed unwanted interfering signal level.

The frequency bands for DRM is lay on LF until VHF bands, however in Indonesia most of AM radio use HF frequency bands [6]. Therefore, in this work we use HF propagation to calculate the coverage for DRM system in RRI station.

### C. HF Propagation Model

HF Bands are ideal for providing coverage of large areas ranging from few hundred kilometers to several thousand kilometers from the transmitting site via sky-wave propagation. In addition, it can also propagate via groundwave but the range is only limited to few tens kilometers [7]. There are some methods to calculate HF prediction model which can be divided as follows:

- ICEPAC: IONCAP with ICED profile model developed by NTIA / ITS (Institute for Telecommunication Science)
- VOACAP: IONCAP modified by USIA/VOA

for broadcasting

- REC 533: ITU R PL533 model for international HF planning.

In this work, VOACAP is used as a model for understanding HF propagation for DRM coverage prediction.

## III. SIMULATION AND RESULT

Simulation is based on VOACAP freeware, a free online HF propagation prediction software developed by Jari Perkiomaki, James Watson, and Juho Juopperi. VOACAP is an engine which has the most accurate propagation prediction with radio propagation experience built in. This freeware can be found at <http://www.voacap.com/coverage.html>. The appearance for simulating HF propagation coverage in VOACAP online can be seen in Fig. 2.

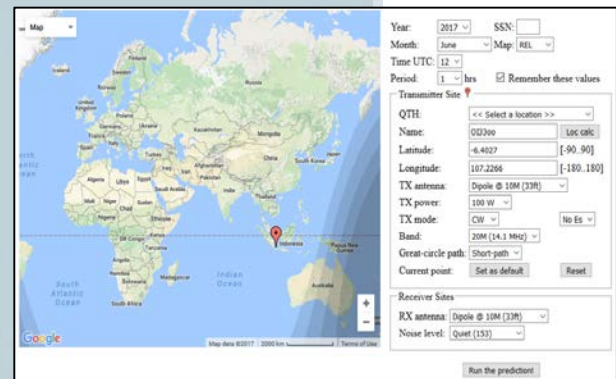


Fig. 2 Appearance of VOACAP coverage map.

### A. Parameter of Simulation

There are some parameters that should be include for calculating HF coverage as follows:

- Date

This contain year, month and time which used for simulation. It can be flexible, depends on the requirement. In this work, the month and year is set as June 2017. The time itself is changed from 8 A.M, 12 A.M, 5 P.M, 9 P.M. and 12 P.M.

- Transmitter Site

Transmitter site is an important parameter for predicting HF coverage. It contains the location of Tx (with its longitude and latitude), antenna, Tx power, Tx modulation, band frequency, and great circle path. RRI

station PRO 3 is chosen as a Tx location with -6.1729000 latitudes and 106.822353 longitude. Frequency band applied for this simulation is 30 M Band with 10.1 MHz frequency.

There are many types of antenna which can be chosen in this simulation. Two widely used antennas are omnidirectional antenna and directional antenna. Based on commonly used antenna in Indonesia for AM/FM broadcasting and recommendation antenna for conduct HF propagation from [8], omnidirectional antenna that selected in the simulation are  $\frac{1}{4}\lambda$  ground plane antenna,  $\frac{5}{8}\lambda$  antenna, and dipole antenna with length of 10 m. Meanwhile, from prior research in [9], the directional antenna that applied in this simulation is 3 element Yagi antenna with length of 15 m. The length of dipole and 3 element Yagi antennas are calculated with formula from [10]. The maximum transmitter power to be permitted in AM broadcasting in Indonesia is 2000 Watt [11] and mostly it ranged from 100 Watt, 500 Watt and 1000 Watt. Therefore, the transmitter power applied in this simulation are 100 Watt, 500 Watt, and 1000 Watt.

- Receiver Sites

The receiver in this simulation is static reception. The parameter only contains antenna used in receiver site. It is set to be the same as the antenna used in transmitter site.

The simulation is divided into three parts. In each part, some parameter is adjusted to obtain optimum specification for DRM coverage prediction with HF propagation approach. In the first simulation, the antenna type is adjusted into 4 types as mentioned before. In the second simulation, the transmitter power is added from the prior condition to see the effect on coverage result while in the third simulation, the time of propagation is changed into several variations. The coverage result is presented in graph which represent signal power received in that area (in percent) or the circuit reliability to conduct broadcasting communication in that area.

#### B. Simulation 1: Adjusting antenna type

In this first simulation, the time is set as 12 P.M with 250 Watt of transmitter power. From the results in Figs. 3-6 we can see that each type of antenna gives different result for predict the coverage. Three elements Yagi antenna gives the most intense reliability DRM coverage compared to  $\frac{1}{4}\lambda$  ground plane antenna,  $\frac{5}{8}\lambda$  antenna, and dipole antenna. Full coverage (100% coverage of DRM) can be reached until another Asia country like India and China. Some states in Australia also can hear RRI PRO 3 broadcast with 80%-100% reliability.

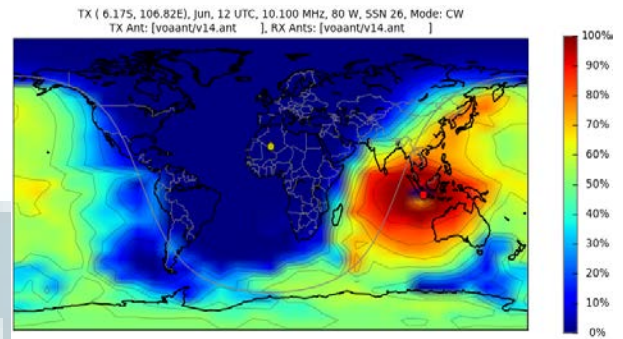


Fig. 3 Coverage Prediction for  $\frac{1}{4}\lambda$  ground plane antenna

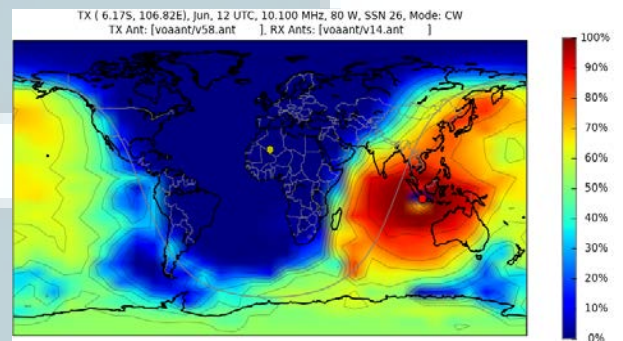


Fig. 4 Coverage Prediction for  $\frac{5}{8}\lambda$  antenna

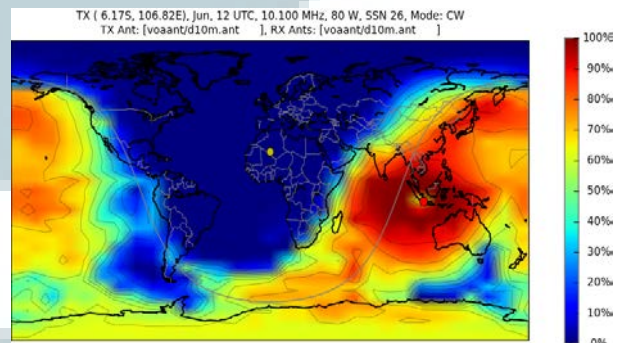


Fig. 5 Coverage Prediction for dipole antenna with length of 10 m



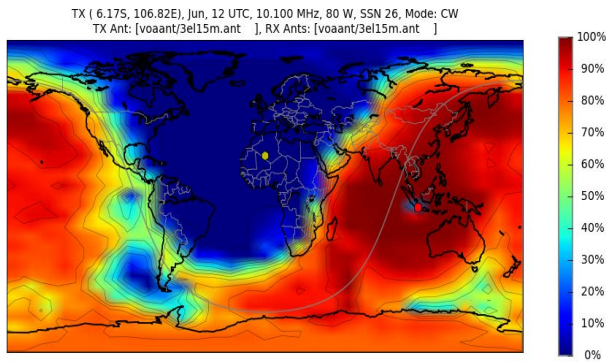


Fig. 6 Coverage Prediction for 3 antenna element Yagi antenna.

### C. Simulation 2: Adjusting Tx Power

In the second simulation, the Tx power is tuned into 500 Watt and 1000 Watt. Because the result in the first simulation shows that Yagi antenna gives most intense DRM coverage, the transmitter antenna in the second and third simulation is set as three element Yagi antenna with length of 15 m. The result given in Figs.7-8 shows that adding power to transmitter will insignificantly increase the range of coverage for DRM, moreover, it just does addition to the intensity of reliability in 70%-100%.

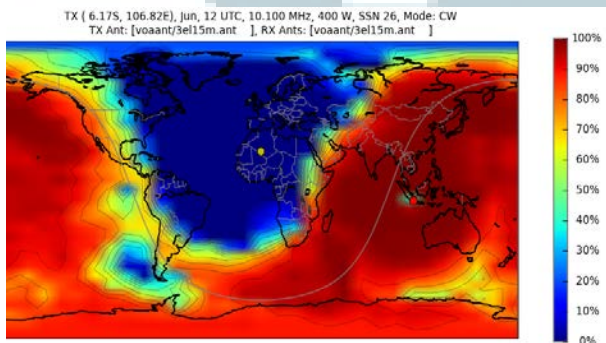


Fig. 7 Coverage Prediction for 500 W Tx Power

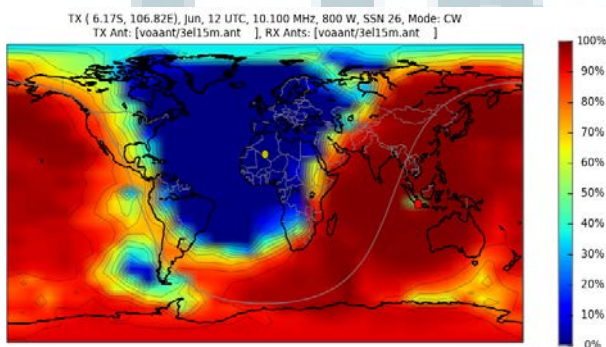


Fig. 8 Coverage Prediction for 1000 W Tx Power

Fig. 7 shows that added transmitter power into 500 W will not really contribute to the range of coverage but only increase the intensity for 80%-90% coverage. While from Fig.8, changed the power to 1000 W gives almost the same result as Fig.7, it only increases the intensity for 80%-90% coverage.

### D. Simulation 3: Adjusting the time

In this third simulation, the time parameter is changed into four conditions as mentioned before. Another parameter remained the same with the first simulation with three element Yagi antenna and 500 Watt transmitter power.

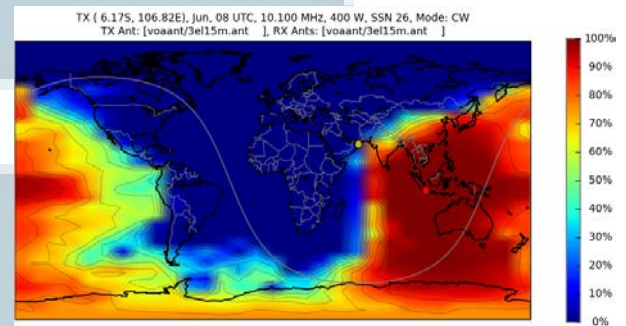


Fig. 9 Coverage Prediction at 8 A.M

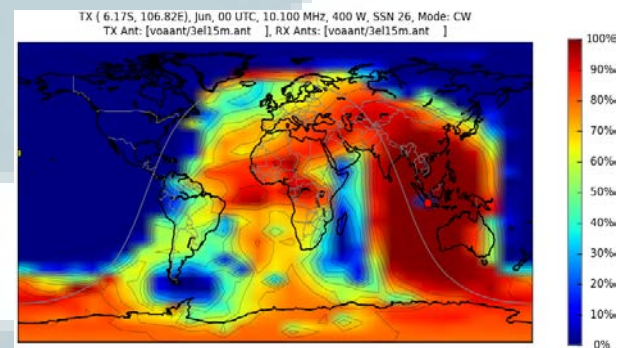


Fig. 10 Coverage Prediction at 12 A.M

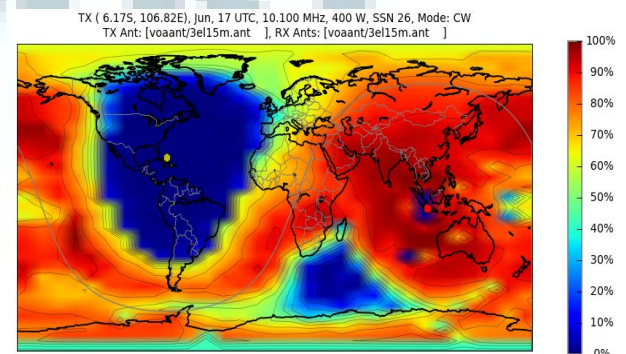


Fig. 11 Coverage Prediction at 5 P.M

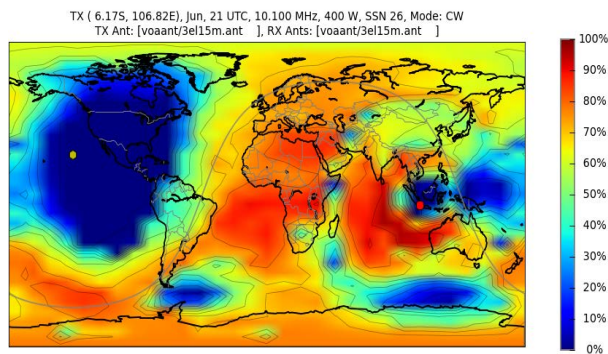


Fig. 12 Coverage Prediction at 9 P.M

HF propagation is affected with ionosphere condition. It can be seen from the simulation result in Figs. 9-12 that the time of propagation affected the coverage result. At 12 A.M and 5 P.M the DRM coverage can reach more country with larger reliability. At 8 A.M the DRM only can deliver the broadcasting content in ASEAN country while at 9 PM it gives wider coverage but decrease the reliability. The difference in the range of DRM coverage is caused by the ionosphere variation that change by the time of the day. The ionosphere condition will affect the HF propagation and its coverage.

#### IV. CONCLUSION

As mentioned in the earlier of this paper, the DRM standard has a large coverage ranging from few hundred kilometers until thousand kilometers. This is proven from the simulation that all the results in the pictures show the reliability to conduct radio communication from RRI Pro 3 to worldwide. Changing some parameters will affect the coverage result. The transmitter antenna will broaden or limit the result of coverage prediction depend on the type of antenna. Three element of Yagi antenna gives widest coverage compared with dipole antenna,  $\frac{1}{4} \lambda$  antenna ground plane, and  $\frac{5}{8} \lambda$  antenna. Adding the transmitter power insignificantly affect the coverage, however it increases the intensity for 80%-90% coverage. The time of simulation also give impact to the range and reliability of coverage because the HF propagation is effected by the variations in the ionosphere.

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# Measuring Operational Management Information Technology: COBIT 5.0 and Capability Level

Kelvin Chandra<sup>1</sup>, Wella<sup>2</sup>

Departemen Sistem Informasi, Universitas Multimedia Nusantara, Tangerang, Indonesia  
kelvin.chandra42@yahoo.com<sup>1</sup>, wella@umn.ac.id<sup>2</sup>

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**Abstract**—Every system need to be well organized so it can achieve what the company expected. So, every company need to do some measurement to create a well organize system. A type of action that can be used for creating a well organize system is quantify their IT governance PT XYZ is a company that engaged in property business. Their company want to measure their IT governance, to measured their IT governance framework COBIT 5.0 was use and as what the company request process that being measure are Manage Service Agreements, Manage Change, Manage Operations, and Manage Service Request and Incidents. Every process have their own importance and will be measured based on framework COBIT 5.0 capability level. Capability level have 5 kind of stage. PT XYZ expectation that they can achieved level 4. But, the result that came out doesn't match what their company has expected, the result was level 3 and on of their process stop at level 2. So, to attain the level that PT XYZ wanted they need to some improvement based on COBIT 5.0 recommendation.

**Index Terms**—Capability Level, COBIT 5.0, Information System, IT Governance.

## I. INTRODUCTION

Information System is one of the most important thing in every company [1][2]. The existence of information system can improve their operational activities. Based on what has been mention above information system can bring great impact to a company. However, if the information system that being use didn't fully support the company, it can bring negative impact to the company for example, 24 November 2014 Sony Picture Entertainment being hacked, their classified information stolen by the hacker [3]. This kind of event prove that there is a flaw in their system.

Deterrence must be established to prevent every kind of stuff that can bring bad impact to the company. Prevention that can be formed are information technology auditing and create a good IT Governance. In Indonesia this kind prevention already being use by some company for example, Bank Central Asia, Tbk

implementing ISO 9001:2008 about quality system management [4]. Based on the importance PT XYZ are interested to implement this kind of deterrence they want to see their accomplishment in their operational activities. Using Framework COBIT 5.0, PT XYZ decided being audit in 4 process which are: Manage Service Agreements, Manage Change, Manage Operation, and Manage Service Request and Incidents.

The benefits of this research are PT XYZ will get recommendation based on the result that can improve their operational activities and the company will know what capability level that they have achieved.

## II. THEORETICAL BASIS

### A. Capability Level

Process Assessment Model capability level are divided into some dimension which are level 1 -5 [5].

- a. Level 1 Performed process, the implemented process achieves its process purpose.
- b. Level 2 Managed process, the previously described performed process is now implemented in a managed fashion and appropriately established, controlled and maintained.
- c. Level 3 Established process, the previously described managed process is now implemented using a defined process that is capable of achieving.
- d. Level 4 Predictable process, the previously described established process now operates within defined limits to achieve its process outcomes.
- e. Level 5 Optimizing process, the previously described predictable process is continuously improved to meet relevant current and projected business goals.

### B. COBIT 5.0

There are 37 process that have been divided into 4 big domain which are APO (Align, Plan, and Organize), BAI (Build, Acquire, and Implement), DSS (Deliver, Service, and Support) and MEA (Monitor, Evaluate and Assess) [5]. In this research, 4 of 37 process will be measured:

- a. APO 09 Manage Service Agreements, Align IT-enabled services and service levels with enterprise needs and expectations, including identification, specification, design, publishing, agreement, and monitoring of IT services, service levels and performance indicators.
- b. BAI 06 Manage Change, Manage all changes in a controlled manner, including standard changes and emergency maintenance relating to business processes, applications and infrastructure. This includes change standards and procedures, impact assessment, prioritization and authorization, emergency changes, tracking, reporting, closure and documentation.
- c. DSS 01 Manage Operation, Coordinate and execute the activities and operational procedures required to deliver internal and outsourced IT services, including the execution of pre-defined standard operating procedures and the required monitoring activities.
- d. DSS 02 Manage Service Request and Incidents, Provide timely and effective response to user requests and resolution of all types of incidents. Restore normal service; record and fulfil user requests; and record, investigate, diagnose, escalate and resolve incidents.

### III. RESEARCH METHODOLOGIES

PT XYZ is a company that move as a property developer. PT XYZ was established at 3 November 1993 and has change becoming one independent city. At 18 December 2007, PT XYZ make a huge decision becoming one of public company which means that PT XYZ are selling their stocks to public market. Until now this company is one of the largest property developer company located in Tangerang [4].

#### A. Research Variable

4 of 37 process will be variable of this research:

- a. APO 09 Manage Service Agreements.
- b. BAI 06 Manage Change.
- c. DSS 01 Manage Operation.
- d. DSS 02 Manage Service Request and Incidents.

#### B. Research Method

This research will be executed based on framework COBIT 5.0. For collecting data from PT XYZ there will 3 types of method which are [6]:

- a. Observation, for the observation step things that will be observe is the company documentation. Their completeness will be assess based on Process Assessment Model COBIT 5.0 [5].
- b. Interview, the interview will be done with one of SOP division of PT XYZ. every process have different amount of question based on framework COBIT 5.0 matrix [5].
- c. Questionnaire, for this method questionnaires will be given to the respondent which is Mr. Jonathan Weyn as one of their SOP division. Every process have different amount and type of question base on their concerns [5].

#### C. Data Analysis Techniques

Data analysis techniques will be based on the problem of analysis which are:

- a. Capability level will calculate based on the questionnaires that was given to the respondent.
- b. Recommendation will be made based on the result of observation, interview, and questionnaires that being analysis to become one recommendation that can give great impact to the company.

#### D. Measurement Stage

Stage of measuring the capability level of PT XYZ were adapted from Hunton [7]. There are 7 step in measuring capability, which are:

- a. Planning. Stages in conducting an audit is to plan. This can be interpreted before the audit should be made determining what risks can arise, build relationships with clients, then adapt to the environment and determine audit staffs. The planning stages are [5]:
  - Determine the limits and objectives of the audit.
  - Conduct a relevant initial assessment.
  - Gathering knowledge of the organization.
  - Identify outsiders.
  - Establish an audit program that contains audit procedures.

- Assist the audit plan to be performed during the audit.
  - Collecting audit process documents includes audit plans, audit programs and other important documentation.
- b. Risk Assessment. Many auditors now use a risk-based audit approach to audit. See the errors that can occur so that makes the auditor SI determines the important process to perform the audit. In doing risk assessment there are 3 ways that can be done, among others [5]:
- Inheritance, the risk posed by the derivative or innate of the company resulting in the auditor's judgment becomes inaccurate. This risk can occur due to less robust evidence.
  - Control, the risk caused by errors to material that cannot be prevented or detected in a timely manner by the internal control system.
  - Detection, is a risk that occurs because the auditor cannot find errors that occur within the company. Such risks are usually caused by insufficient materials, undetected procedures, or a combination of both.
- c. Program Audit. There is no auditing standard for IT audits because each audit procedure must be tailored to the hardware and software used.
- d. Gather Evidence. To obtain the audit findings and the right conclusions requires proper analysis and interpretation of the available evidence. The evidence is the basis of any established audit opinions. There is some evidence that can be collected by the SI audit, among others [5]:
- The process of observation and the existence of physical components.
  - Documentation proof has been done.
  - Flowcharts, narratives, and written procedures available within the company.
  - Analyse such a running procedure.
- e. Make Conclusion. After evidence of subsequent assignment as an auditor is evaluating the evidence. Then, from the results of the evaluation will be drawn a conclusion in accordance with the purpose of the audit of whether the entire audit process run in accordance with the procedure or not. As an auditor identifying conditions to be reported is also part of their task.
- f. Preparing Audit Opinions. The audit report contains general guidelines and general overview of audit outcomes.
- g. Following Up. After the auditor communicates the results of the audit to the client and prepares the audit opinion, the auditor needs to make provisions to keep the follow up handling the conditions that have not been able to be done.

#### IV. RESULT

##### A. Questionnaire

The result of the questionnaire that was given to the responded is that most of the process capability level stops at level 3 but one of them stops at level 2. Base on the result, the result was quite good however, it was below what the company has expected which is level 4. Complete information can be seen from the table 1.

Table 1. Questionnaire Results

No	Process	Total	Status
1	APO09	78%	Stop at Level 3
2	BAI 06	78%	Stop at Level 2
3	DSS 01	71,67%	Stop at Level 3
4	DSS 02	72,33%	Stop at Level 3

##### B. Interview

The result of the interview, is that every process that has been tested have their own standard of operation that act as every process bases. They also have a division called SMBD (Strategic Management business development) and SOP division working together controlling all their work done base on the standard and make sure that all their documentation are complete.

##### C. Observation

Based on the documentation observation, PT XYZ has a clear and complete document. Every process have their own kind of documentation and ever document have different kind of purpose. Table 2 provide the complete information of their documentation.

Table 2. Observation Results

Proses COBIT 5.0	Document Name	Status
APO 09 Manage Service Agreements	Flowchart request Service Agreements for Business Service dan Infrastructure	Given
	Flowchart Cash advance, tagihan, Reimbursement	Given
	Service Agreement Documentation	Not Given
	Flowchart project assesment	Given
	Strategy Management Business development audit document result	Not Given
	Budget Approval Document (PPD)	Not Given
BAI 06 Manage Change	Flowchart Project implementation	Given
	SOP documentation	Given
	List-list Project yang membuat perubahan	Not Given
	Training Documentation	Given
DSS 01 Manage Operation	Operational Flowchart	Given
	SLA document	Not Given
	Project document (SRA & BRA)	Given
DSS 02 Manage Service Request and Incidents	Request Document	Given
	OS TICKET	Not Given

#### D. Result

Based on questionnaire, interview, and observation conducted then obtained the findings as follows:

- APO 09 Manage Service Agreements. Some of the things that cause PT XYZ still do not get maximum value, among others, the company is less utilize the review will be owned by standards to project and identify trends in services level performance and provision of appropriate information for the management used to improve the company's performance. In addition, some of the existing activities carried out by the company. These things make the value achieved by the company in the Manage Service Agreements process has not been maximized.
- BAI 06 Manage Change. The problem experienced by the company is the information that is not used or allocated by the company used to solve the problem at the time of the change. In making changes the company also less involving other parties and less maintain communication between other parties. In addition, the company is less sure of changes made in accordance with existing design plans.
- DSS 01 Manage Operation. PT XYZ does not take full advantage of the documentation in which they investigate issues that may occur in the future. Companies do not maximize the security of companies that can bring adverse impact to the company's operational activities in case something happens while the entire system that exist in the company using the web base. Company only doing activities that exist in large part,

which means that activities have not been done optimally.

- DSS 02 Manage Service Request and Incidents. Companies are still experiencing downtime often because they are not in accordance with the established process standards. In addition, because the company's infrastructure uses outsourced parties the company is very difficult to maintain existing infrastructure because of lack of human resources. Things like this can disrupt the performance of services performed by the company.

Figure 1 explain the result capability level that PT XYZ have achieved which are, Manage Service Agreements achieved level 3, Manage Change achieved level 2, Manage Operation achieved level 3, and Manage Service Request and Incidents achieved level 3. Their achievement are quite good but they didn't achieved their expectation so they need to do some changes that can improve their operational activities and achieved what they wanted.

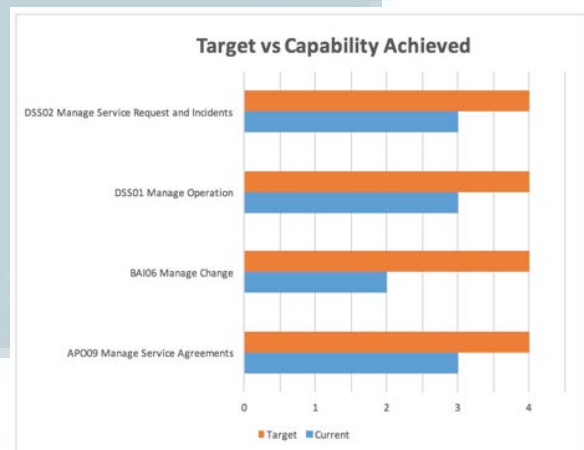


Figure 1. Result and Target Capability Level PT XYZ

#### E. Recommendations

Form the overall data that have been collected by observation, interview, and questionnaire recommendation that can be given are:

- PT XYZ need to find more human resource that have specific skills especially in infrastructure.
- PT XYZ need to consider about their budget allocation especially for their infrastructure to decrease their downtime that make financial loss to their company.
- PT XYZ need to fix their communication between users and their development team.



## V. CONCLUSION

In conclusion, most process that have been tested have reach level 3. The process that reach level 3 are, Manage Service Agreements, Manage Operations, and Manage Service Request and Incidents. On the other hand, there is a process that only reach level 2 which is Manage Change. This achievement where quite good achievement for their company. However, what they achieve still below target that the company wanted which is level 4 so the company need make some improvement to achieve their target. Improvement that they can make are finding a good human resource, improvement on their infrastructure and communication. From this research, can also be conclude that a company that already open for public

should have level 3 capability level because their organization structure already complex.

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# Implementation of Topsis Method In Web Based System Recommendations For Students Laptop Selection (Case Study: Bhinneka.com)

Adhi Kusnadi<sup>1</sup>, Edwin Kurniawan<sup>2</sup>

<sup>1</sup> ICT Faculty, University of Multimedia Nusantara, Tangerang, Indonesia  
Adhi.kusnadi@umn.ac.id

<sup>2</sup> ICT Faculty, University of Multimedia Nusantara, Tangerang, Indonesia  
Ekurniawan231@gmail.com

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Approved on June 16<sup>th</sup>, 2017

**Abstract-** Computer needs at work are very helpful and make easier for human to complete his work. The usage of laptops growing rapidly with increasing mobility of the community who uses laptop to run the activities. In addition, laptop continues to update its technology with the variation of the specification so that it can attract the interest of consumers, especially for students, but the variety of laptops is confusing for some users to choose. Based on a survey that has been done to the students, it concluded that laptop is 80% more interesting than desktop computer. Some students really need a recommendation system for choosing a laptop. In making a recommendation system, using TOPSIS method is the recommended one because the concept is simple, easy to understand, efficient, and have the ability to measure the relative performance of alternatives decision. According to the implementation, the recommendation system with TOPSIS method has 70% accuracy rate.

**Index Terms**—System Recommendation, TOPSIS, Laptop,

## I. INTRODUCTION

Computer usage at the works is very helpful and makes easier for people to complete his work, but lately the use of laptops becomes favorites than desktop computer [1]. The use of laptops is getting rapidly with increasing mobility of the community who use a laptop to run their activities [2]. In addition, the laptop continues to update its technology with the variation of the specification so that it can attract the interest of consumers in particular students, but variety also make its users difficulties in choosing a laptop.

Students as part of the community in its activities require laptops have difficulty in determining the appropriate laptop needs and information regarding the appropriate laptop [3].

Bhinneka.com, as an e-commerce site in running his business, provides online chat and direct consultation as well as recommendations for the users who confuse to choose laptop, but constrained by the effort capacity and time available in provides recommendations so that required a recommendation system.

There is previous research on recommendation system selection laptop entitled Design Application System Recommendations for Laptop purchase with Fuzzy Method Database Model Tahani Web based (case study: Store Ricky's Computer) give advice that the criteria used are added and customized to the user where the previous criteria given by the seller [4]. In this research, there are differences in the methods used and the criteria. The criteria used are obtained from the student through the survey.

Then there is another research, entitled Comparison of Weighted Product Method with Technique Method For Order Preference By Similarity To Ideal Solution (TOPSIS) in Decision support system on Student Recruitment of internship (Case Study: PT Telecommunication Industry Indonesia)" [5]. The study compares the weighted product method with TOPSIS for the selection of students who will conduct internship and the results of the study concluded that TOPSIS method has a higher accuracy than Weighted Product.

## II. THEORETICAL BASIS

### A. Recommendation System

According to Kamus Besar Bahasa Indonesia (KBBI), recommendations are suggestions that advocate (justify, strengthened). In other words, these recommendations are a way to help people with lack of knowledge to take some decision that can be trusted. And a recommendation system is a system

that can be used to inform and convince the user to make choices against period.

### B. TOPSIS Method

TOPSIS is one of the multi criteria method of the decision maker was first introduced by Yoon and Hwang in 1981. This method is widely used to solve decision making because the concept is simple, easy to understand, computationally efficient, and have the ability to measure the relative performance of decision alternatives [6].

There is some sequence of steps that are used to implement method TOPSIS [7], as follow:

1. Make a decision matrix (X), which refers to an alternative that is evaluated based on the n criteria.
2. Make a normalized decision matrix (R)

$$r_{ij} = \frac{x_{ij}}{\sqrt{\sum_{i=1}^m x_{ij}^2}}$$

Description:

$i = 1, 2, 3, \dots, m$ ; and  $j = 1, 2, 3, \dots, n$ ;

$r_{ij}$  are elements from decision matrix normalized (R).

$x_{ij}$  are elements from decision matrix X.

3. Creating weighted normalized decision Matrix (Y).

$$y_{ij} = w_j r_{ij}$$

Description:

$w_j$  are the weights that have been determined,

$r_{ij}$  are elements from decision matrix normalized (R).

And  $y_{ij}$  are elements weighted normalized (Y)

4. Determining the ideal solution both positive and negative ideal solution matrix.

$$y_i^+ = \begin{cases} \max_i & y_{ij} \\ \min_i & y_{ij} \end{cases}$$

$$y_i^- = \begin{cases} \min_i & y_{ij} \\ \max_i & y_{ij} \end{cases}$$

Where:

$y_i^+ = \max$ , if i is the criterion of advantage (benefit)

$y_i^+ = \min$ , if i is the costs criterion (cost)

$y_i^- = \min$ , if i is the criterion of advantage (benefit).

$y_i^- = \max$ , if i is the costs criterion (cost)

Based on the equations 4 and 5 above, then determined the positive ideal solution ( $A^+$ ) and negative ( $A^-$ ) with equations 5 and 6.

$$A_j^+ = \max(y_1^+, y_2^+, \dots, y_n^+)$$

$$A_j^- = \min(y_1^-, y_2^-, \dots, y_n^-)$$

$A^+$  is the maximum value of each criteria.

$A^-$  is the minimum value of each criteria.

5. Determining the distance between the (separation) of each alternative with positive ideal solution and negative ideal solution.

$$D_i^+ = \sqrt{\sum_{j=1}^n (y_{ij} - A_j^+)^2}$$

$$D_i^- = \sqrt{\sum_{j=1}^n (y_{ij} - A_j^-)^2}$$

Description :

$D_i^+$  is an ideal solution calculation of the distance from the positive ( $y_j^+$ ) and the normalized weighted matrix elements ( $y_{ij}$ ), and a calculation of the distance from the negative ideal solution ( $y_j^-$ ) and the normalized weighted matrix ( $y_{ij}$ ),

6. Determining the value of a preference for each alternative ( $V_i$ )

$$V_i = \frac{D_i^-}{D_i^+ + D_i^-}$$

Description :

$V_i$  is the preference value for each alternative of calculating the value of a positive distance ( $D_i^+$ ) and negative distance value ( $D_i^-$ ).

## III. RESEARCH RESULT

### A. Recommendation Process

The system consists of several parts such as front-end, back-end, and TOPSIS method. The front-end section is the part that will be used by the user, the back-end part is the part that will be used by Admin and TOPSIS method is a step in doing the calculation of decision making to rank alternative according to value that have been calculated. Here is a flowchart front-end system:

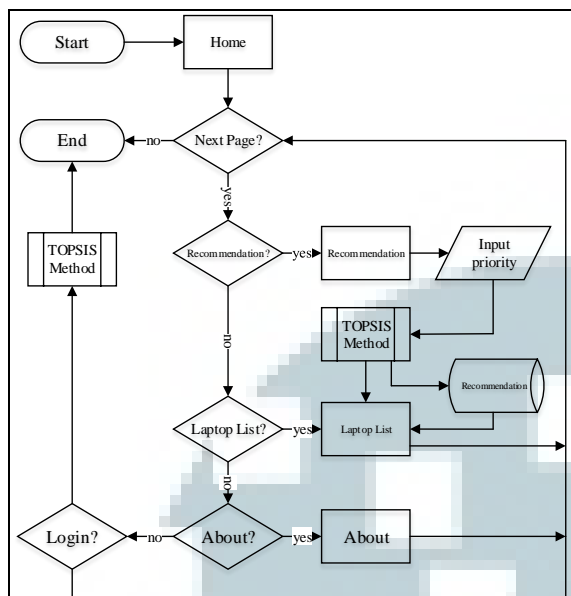


Figure 1. System Flowchart

When accessing the recommendation website will display the home page, recommendations, laptop list, about, and login. For the recommendation page, user has to determine the priority scale that will use in the TOPSIS method calculation. For the login page, specifically access admin/back-end page used to add , change and / or delete laptop data

Recommendation process using simple random sampling consisted of 30 data types and criteria. The criteria consist of the screen, RAM, hard drive, price, weight, battery life and warranty. Then modified by the term by using a scale of criteria in Table 1. For processor criteria is used basic speed, not speed turbo (upto). For criteria used screen size in in inches. Hard disk criteria referring to a regular hard disk capacity, instead of the SSD.

Table 1. Criteria and Value

Criteria	Conditions	Value
Processor (Speed)	Less than 1,5 GHz	1
	1.5 GHz to 2 GHz	3
	2 GHz to 2.5 GHz	4
	Equal or more than 2,5 GHz	5
Screen (Size)	Less than 12 inch	1
	12 inch to 13 inch	2
	13 inch to 14 inch	3
	14 inch to 15 inch	4
	Equal or more than 15 inch	5
RAM (Capacity)	Less than 1 GB	1
	2 GB to 3 GB	2
	4 GB to 7 GB	3
	8 GB to 15 GB	4
	Equal or more than 16 GB	5
Harddisk (Capacity)	Less than 250 GB	1
	250 GB to 500 GB	2
	500 GB to 750 GB	3
	750 GB to 1000 GB	4
	Equal or more than 1000 GB	5
Price	More than 20 juta	1
	15 juta to 20 juta	2
	10 juta to 15 juta	3
	5 juta to 10 juta	4

Weight	Less than 5 juta	5
	More than 2,5 kg	1
	1,5 kg to 2,5 kg	3
	Less than 1,5 kg	5
Battery	Less or equal than 2 cell	1
	2 cell to 4 cell	2
	4 cell to 5 cell	3
	6 cell to 7 cell	4
	More or equal than 8 cell	5
	None	1
Warranty	1 months to 12 months	2
	13 months to 24 months	3
	25 months to 36 months	4
	More than 36 months	5

After changing the laptop data with the provisions of scale criteria in Table 1, and then obtained such a decision matrix that contains the value of any laptop based on the criteria in Table 1. After that, created a normalized decision matrix. For example of calculation of a normalized decision on the criteria for a laptop processor with the value criteria: 5 Processor, Screen 3, RAM 5, Hard Drive 3, Price 5, Weight 4, Battery 3, and Warranty 4.

$$r_{ij} = 5 : \sqrt{5^2 + 5^2 + 5^2 + 3^2 + \dots + x_{ij}^2} = 0.243108319$$

From normalized decision matrix and then converted into weight normalized decision matrix, was obtained:

$$y_{ij} = 0.24310831916316 * 5 = 1.2155415958158$$

Next step is determine the positive ideal solution and negative ideal solution for each criteria. After, get the positive ideal solution and negative ideal solution, can be calculate the positive separation and the negative separation. Here's an example of calculation for positive ideal solution

$$D^+ = \sqrt{(0.4862)^2 + (0.6537)^2 + (0.6226)^2 + (0.2841)^2 + (0.2344)^2 + 0^2 + (0.2813)^2 + (0.1875)^2} = 0.97167263904494$$

As an example for negative separation :

$$D^- = \sqrt{0^2 + 0^2 + (-0.3113)^2 + 0^2 + (-0.7032)^2 + (-0.3751)^2 + (-0.1406)^2 + (-0.1875)^2} = 1.1859749435949$$

Final, calculate value preferences of each laptop, and giving rank in order of highest to lowest value. As an example for the Value Preference:



$$V_i = \frac{1.1859749435949}{0.97167263904494 + 1.1859749435949} = 0.5496610999577$$

### B. Decision Making Accuracy

In the calculation process of accuracy, there are two variables which are compared to determine the degree of match, the ranking system and ranking manual. For the ranking system, the use of calculation ranking system has been made in research, while for the manual ranking used calculations from the Bhinneka. The results of accuracy is 70%, obtained from 21 data from 30 data generated by the system equal to the calculation of Bhinneka.

### C. System Evaluation

The minimum sample number of respondents required in a questionnaire is 30 samples [8]. Questions are based on End User Computing Satisfaction (EUCS). There are five factors: content, accuracy, design, ease of use, and timeliness. Example for the factor of accuracy is made to question Do the results of the recommendations produced by the system are in accordance with the expected? The survey result is shown in table below.

Table 2. Survey Result

Question	Less	Enough	Good	Very good
content	17	60	23	-
accuracy	23	57	20	-
design	10	47	33	-
Ease of use	13	60	20	7
timeliness	-	63	37	-

From table 1, the average of the results are good dan enough.

## IV. CONCLUSION

TOPSIS method successfully implemented into the recommendation system for the selection of the laptop by using the tools Notepad ++ and Bootstrap. The system accuracy rate of 70% of the data that has been tested and compared to manual calculation. And the satisfaction level of respondents on the system recommendation with a average rate value is enough and good.

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# Design and Development of Animal Recognition Application Using Gamification and Sattolo Shuffle Algorithm on Android Platform

Case Study: Kebun Binatang Ragunan

Samuel Christopher Santo<sup>1</sup>, Ni Made Satvika Iswari<sup>2</sup>  
 Faculty of Information Technology, Dept. of Computer Science  
 Universitas Multimedia Nusantara, Tangerang, Indonesia  
 samuel.christopher.santo@gmail.com<sup>1</sup>, satvika@umn.ac.id<sup>2</sup>

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**Abstract**—Information and communication technology has been developed rapidly and affected various aspects such as propagation of information and marketing strategy of tourist attraction. Kebun Binatang Ragunan is one of tourist attraction in Indonesia. Aside from recreation area, Kebun Binatang Ragunan can be a place to learn animals. However, learning animals itself tends to be less attractive and less interactive. Therefore, an application was developed as one of animal learning media to increase tourist motivation. The application developed in form of quiz game by using gamification like achievement to increase their motivation in animals learning and using Sattolo Shuffle algorithm in order to make quiz more varied. After testing, the application is known affect the Behavioral Intention to Use level around 76.96% and Immersion level around 82.43% in giving motivation and attracting tourist attention to use the application. Sattolo Shuffle algorithm successfully applied in application to produce a unique sequence of each randomized quiz.

**Keywords**—Achievement, Animal Recognition, Gamification, Quiz Game, Sattolo Shuffle.

## I. INTRODUCTION

Information and communication technologies have an important role in propagating informations and modification in business strategies of tourism industry [1]. Tourism is an activities for recreation purpose, personal development, or to learn about uniqueness of tourist attraction that visited within a certain period [2]. One of the tourist attraction in Indonesia is Kebun Binatang, located in South Jakarta.

Gamification is one of the example of method that can attract users to have a different experience when visiting a tourist attraction [3]. Gamification is the use of game mechanisms and elements into non-game

contexts [4]. Example of elements in gamification such as challenges, points, leaderboard, levels, badges, onboarding, and social engagement loops. Based of research that conducted by [5], the use of gamification in tourism can attract tourist when visiting an attraction, as well as improve experience and motivation in looking for informations at the tourist attraction.

Sattolo Shuffle algorithm is an algorithm for generating a randomized cyclic permutation that can give an unique result of randomness [6]. This algorithm is a modification from Fisher-Yates Shuffle algorithm.

In this research, an animal recognition quiz application with gamification methods and Sattolo Shuffle algorithm on Android platform to increase visitor's motivation to access informations about animals in Kebun Binatang Ragunan.

## II. LITERATURE REVIEW

### A. Gamification

Gamification as a concept has some meaning from some experts as follows.

1. Gamification is the use of game design elements from game into a non-game context [4].
2. Gamification is the application of game-thinking and game mechanisms of the game to engage users in solving daily problems [7].
3. Gamification is the use of game mechanisms, aesthetic values, and thinking patterns to motivate action, learning, and problem solving on people who participate in it [8].
4. Gamification is a process combining something that already exist with game mechanisms that can

motivate users in taking actions that can yield result to a business [9].

Based on some of these meaning, we can draw conclusion that gamification is a use of game models, mechanisms, elements, and thinking patterns into non-game context in order to motivate users to perform actions such as learning and problem solving. Some of the gamification features according to [7] are points, levels, leaderboards, badges, onboarding (tutorial), challenges, and social engagement loops.

#### B. Sattolo Shuffle Algorithm

According [10], Sattolo Shuffle algorithm is an algorithm for generating a randomized cyclic permutation from finite sequence. This algorithm is the result of modification of Fisher-Yates Shuffle, which generate non-biased permutation, like Sattolo Shuffle. Sattolo shuffle has several advantages such as simple concept and randomization of a permutation performed in same array so it can save the use of resources. The steps of Sattolo Shuffle algorithm are summarized from the study of [6] and [10] as follows.

1. Specify the length of the array which will be randomized.
2. Take the length of array into variable  $i$ .
3. Select a random number  $r$  between 0 and  $(i-1)$ . This number will be array's index pointer.
4. Swap the array element of  $r$  with array element of  $(i-1)$ .
5. Reduce the variable  $i$  by 1 and check whether  $i$  is greater than 1. If correct, repeat the third step until the variable  $i$  is equal to 1.

#### C. Hedonic-Motivation System Adoption Model

Hedonic-Motivation System Adoption Model (HMSAM) is a measurement model of a system that adapts from Hedonic-Motivation System (HMS). HMS is a system used to fulfillment intrinsic elements of users motivation based on hedonic characteristic [11]. There are five HMSAM measurement factors: *Perceived Usefulness* (to measure the performance of a system), *Perceived Ease of Use* (to measure the ease of use of system usage), *Curiosity* (to measure of cognitive level in curiosity), *Control* (perception as if users directly interact with system) and *Joy* (pleasure gained from interaction between users and system) that may affect *Behavioral Intention to Use* and *Immersion* of an application.

#### D. Usability Measurement

According to [12], *usability* is derived from *usable* which means it can be used well. [12] also reveals several notions of *usability* as follows.

- According to [13], *usability* is a branch of Human Computer Interaction that learn how to design

interface in an information system application for convenient use by users

- According to [14], something that can be said to be useful if errors can be eliminated or minimized and gives benefit and satisfaction to the users.
- According to [15], *usability* refers to how users can learn and use the product to obtain their goals and how satisfied they are with the product
- According to [16], *usability* is the extent of a product can be used by users to achieve a target that set by effectiveness, efficiency, and satisfaction of product usage in a context such as product usage, tasks, and equipments.

Based on these definition, *usability* can be measured based on several components:

- *Learnability* defined how fast users adept in using the system as well as the ease of use of using a system function and what the users want.
- *Efficiency* defined as the resources spent in order to achieve accuracy and objective.
- *Memorability* defined how the user's ability to retain knowledge after a certain period, the ability to remember the menu layout always fixed.
- *Errors* is defined what mistakes that user make, including incompatibility of what user think with what actually represented by system.
- *Satisfaction* is defined as freedom from inconvenience, and a positive attitude towards the product usage as the user feels about the system.

#### E. Qualitative Research Methods, Survey, Likert Scale

Based on [17] research, qualitative research methods can be interpreted as a form of method that based on postpositivism or interpretive philosophy, that used to examine natural objects with qualitative research results emphasize more in meaning. [17] also stated that qualitative research methods suitable for random sampling data, collecting data based on research instruments, as well as statistical data analysis for hypothesis testing that has been established.

Survey, according to [18] is one of research method that examines large and small population and examines samples drawn from a population to find relative, distributive, and linked events between sociological variables and psychological variables.

Likert scale is a method that can be used to interpret qualitative result into statistical data. Data analysis with qualitative research method is statistical. Therefore, Likert scale is suitable for use along with qualitative research methods that process qualitative data into statistical data to ease in draw conclusions

### III. METHODOLOGY

#### A. Application Design

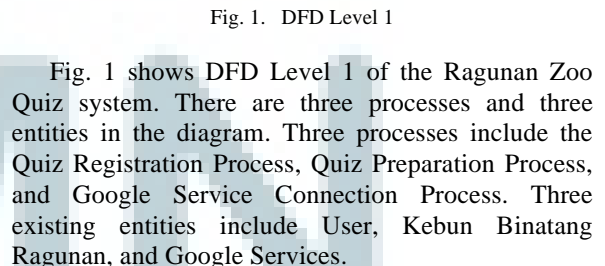
The focus of this research is to make an application contains questions of animal information in Kebun Binatang Ragunan. This application name is Ragunan Zoo Quiz which is built based on Android with Ice Cream Sandwich OS as minimum OS .

### A. Application Design

Ragunan Zoo Quiz created based on the following gamification elements.

- The more types of animals in one area, the greater the *experience point* gained.
- *Points* are used to calculate the correct or wrong answers and the Chance number they have. The result will be used to open the *achievement*.
- *Leaderboard* using Google Play Games Leaderboard to show *points* that users get after completing the quiz.
- *Social engagement loops* are used in the form of sharing user's point in Twitter.

### B.1. Data Flow Diagram



Quiz Registration Process serves to store quiz data and answers on a storage. Quiz Registration Process retrieves data from animal information in Kebun Binatang Ragunan.

TABLE I. ACHIEVEMENTS AND EXPERIENCE POINTS

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Google Service Connection Process involves Google Service entity. This process authenticates and connects user's account with Google Play Games Service. Once connected to Google Play Games Service, user can view and unlock the achievements in the application. In addition, this process also connect apps with Google Maps Service with intention to showing the user's location on the map.

## B.2. Flowchart

Flowchart is a media representate of work flow of a process to simplify the visualization of a process.

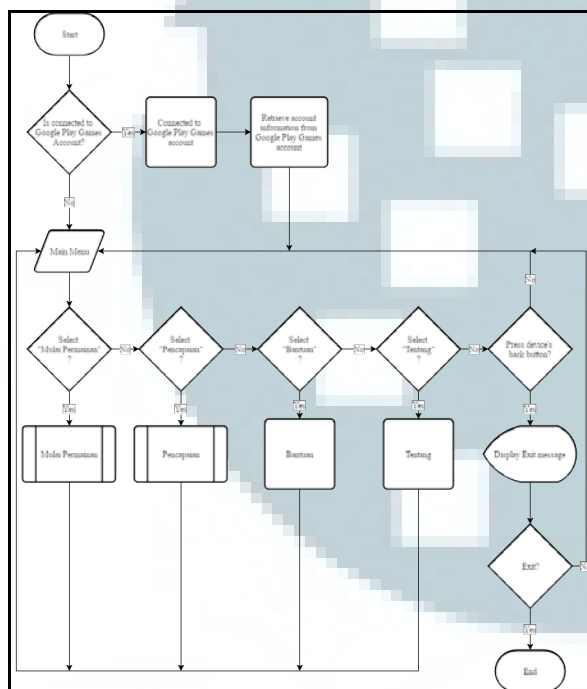


Fig. 2. Flowchart Main Menu

Fig. 2 shows the Main Menu flowchart of Ragunan Zoo Quiz. User that not connected to Google Play Games will have options to link their Google Play Games with Google Play Games. Then the user can select Mulai Permainan (Game Start) menu to start the game, Pencapaian (Achievements) menu to see the achievement list, Leaderboard menu to see the user's scores, Bantuan (Help) menu to see how to use the application, and Tentang (About) menu to see application information.

After selecting Mulai Permainan menu, the app will show a display with a list of areas. User can select the area then will be forwarded to QuizArea page as in Fig. 3 which shows the QuizArea flowchart. In Fig. 3, Quiz Preparation process works to prepare quizzes base on user-selected area. Shuffle process serves to randomize the sequence of the problem that have been prepared by the Quiz

Preparation process. Calculate Quiz process works to calculate the results obtained from how many wrong or correct answers and chance that user have after do the quiz. Quiz Complete process serves to display the obtained scores.

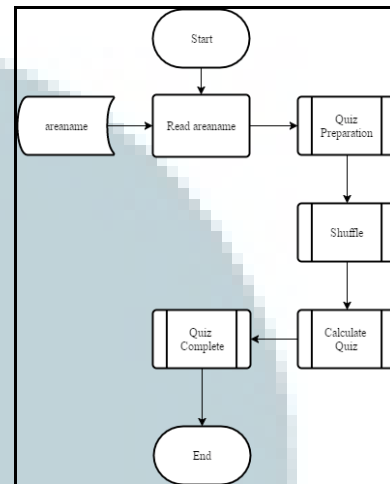


Fig. 3. Flowchart QuizArea

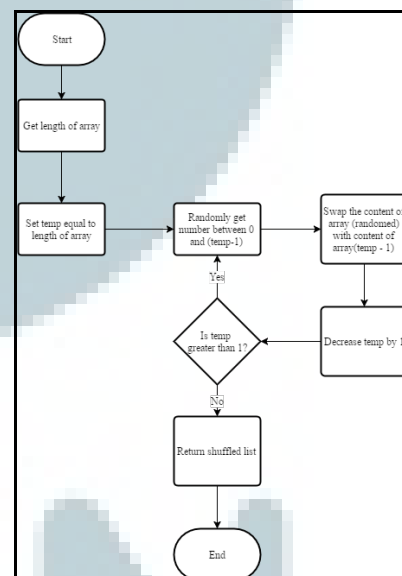


Fig. 4. Flowchart Shuffle

Fig. 4 shows a Shuffle flowchart. After the quiz taken from Quiz Preparation process, Shuffle process will randomize the sequence of the quiz. This process starts by determining the length of the questions' array. Then the length of the questions' stored into the temp variable. After that, a random number is selected between zero and temp minus one, defined as variable x. This selected number will be the index pointer array, defined as variable r. After that, swap between content of array r and content of array x. The temp variable will be reduced by one and checked whether the temp variable is greater than one. If the temp variable is greater than one, the randomize and

swapping process will take place until the temp variable is equal to one. If temp variable equal to one, stop the randomization and swapping and return the random results. The randomize result will be used in Calculate Quiz process. Calculate Quiz process will be calculate the result obtained from randomized quiz sequence and calculate the chance user have. The Quiz Complete process serves to display the calculate score from Calculate Quiz process and unlock the achievement based on score, chance, and area.

#### IV. IMPLEMENTATION, TESTING, EVALUATION

##### A. Implementation



Fig. 5. Tampilan Aplikasi Ragunan Zoo Quiz

The application and system design that have been done will be implemented into the Ragunan Zoo Quiz. Fig. 5 shows the result of Ragunan Zoo Quiz implementation. There are five menus: Mulai Permainan (Game Start) menu to start the quiz, Pencapaian (Achievements) menu to see the list of achievements, Leaderboards menu to see the score per area, Bantuan (Help) menu to see the application usage tutorial, and Tentang (About) menu to see application information.

##### B. Testing and Evaluation

After the implementation of Ragunan Zoo Quiz finish, the next step is to test and evaluate the system. Testing were conducted by test the application to the users. From the population of Kebun Binatang Ragunan visitors, sample of participants were taken using accidental sampling. Accidental sampling is a method of determining sample by chance, i.e. anyone who happens to meet with the researcher and considered suitable as a source of data. Total samples taken as many as 37 respondents. The respondents are filling out the questionnaire after doing the application testing. The questionnaire is a set of questions related to Hedonic-Motivation System Adoption Model (HMSAM), usability measurement, and the influence of achievement use on the motivation of participants using Likert scale. The

calculation of Likert scale scores with five scales or categories is shown in Table II with 'X' as the value obtained.

TABLE II. LIKERT SCALE CATEGORY

Category	Code	Weight	Category Interpretation
Strongly Agree	SA	5	$X \geq 80\%$
Agree	A	4	$60\% \leq X < 80\%$
Neutral	N	3	$40\% \leq X < 60\%$
Disagree	D	2	$20\% \leq X < 40\%$
Strongly Disagree	SD	1	$X < 20\%$

From Table II, a Likert scale formula as follows.

$$X = \frac{(SA * nSA) + (A * nA) + (N * nN) + (D * nD) + (SD * nSD)}{\text{amount of criteria} * \text{amount of sample}} \quad (1)$$

Descriptions of (1) are:

- SA is the weight of Strongly Agree equal to 5.
- nSA is the number of response Strongly Agree category.
- A is the weight of Agree equal to 4.
- nA is the number of response Agree category.
- N is the weight of Neutral equal to 3.
- nN is the number of response Neutral category.
- D is the weight of Disagree equal to 2.
- nD is the number of response Disagree category.
- SD is the weight of Strongly Disagree equal to 1.
- nSD is the number of response Strongly Disagree category.

TABLE III. SUMMARY OF QUESTIONNAIRE

#	Strongly Disagree	Dis-agree	Neu-tral	Agree	Strongly Agree	Aspect
1	0	0	1	23	13	Perceived Ease of Use
2	0	0	13	23	1	Perceived Usefulness
3	0	1	7	20	9	Curiosity
4	0	0	4	24	9	Control
5	0	0	10	22	5	Joy
6	0	0	6	25	6	Immersion
7	0	9	16	10	2	Behavioral Intention to Use
8	0	0	2	28	7	Learnability
9	0	0	4	24	9	Efficiency
10	0	1	10	20	6	Satisfaction
11	0	0	5	26	6	Motivation

Based on Table III, Likert scale is calculated to represent the aspects of HMSAM.

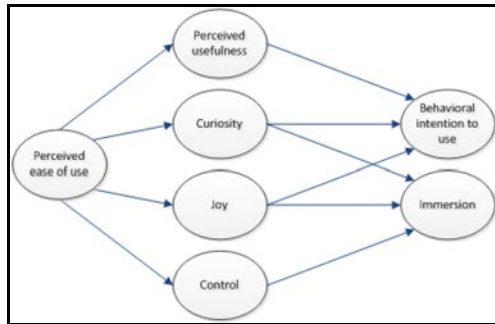


Fig. 6. Hedonic-Motivation System Adoption Model

Based on Fig. 6, there are five HMSAM measurement factors that affect the *Behavioral Intention to Use* aspect and *Immersion* aspect. According to Fig. 6 obtained formulas such as:

$$BIU = \frac{PU + CU + J}{n \text{ of aspect}} \quad (2)$$

$$I = \frac{CU + J + Co}{n \text{ of aspect}} \quad (3)$$

Descriptions of (2) and (3) are:

- BIU is Behavioral Intention to Use.
- I is Immersion.
- PU is Perceived Usefulness.
- Cu is Curoosity.
- J is Joy.
- Co is Control.

HMSAM calculation result are presented in Table IV.

TABLE IV. LIKERT SCALE RESULT OF HMSAM

HMSAM Aspect	Likert Scale Result	Percentage and Likert Scale Interpretation
Perceived Ease of Use	0.864864865	86.49% (Strongly Agree)
Perceived Usefulness	0.8	80% (Strongly Agree)
Curiosity	0.832432432	83.24% (Strongly Agree)
Control	0.845945946	84.59% (Strongly Agree)
Joy	0.818918919	81.89% (Strongly Agree)
Immersion	0.824324324	82.43% (Strongly Agree)
Behavioral Intention to Use	0.769594595	76.96% (Agree)

The *Behavioral Intention to Use* aspect result around 76.96% dan *Immersion* aspect result around 82.43%.

Based on Table III, a Likert scale calculation performed and representd *usability* and influence of achievement in participants' motivation aspect. The calculation result are presented in Table V.

TABLE V. LIKERT SCALE RESULT OF USABILITY AND MOTIVATION

Usability and Motivation Aspect	Likert Scale Result	Percentage and Likert Scale Interpretation
Learnability	0.827027027	82.7% (Strongly Agree)
Efficiency	0.827027027	82.7% (Strongly Agree)
Satisfaction	0.767567568	76.76% (Agree)
Achievement as Motivation	0.805405405	80.54% (Strongly Agree)

*Learnability* aspect is around 82.7%, *Efficiency* aspect is around 82.7 %, and *Satisfaction* aspect is around 76.76%. The influence of achiement in participants' motivation is around 80.54%.

Beside the application testing by participants, Sattolo Shuffle algorithm also tested to prove randomness using Sattolo shuffle produce a unique randomization. This testing was conducted on 81 quiz questions with 50 randomization tests. From these 81 quiz questions, the first ten questions were taken to show the uniqueness of randomized sequence.

TABLE VI. SATTOLO SHUFFLE ALGORITHM TEST

Quiz Sequence	Occurence
6 10 7 2 8 5 9 3 1 4	1
1 5 8 10 7 2 4 6 9 3	1
4 1 6 5 7 10 3 9 8 2	1
3 7 6 9 4 5 10 2 8 1	1
2 6 3 7 5 4 8 1 10 9	1
6 5 10 2 3 4 7 9 1 8	1
2 5 1 3 10 4 7 6 8 9	1
9 3 8 6 5 2 10 7 4 1	1
3 8 2 1 6 9 4 7 5 10	1
9 7 4 3 6 2 5 8 10 1	1
5 8 4 7 1 9 3 2 6 10	1
6 10 4 2 5 3 9 7 1 8	1
4 10 6 2 5 7 9 3 1 8	1
9 10 4 1 8 6 5 3 7 2	1
2 7 10 1 5 3 4 9 8 6	1
7 5 9 3 8 2 10 6 4 1	1

Quiz Sequence	Occurence
3 8 2 9 7 4 1 0 5 6 1	1
1 0 3 8 7 6 1 4 2 9 5	1
2 1 0 4 7 3 5 9 6 1 8	1
2 1 1 0 4 9 3 8 7 6 5	1
8 9 3 7 2 1 0 3 5 4 1	1
6 2 3 8 4 7 1 9 1 0 5	1
8 2 7 5 1 9 3 4 1 0 6	1
4 3 4 1 1 0 9 7 2 8 5	1
6 1 0 4 7 8 5 2 7 1 3	1
7 5 6 1 9 8 1 0 3 4 2	1
8 4 1 0 9 6 7 1 5 2 3	1
9 4 1 2 6 1 0 3 8 5 7	1
1 0 8 9 3 1 6 7 4 5 2	1
4 1 0 6 5 7 8 1 9 3 2	1
3 6 5 8 4 2 7 1 0 1 9	1
1 8 9 5 4 1 0 2 3 6 7	1
2 8 1 0 6 7 3 6 5 1 4	1
4 3 1 0 6 7 5 8 1 9 2	1
5 3 6 2 9 8 1 0 1 4 7	1
6 1 0 8 3 5 9 4 2 1 7	1
1 0 6 7 8 3 1 2 9 4 5	1
1 0 2 1 9 3 8 4 7 5 6	1
5 4 3 6 1 9 7 2 1 0 8	1
5 6 9 7 8 1 4 1 0 2 3	1
9 5 8 1 7 1 0 4 2 6 3	1
4 7 2 3 1 0 5 9 6 1 8	1
4 7 3 1 6 8 9 5 1 0 2	1
3 6 8 2 1 7 1 0 9 5 4	1
9 6 5 2 7 4 1 8 1 0 3	1
7 2 5 3 4 1 0 8 6 1 9	1
1 0 6 4 3 2 5 8 1 7 9	1
6 5 3 7 1 4 2 9 1 0 8	1
7 2 4 1 0 6 9 8 6 5 1	1
2 6 1 5 3 9 1 0 7 4 8	1

Table VI shows number of occurrences of the randomized question sequence is one. It means in 50 tests yielded 50 different sequence variations. The conclusion of this test is the usage of Sattolo Shuffle algorithm in Ragunan Zoo Quiz can generate unique sequence of question.

## V. CONCLUSION

1. Animal recognition quiz application using gamification method and Sattolo Shuffle algorithm on Android platform has been successfully designed and built, named Ragunan Zoo Quiz. This application already has seven gamification elements such as *points*, *levels*, *leaderboards*, *achievement* and *badges*, *challenges* and *quests*, *onboarding*, dan *social engagement loops*.
2. Ragunan Zoo Quiz generate *Immersion* rate around 82.43% which means users strongly agree that using Ragunan Zoo Quiz can keep them focused using the application and *Behavioral Intention to Use* rate around 76.96% which means users agree to use Ragunan Zoo Quiz in the future.
3. Ragunan Zoo Quiz also produces *Learnability* aspect around 82.7% which means users strongly agree that Ragunan Zoo Quiz is easy to use and fast to learn, resulting *Efficiency* around 82.7% indicating users strongly agree no need excess effort in using application, and *Satisfaction* around 76.76% which shows that users agree to the satisfaction gained after using Ragunan Zoo Quiz.
4. The influence of achievement usage to motivate users produced result around 80.54% indicating users strongly agree that achievement usage affect the users motivation to use Ragunan Zoo Quiz.
5. Sattolo Shuffle algorithm also successfully applied to randomized question and generate an unique sequence. This statement proven by 50 randomization tests and produced 50 unique sequence variations that different from each other.

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# Capability Model of Manage Human Resource And Service Agreement at PT X

Inez Gavrilah Wahyudi<sup>1</sup>, Johan Setiawan<sup>2</sup>, Wella<sup>3</sup>

Information System, Universitas Multimedia Nusantara, Tangerang, Indonesia

inezgavrilah17@gmail.com<sup>1</sup>, johan@umn.ac.id<sup>2</sup>, wella@umn.ac.id<sup>3</sup>

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**Abstract**— This research was made with purpose to measure the capability of human resource and work management in PT. X using COBIT 5.0. In the assessment process, researcher applied 1 domain (align, plan, and organize) with 2 processes, Manage Human Resource APO 07) and Manage Service Agreement (APO 09). Data collection was obtained from the distribution of questionnaires to IT division (there were 127 items of the question and 10 respondents). The result of this research figured out that APO 07 stopped in level 2 with score 82.50 in level 3 and APO 09 ended in level 3 with score 84.10 in level 4. In conclusion, there were still few problems that made human resources in PT X unable to reach level 5. PT.X ought to do audit regularly in deep and holistically.

**Keywords**— Align Plan and Organize, Capabilities Level, COBIT 5.0, Manage Human Resources, Manage Service Agreement

## I. INTRODUCTION

Along with the rising numbers of institutions, both government and private sector are all depends and relies on information technology to support the annual activities, therefore a decent quality of employees are needed to work on their jobs. One of the examples is PT. X a major company who operates in the banking sector that contributes an impact in national economy and employed most likely 2000 employees that are working in IT/Operation division, in emphasizing the development and enhancement of Human Resource. Hence, human resources are required to have good skills and capabilities of technologies that are needed in order to serve their customers. To meet the need of human resources' enhancement, researcher was attempting to measure the level of capacity in human

resource management and agreement service management division in PT. X.

Researcher is eager to offer a solutions in doing the measurement level of capacity and provide reviews, and moreover the documentations as the evidence to show to what extent the capability level that PT. X have prior to these 2 particular divisions. Throughout the observation, researcher were utilized the COBIT 5.0 with 1 domain, Align, Plan, and organize, and also with 2 process, APO 07 (Manage Human Resource) and APO 09 (Manage Service Agreement).

## II. THEORY

### A. Human Resource

Human resources contained 2 definitions. First, it is a work effort or services that could be offered in a production process. Whereas on the other hand, human resource reflects the quality of effort that's been given by a person in a certain time to produce products or services. The second definition is related to a person able to offer service or work effort itself. Capable in working means able to do economist activities, in could produce product or service that fulfill society's needs [1].

### B. Information System Audit

Information system audit is an evaluation to discover the level or conformity between information system application with the procedures that has been established [2]. Beside, it is to find out whether the information system has been designed and implemented effectively, efficiently, and economically, as well as holding a decent mechanism of assets security, also to guarantee an adequate integrity. Through the information system audit, a company is able to have grown and develop, therefore it could benefit people.

### C. COBIT 5.0

COBIT 5.0 aims to manage and get the right decision, and can be utilized and executed using technology [3]. COBIT 5.0 had 5 domains, namely: EDM (Evaluate, Direct, and Monitor), APO (Align, Plan and Organize), BAI (Build, Acquire and Implement), DSS (Delivered, Service, and Support), and MEA (Monitor, Evaluate Access). While the existing processes in COBIT 5.0 has 5 EDM process, the APO has 13 process, BAI has 10 process, DSS has 6 process, and MEA has 3 processes.

### III. METHODS

The object of this research is the PT X. PT X is a banking company that was implemented by the Government of Indonesia. The following is the details of the method that researcher applied:

#### A. COBIT 5.0

The methods used in this research is COBIT 5.0. variable is used to Manage Human Resource (APO 07) and Manage Service Agreement (APO 09).

#### B. Capability Model

The output of this research is the level of capability of the model where the capability model has 6 levels include :

1. Level 0: Incomplete Process  
In this level, organization is not implementing any kind of information technology processes that suppose to be carried out or haven't reached out the goal yet.
2. Level 1: Performed Process  
This stage, the organization has succeeded to perform information technology process, moreover the purpose has been achieved indeed.
3. Level 2: Managed Process  
At this level while implementing the IT process and achieved the goal, it has to be performed and managed well, therefore there's an additional grade in the assessment.
4. Level 3: Established Process  
In this stage the organization is having the standardised in the entire IT process.
5. Level 4: Predictable Process  
At the moment, organization has ran the IT process in a certain boundary (for instance: time) and generated from the measurement that has been held in the previous IT process.
6. Level 5: Optimizing process

On this very stage, organization inventing innovations and working on a continuous improvements to enhance the abilities.

This study adopts the audit stages according to Gallegos. Hereby is the 4 steps from Gallegos.

#### A. Planning

This stage is determining the scope of the audit object, evaluation standard of evaluation from the audit results, and communication with the management of an organization regarding the vision, mission, target, object's purpose that will be observed. Activities that are done while planning, as follows: scope determination and audit purpose, organizing the audit team, comprehension regarding business client operation, evaluation of the previous audit outcome, and the preparation of the audit program.

#### B. Field work

This phase could be done by doing interview, stage, or any surveys to the observation location in order to get the data from related parties.

#### C. Reporting

In this stage, the obtained data are gathered and capability level calculation is held that refers to the interview results, surveys, and summary of the questionnaire that were distributed. Based on the result, the level of capability and the ideal performance expected could be shown as the next reference.

#### D. Follow Up

While in this stage, the auditor is responsible to provide the documentation of the audit results in a form of recommendation of improvement that has been observed. However, the rest of the improvement's right will be management's obligation, whether to apply the solution offered or only take it as a guidance for the future development.

While working on this research, researcher spreaded out the questionnaires to 10 persons (IT strategy and architecture, IT infrastructure, IT Applications Development, and IT Applications Support. The questionnaires which researchers take from COBIT 5.0 [4]. And also did interviews to 4 persons in IT division (Human Resource Development, IT Application development, and Internal Audit).

### IV. RESULT

This result could be shown through audit steps as following:

#### A. Planning

Researcher discovered the need of PT. X and started to list down the needs, will be audited,

those are: human resource and work agreement. For this matter, researcher applied the COBIT 5.0 framework to measure the capability level in PT. X, in particular researcher using IT Enabler: Align, Plan, Organize 7 (human resource) and Align, Plan, and Organize 9 (service agreement).

#### B. Field Work

To obtain the data, researcher used questionnaires, interview, and observation as the technique in field survey of IT division. The questionnaire contains 127 question items and 10 respondents, whereas in the interview there was 4 representatives as the respondent from IT division. Lastly, researcher process all the data that has been submitted.

#### C. Reporting

From the questionnaire and interview results, researcher found 56 audit findings in the questionnaire and 20 audit findings from the interview. However, there were some crucial findings need to be solved immediately.

#### D. Follow Up

Researcher will deliver this report to the internal audit team in PT. X as an advice and recommendation. Nevertheless, in order to execute, internal audit parties definitely need time due to the permission proposal to the related or involved parties audited.

Table. 1

PROCESS	AUDIT	IMPACT	RECOMMENDATION
APO 07.01.01	There are functions for resource planning and monitoring that weren't arranged well.	Unable to encounter possibilities that occurred	Re-arranging management resources and offer backup plan.
	The presence of cooperation with third party for the development of IT, it can't be executed internally.	Degradation of internal skills and increasing cost.	Corporation is supposed to maximizing the internal human resources, before considering the outsources
APO 07.02.01	Independency of one's in the process of PTO and SPO	There's a possibility that someone is using the information for another interest especially in PTO and SPO.	There should be only one person accountable for the information to reduce the misuse of the information
APO 07.02.04	Capacity planning function in the Information Security Department, Infrastructure Architecture, and capacity analysis in Feasibility Study were not done since Human Capital makes no detail plan.	The further risk is unknown.	Even though the Human Capital made the detail plan, the result should be informed to other division as well so required action can be made to minimize possible risk.
APO 07.06.07	There was review draft that was done by the project team, however the procurement division did it as well, it can make different decisions and opinions are possible to occur.	There's a high probability of different decision/solution due to more than 1 division made the decision	The review should be made by only one division so the decision is unanimous.

Table. 1 Shows the impacts and recommendations that were found in the questionnaires by COBIT 5.0 that were distributed in several divisions at PT. X such as, IT, Internal Audit, and Human Capital Business Partner.



Table 2

No	PROBLEM	EFFECT	RECOMMENDATION
1	No guidance for taking training on Easy tools system.	Employees could took the wrong training that could make them unable to maximize their capabilities	A big company like PT X should start giving guidance in order to increase the capabilities of current employees
2	Every unit in IT is having trouble to finish projects on time because of lack of quality and quantity of employees	If there are any additional projects, every unit will be overloaded due to the lack of resources	Start mapping resources and requirements for each projects on the beginning of the year as precaution for additional projects in the future
3	All program are made from vendor.	IT division/department only reads and understands coding	Programmers should work on at least 1-2 projects in a year in order to maintain their skills.

Table. 2 Indicate the effects and recommendations that were discovered in the interview result and were answered directly by IT divisions, Internal Audit, and Human Capital Business Partner in PT. X.

Table. 3

	1 <sup>ST</sup> LEVEL	2 <sup>ND</sup> LEVEL	3 <sup>RD</sup> LEVEL	4 <sup>TH</sup> LEVEL	5 <sup>TH</sup> LEVEL
APO 07	93.69	96.59	82.5		
APO 09	91.35	97.04	92.75	84.1	

Table. 3 Represent the process calculation of APO 07 (Manage Human Resource) and APO 09 (Manage Service Agreement).

#### CONCLUSION

After doing measurement on Manage Human Resource and Service Agreement, therefore we came up with a conclusion that at APO 07 Fully Achieved in level 2 and named Managed Process. In this stage, organization was performing the IT process and it was well managed in achieving the goal, hence there was a better mark. The management includes few processes are, planning, evaluation, and adjustment toward improvements, whereas APO 09 Fully

Achieved was on level 3 and named Establish Process. Hereby, organization had standardized IT processes within the entire organization.

APO 07 (Manage Human Resource) and APO 09 (Manage Service Agreement) hardly reach level 5 since there were few unsolved problems, as follows:

1. There is a function of resource planning and monitoring that didn't go well in arranging employees' needs in the beginning of the year based on the employees' capabilities.
2. No maximum works in IT division, due to outsource personnels that are used.
3. PTO and SPO processes were not depending on 1 person, therefore many people could see the documentations.
4. Capacity planning function in the Information Security Department, Infrastructure Architecture, and capacity analysis in Feasibility Study were not done since Human Capital makes no detail plan.
5. There was review draft that was done by the project team, however the procurement division did it as well, make different decisions and opinions are possible to occur.
6. No guidance for taking training on Easy tools system.

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# Implementation of Sales Executive Dashboard for A Multistore Company in Yogyakarta

Halim Budi Santoso<sup>1</sup>, Priyanka Ayu Sonia Putri<sup>2</sup>, Budi Sutedjo Dharma Oetomo<sup>2</sup>

<sup>1</sup> Department of Information System, Faculty of Information Technology, Duta Wacana Christian University  
hbudi@staff.ukdw.ac.id

<sup>2</sup> Department of Information System, Faculty of Information Technology, Duta Wacana Christian University  
budi@staff.ukdw.ac.id

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**Abstract**— Information Technology is a part of strategic part for enterprise strategic planning. Information Technology can help the enterprise to determine its strategic planning. Through data from the past, the company can learn something and help to decide some strategic issue. A Multistore Company in Yogyakarta has more than five stores. The problem raises to generate real-time sales reporting. Sales manager and owner do not have access to real-time sales condition.

To ease management analyzing and reporting sales condition, dimension model of the sales data needs to be built. This dimension model will help to make executive report from some dimensions mentioned in data warehouse. Sales data will pass through some processes: Extract, Transform, and Load (ETL) in order to prepare the data warehouse. This process is pre-processing data before dimensional model is built. In this research multi-dimensional modelling by taking data from 3 stores ranging from 1 February 2014 to 31 January 2015.

By implementing sales executive dashboard, it helps to monitor and analyze sales condition. Dashboard shows graphic which ease user, especially sales manager and owner to learn current and updated sales condition based on dimensions: time, outlet / store, and product. Report gives detail information and multidimensional helps to analyze data from different perspective.

**Index Terms**—Dashboard, Multi Dimensional Model, ETL, Executive Reporting

## I. INTRODUCTION

Development of Information Technology has been switched from operational to strategical issue. Information Technology helps company to make better decision by providing data analysis. Management takes benefits from this strategic information technology. One of the issues of strategic information technology is Business Intelligence. Business Intelligence brings a new horizon for company and bring real-time processing and analyzing data. Business Intelligence brings data processing into one step ahead. Business Intelligence providing information from the enterprise data.

Processing data from database needs three processes: extract, transform, and load (ETL). These three processes combine data from different and many data sources. It pull these data and store it into another database, which is called a data warehouse. Data Warehouse is built by using multidimensional model. Multidimensional model contains fact as a subject analysis and dimensions as perspectives to analyze the fact. This multidimensional model will be a baseline to build dashboard reporting.

Report visualization is a process to bring enterprise data into a meaningful information fast and easy to understand [1]. This visualization is called dashboard. Dashboard is a visualization result for data processing and has a purpose to be used for company's executive or manager (stakeholder) to measure company performance real time [1]. A system in the dashboard can handle and process big data and show it into short pages, show trends and information needed by company's manager or executive. Dashboard also gives manager a responsive user interface comparing with traditional reporting. Dashboard also give more information comparing with traditional reporting [1]. Designing the dashboard will help management and executive to identify trend, pattern, and / or data anomaly. Dashboard also can be used to help data analysis.

A retail company in Yogyakarta with more than one store has obstacles for management to manage and monitor sales condition. Sales data from outlet only save in local computer. It raises a problem if management want to monitor real time sales reporting. It takes much time to analyze the sales condition and needs to take strategic decision.

Management also has difficulties to produce real time sales report. Generating sales report spend more time. It needs to collect reports from stores and summarize it manually. Thus, management is unable to generate real-time reports. It needs much time to analyze some sales and managerial issues, such as stock level in every store / branches. From those situations, there are two research questions: (1) How to formulate multidimensional model for this

multistore retail company; (2) How to implement dashboard to visualize transaction data and bring information to management. In order to solve the research questions, researchers took data from 3 outlets as samples ranging from 1 February 2014 to 31 January 2015.

## II. LITERATURE REVIEW

### A. Data Warehouse and Dimensional Model

Data warehouse system were conceived to support decision making within organizations. These systems homogenize and integrate data of organizations in a huge repository of data in order to exploit this single and detailed representation of the organization's decision making [2]. Data warehouse is a system to extract, clean, transform, and send data source into a dimensional model and support to implement query and analysis to support decision making [3].

Therefore, considering that the very survival of the organizations frequently depends on the correct management, security and confidentiality of information [4], and the extreme importance of the information that users can discover by using these kinds of applications, it is crucial to specify confidentiality measures in the MD modeling process, and enforce them [4].

The data warehouse is a huge repository of data that does not tell us much by itself; like in the operational databases, we need auxiliary tools to query and analyze data stored [5]. Without the appropriate exploitation tools, we will not be able to extract valuable knowledge of the organization from the data warehouse, and the whole system will fail in its aim of providing information for giving support to decision making.

The usage of data warehouse will bring a good analysis of data. It will bring a good information to the business user. This information will support to make decision. Although as a decision support, information security is also a serious requirement which must be carefully considered as a element in the development lifecycle, from requirement analysis to implementation and maintenance [6].

Building data warehouse, the data should follow these three steps: extract, transform, and Load [7]. Extract is the first step. In this step, data is extracted. In this step, what information will be retrieved is also defined. The purpose of this step is to take data from its source. The next step is transform. In data transformation, some processes can be done: (1) data filtering; (2) data modification; (3) calculate measure and other new values; (4) Generate surrogate key value; (5) Creating summary from data. The last step is load. In this phase, data is loaded into data warehouse. In this phase, loading time interval is also be released.

The multidimensional conceptual view of data is distinguished by the fact / dimension.

Multidimensional modelling is the process of the data modelling in the universe of discourse with the modelling structure to provide a multidimensional data model [8]. Multidimensional models categorize data, either as facts associated with numerical measure or as dimensions that characterize the facts and generally in plain text.

All multidimensional model contains fact and dimension tables with the variant of star schema or snowflake models. Fact is a term of the subject of analysis [2]. While, dimension shows different perspective or point of views where a subject can be analyzed from [2].

Multidimensional model is stored in a data structure called cube [2]. Cube can be generalized interpreted as a basic logical structure to describe multidimensional database. Cube operation is based on the most straight forward way to model multidimensional data. Each cube has a quantitative data that can be analyzed. This kind of data is called measures [2].

Building multidimensional model follows some phases / steps [5]: (1) Identify business process requirements; (2) Identify the grain; (3) Identify the dimensions; (4) Identify the facts; (5) Verify model; (6) Physical design considerations.

### B. Business Intelligence

Business Intelligence is a term that covers data warehousing, data integration technology, query, report, and analysis tools [3]. Business intelligence gives business user independent access to information. One of the Business Intelligence implementation examples is implementation of Business Intelligence in multi-channel service delivery capability [9].

Business intelligence as IT application that helps organizations make decisions by using technology for reporting, data access, and also analytical applications [10]. Business Intelligence application also help to retrieve information that is hiding in database [10]. This hiding information are able to help worker formulate decisions by analyzing data [11]. A thorough formulation of business objectives and information technology must be established for an enterprise to obtain value from a BI implementation [12].

Performance Dashboard is a new model for Business Intelligence, building innovation to give suitable user interface for every user to retrieve information [1]. Imelda [13] tells that business intelligence is a process to extract company operational data and collect it into data warehouse. During data extraction, transformation and cleaning are done to implement formula, aggregation, and validation. This will bring a good for business issue.



### III. RESEARCH METHODOLOGY

#### A. Building Data Warehouse

This research takes data from 3 stores ranging from 1 February 2014 to 31 January 2015. This data is used as a sample data. Researchers takes 3 stores as example. Those are: (1) Store at Jalan Magelang; (2) Store at Jl. KS Tubun (Kuncen); (3) Store at Jl. KS Tubun (Minang). To build the data warehouse, researchers adopt Johnson and Jones [7] methodology: (1) Data Extraction; (2) Data Transformation; (3) Data Loading.

##### 1) Data Extraction (Extract)

Data from 3 stores are generated from different database. Those 3 stores use Access Database. These data are exported into SQL Server Database. From 3 stores, the number of data gained by researchers as follows:

1. Outlet in Jamal :  
There are 9649 transaction data and 30993 transaction detail data from this outlet.
2. Outlet in Kuncen  
There are 6825 transaction data and 19019 transaction detail data from this outlet.
3. Outlet in Minang  
There are 9521 transaction data and 31751 transaction detail data from this outlet.

Researchers drop some unnecessary columns. Those columns are in the some tables:

##### 1. Table M\_Data\_Harga\_Jual

This table contains master data for product. In this table, columns for product code [Kode Barang], product name [Nama Barang], selling price [Harga Jual], and net selling price [Harga Net] is used. Other columns will be dropped since it is not needed in dashboard reporting. After the cleaning process, the table structure as shown in table I below:

TABLE I. TABLE STRUCTURE M\_DATA\_HARGA\_JUAL AFTER DELETE SOME COLUMNS

Fields / Column	Data Type	Size	Allow Null?
[Kode Barang]	Nvarchar	50	No
[Nama Barang]	Nvarchar	50	Yes
[Harga Jual]	Float		Yes
[Harga Net]	Float		Yes

From the table I, it is shown that the data warehouse uses 4 columns. Those columns have important information: Product id, product name, selling price, and net price.

The other columns are deleted since have null values or 0.

##### 2. Table Dt\_Nota\_H

This table is the header for transaction data. There are some columns which have null values. Three columns are remaining: [No Faktur], [Tgl Keluar], [Tipe Pembayaran]. The table structure can be shown in table II:

TABLE II. TABLE STRUCTURE DT\_NOTA\_H AFTER DELETE SOME COLUMNS

Fields / Column	Data Type	Size	Allow Null?
No Faktur	Nvarchar	20	Yes
Tgl Keluar	Datetime		Yes
Pembayaran	Float		Yes

From table II, it is shown that there are 3 columns that have data about transaction number, transaction date, and total transaction.

##### 3. Table Dt\_Nota\_D

This table contains detail transaction data. Columns which have null values or 0 will be deleted. The remaining columns can be seen in table III:

TABLE III. TABLE STRUCTURE DT\_NOTA\_D AFTER DELETE SOME COLUMNS

Fields / Column	Data Type	Size	Allow Null?
No Faktur	Nvarchar	20	Yes
Kode Barang	Nvarchar	50	Yes
Nama Barang	Nvarchar	100	Yes
Jumlah	Float		Yes
Harga Satuan	Float		Yes
Total Gross	Float		Yes
Harga Netto	Float		Yes

From the table III, it is shown that there are 7 columns are used in this table. These 7 columns have information of transaction number, product code, product name, quantity, price per item, gross total, net price.

##### 2) Data Transformation

Transformation is a process where extracted raw data is filtered and coded. This transformation will change data into specific value or add new columns.

There are some transformation processes that are done:

1. Categorize the product into generic and specific code. Category is used to simplify the analysis process. It will ease the management and executive to read the analysis.

2. Checking the product name and determine the new name for its product. Raw data from 3 outlets have different kind of product naming. As an integrated database, it should have the same name. Researchers did some changes for product names.
3. Researchers also give a new code to bring the same code among 3 database from 3 outlets. Although it is from the same company, 3 outlets have different kind of product code. Researchers transform it into a single code for the same product.
4. Adding transaction date to detail transaction table (DT\_NOTA\_D). This transaction date is derived from transaction date in header table (DT\_NOTA\_H).
5. Give outlet code for every transaction. The development of data warehouse involves 3 database from 3 outlets. Thus, every single transaction should be added outlet code. The outlet code are: (1) jamal for outlet located on Jl. Magelang KM 4.5; (2) kuncenn for outlet located on Jl. KS Tubun No 75; (3) minang for outlet located on Jl. KS Tubun No. 83
6. Cleaning the data which have null values for product id and product name
7. Update the data which has different values for selling price [Harga Jual] and Net price [Harga Net]. The selling price and net price should have the same value.
8. Deleting row data in transaction detail for sales data which have quantity  $\leq 0$ .
9. Copy the product data which have no sales record into a new table.
10. Add outlet code into a new table that contains product data from step 9.

### 3) Data Loading

Cleaning data cause reduce the number of rows. Table IV shows the number of rows before and after cleaning

TABLE IV. NUMBER OF ROWS BEFORE AND AFTER CLEANING DATA

Outlet ID	Number of Rows	
	Before Cleaning	After Cleaning
Jamal	30993	29419
Kuncenn	19019	18018
Minang	31751	30224

From the table IV, it is shown that there are some rows are deleting. Delete the rows that is not needed will bring a good analysis result.

### B. Dimensional Model

To build dimensional model, researchers adopted processes from Ballard [5]. Dimensional model is a model based data to support high volume query access. Star schema is a tool to modelling multidimensional data in data warehouse. Star schema contains fact table with composite primary key and dimensional table with foreign key. Foreign key in dimensional table should respond exactly one component of primary key in fact table. There are some processes in order to design dimensional model [5]:

#### 1) Identify Business Process Requirements

TABLE V. IDENTIFY BUSINESS PROCESS REQUIREMENTS

Business Process	Description	Functions
Sales Transaction	This business process record every transaction in each outlet. It needs to read reporting from different outlet as a dimension. Thus, it will help to define the suitable strategy for every outlet	Managerial Level

From table V, there is only 1 business process which involve in developing dimensional model. From the table V, it is needed outlet data as a dimension. It is needed to arrange the suitable plan and strategy for every outlet.

#### 2) Identify the grain

TABLE VI. IDENTIFY GRAIN

Grain / Fact	Description	Business Process
Transaction Detail	Analysis is needed to view from different perspective related with information value from every transaction detail: quantity, transaction date, product name, price per item, gross total, and outlet.	Sales Transaction

From the table VI, it is known that there is only one source. Transaction detail will be the fact table and its value will be information detail, such as product name, transaction date, quantity, price per item, gross total, and outlet.

#### 3) Identify the dimensions

TABLE VII. IDENTIFY DIMENSION NEEDED

Dimension	Description	Grain
Time	Time is identified into transaction date, year, quarter, month, week, and day	Transaction Detail
Product	Product is classified into product code, generic category, specific category.	Transaction Detail
Outlet	Outlet is identified into outlet code.	Transaction Detail

From the table VII, it is shown that there are 3 dimensions are needed in dimensional model. Those are time, product, and outlet. Every dimension is categorized into subcategory.

#### 4) Identify the Facts

TABLE VIII. IDENTIFY FACT TABLE

Fact	Description	Dimension
Transaction Detail	Fact table of Transaction Detail is a collection of information and analysis with dimensions. Fact table contains transaction code, product id, product name, quantity, price per unit, gross total, and net price	Time Dimension Product Dimension Outlet Dimension

From table VIII, it is shown that there is one fact tables and 3 dimensions: time, product, and outlet. Fact table (transaction detail) already contains data which is needed for analysis process.

#### 5) Verify the model

In this process, model is verified and some columns are recalculated as a formula.

Fact table: Transaction Detail

Model:

- $\text{SalesTotal} = \text{sum}(\text{detail\_nota.Jumlah})$
- $\text{GrossRevenueTotal} = \text{sum}(\text{detail\_nota.totalgross})$

In this process, there are two columns as a model. SalesTotal is the sum of quantity of sold product. GrossRevenueTotal is the sum of total gross.

#### 6) Physical Design Consideration

The last step is physical step, especially data sorting and searching through indexing. Data in data warehouse already sorted based on primary key.

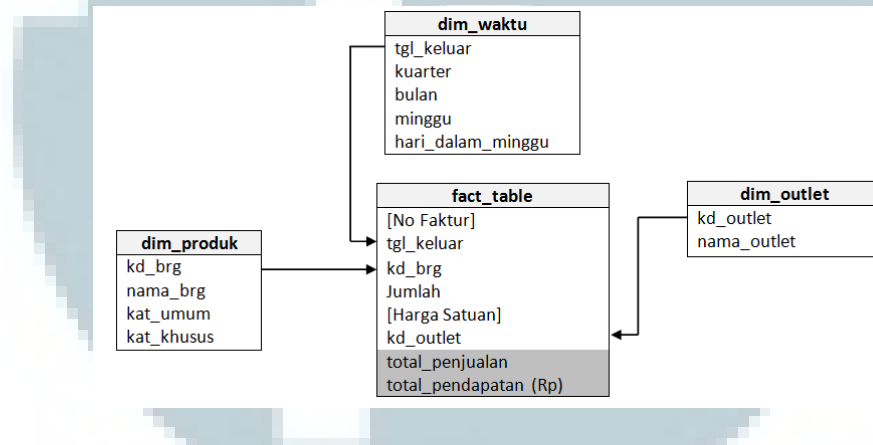


Fig. 1. Dimensional Model (Detail)

From figure 1, it is shown that there are 1 fact table with 3 dimensions. It is based on the design step. As a fact table is transaction detail with 2 added columns: sales total and total revenue. These 2 columns will be facts.

Facts:

Total Penjualan (Sales Total)  
Total Pendapatan (Sales Revenue)

Table IX shows the dimensional model. Dimension time is divided into: Days in Week, Week, Month, and Quarter. While product is divided into: Generic Category, Spesific Category (Sub Category), and Product ID. Outlet dimension only has one dimension, which is outlet ID. As facts in this dimensional model are: Sales Total (Total penjualan produk) dan Revenue Total (Total pendapatan).

TABLE IX. DIMENSIONAL MODEL

Time	Product	Outlet
Quarter	Generic Category	Outlet ID
Month	Spesific Category	
Week	Product ID	
Days in Weeks		

#### C. Dashboard

Building dimensional model will lead to dashboard design. Information from the fact and dimension table will be presented using graphics.

1. Line Chart will be used to present sales transaction trend from specific period. Line chart will help user to read the trend of the data
2. Bar Chart will be used to compare between sales conditions among specific time.
3. Pie chart will be used to give information about percentage of product sales and comparing with dimension category, specific and generic category.

## IV. IMPLEMENTATION AND ANALYSIS

## A. System Implementation

Fact table and dimension table in Figure 1 and Table IX are initial steps to make cube and multidimensional database.

Outlet Minang					Bakpia	Makanan Basah	Makanan Kering	Minuman	
Outlet Kuncenn					Bakpia	Makanan Basah	Makanan Kering	Minuman	3169
Outlet Jamal					Bakpia	Makanan Basah	Makanan Kering	Minuman	2089
2014					18727	4963	7537	2167	573
2015					8809	2342	3256	1023	

Fig. 2. Cube Multidimensional Model

Figure 2 shows cube multidimensional database that will be implemented to generate sales dashboard. Cube consists of fact table, dimensional table which has some descriptive columns, and measure. Descriptive columns in dimensional table will help to filter data based on dimension attribute. Measure is quantitative value to be analyzed. Measure value is gained from fact table and will be counted based on dimension on cube.

Data warehouse is ready after ETL process and cube multidimensional model design. Data warehouse can be used to analyze sales report. The next step is report implementation which has important role in managerial level and help in analysis process. It will bring to decision making based on this report.

		Measures TotalBrgTerjual dim-produk				
dim-waktu	dim-outlet	Minuman	Makanan Kering	Makanan Basah	Lain-lain	Bakpia
2014	minang	3,169	9,424	7,645	2,274	23,584
M12	minang	807	2,984	2,388	721	7,526
M11	minang	615	2,057	2,002	449	6,205
M10	minang	85	277	232	78	701
M9	minang	145	250	174	63	601
M8	minang	102	222	154	58	617
M7	minang	859	2,580	1,708	655	4,720
M6	minang	91	255	189	57	724
M5	minang	113	216	304	72	705
M4	minang	111	160	164	26	601
M3	minang	109	237	164	52	608
M2	minang	132	186	166	43	576

Fig. 3. Total Product Sold per Month (Item)

		Measures TotalPenjualan dim-produk				
dim-waktu	dim-outlet	Minuman	Makanan Kering	Makanan Basah	Lain-lain	Bakpia
2014	jamal	14,466,900	171,879,000	118,559,500	39,903,500	653,249,000
	kuncenn	12,744,500	85,478,500	102,816,000	11,502,000	420,712,500
	minang	17,587,800	218,472,300	176,818,000	28,263,500	822,085,000
2015	jamal	6,629,000	79,397,000	58,613,000	17,605,000	308,815,000
	kuncenn	3,720,500	26,607,000	34,267,000	3,839,000	141,581,500
	minang	4,847,500	59,002,500	45,158,500	8,075,500	236,240,000

Fig. 4. Total Gross Revenue (Rupiah)

Figure 3 and 4 show the total product sold per month and total gross revenue. This report is generated based on dimensional model. Management is able to make and analyze sales report and gross revenue from

3 dimensions: time, outlet, and product based on measure: total product sold and total gross revenue (in rupiah).



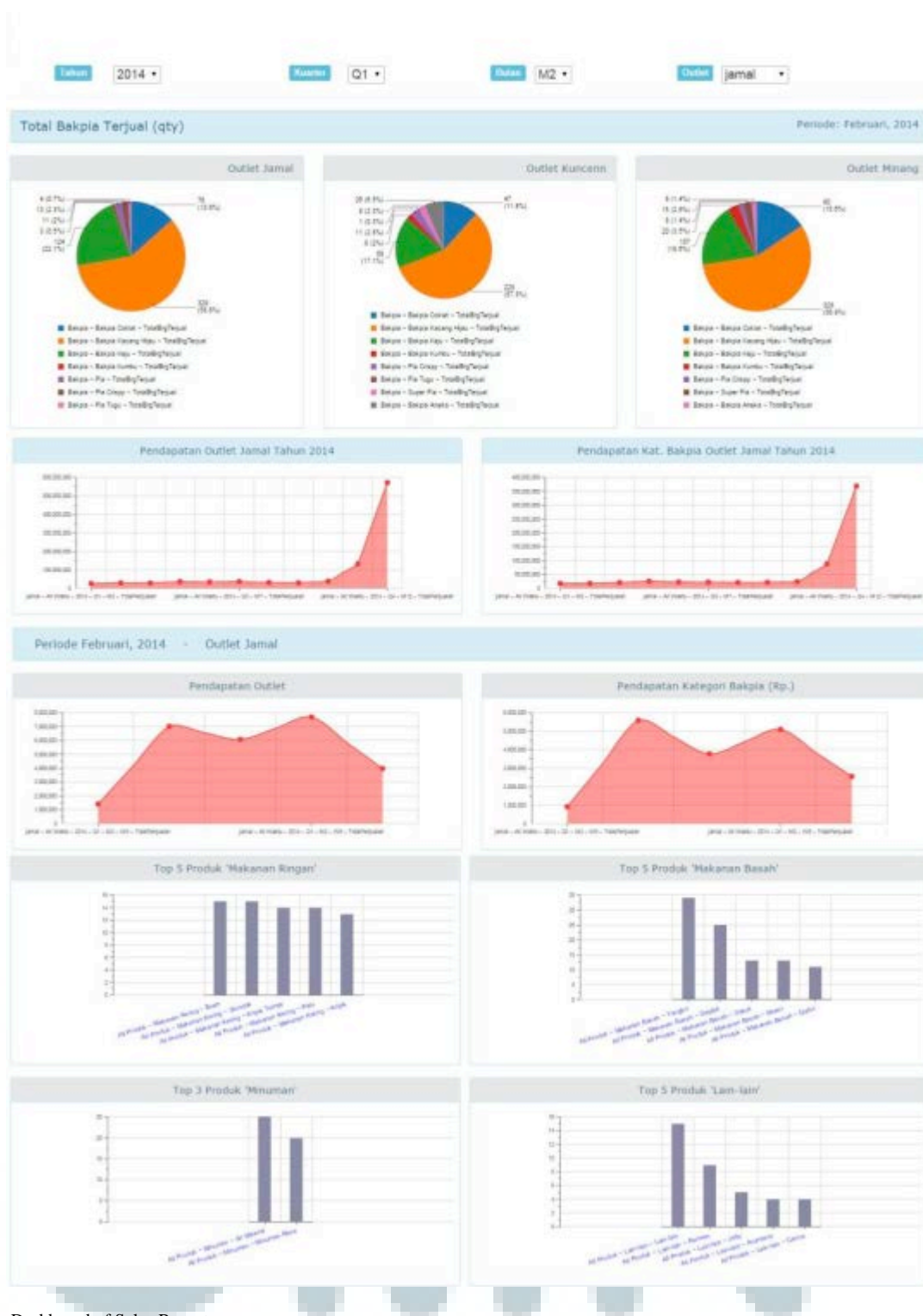


Fig. 5. Dashboard of Sales Report

Figure 5 shows sales report dashboard. Dashboard has feature to show graphics interactive based on chosen dimension value. Dashboard is also designed to capture information based on filter parameter. Filter parameter is defined based on dimension in cube.

### B. System Analysis

Dashboard is designed to monitor and support management analysis for sales condition in company. Using dashboard, management is able to capture and monitor current sales record and condition. Dashboard also help management to explore data in many dimension and support performance review between

management and operational [1]. Sales transaction data will be visualized into 3 dimensions: time, outlet,

and product. Using these 3 dimensions will help user to generate report based on its need.

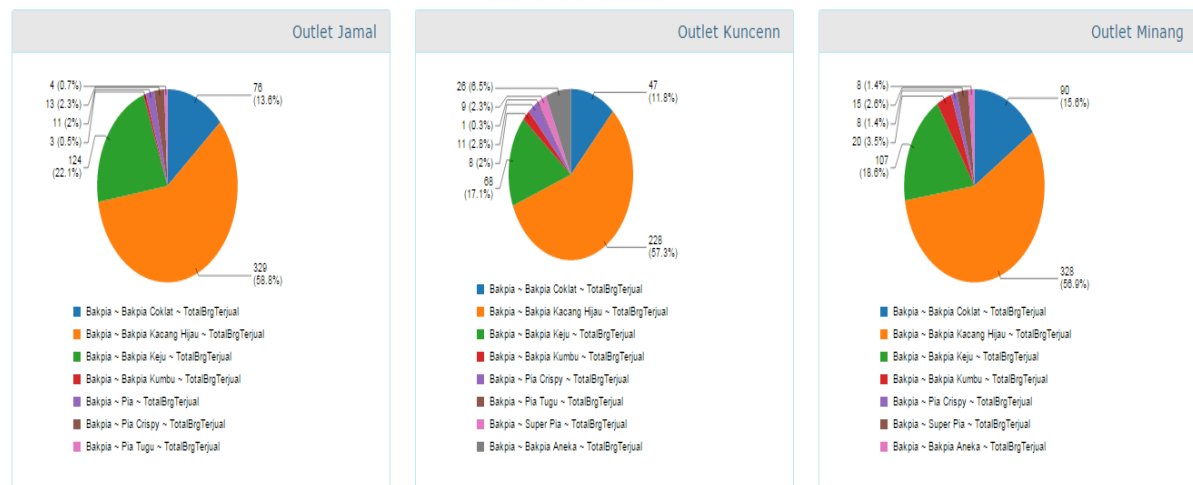


Fig. 6. Graphic of Item Product sold based on outlet dimension

Figure 6 shows total item product sold in every outlet. This graphic also indicates outlet dimension is used in this report. With this graphic, user is able to

gain percentage of product sold based on product category. Color domination in pie chart shows best seller product.

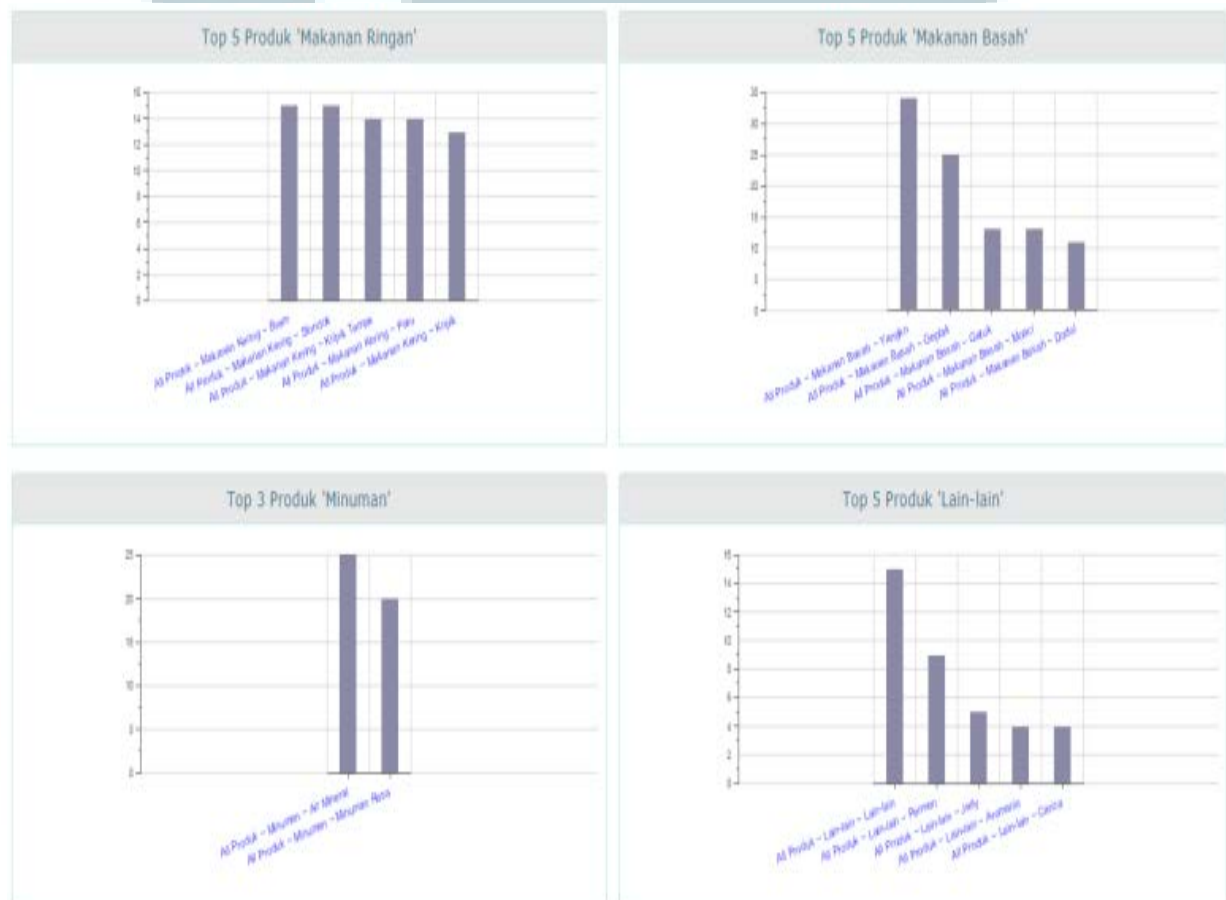


Fig. 7. Top 5 product for Generic Category

Figure 7 shows top 5 product. Bar chart shows top 5 product of generic category. Available generic category: Snacks, Food, Drinks / Beverages, and

Others. Diagram in figure 7 shows information of item product sold for specific period and outlet.

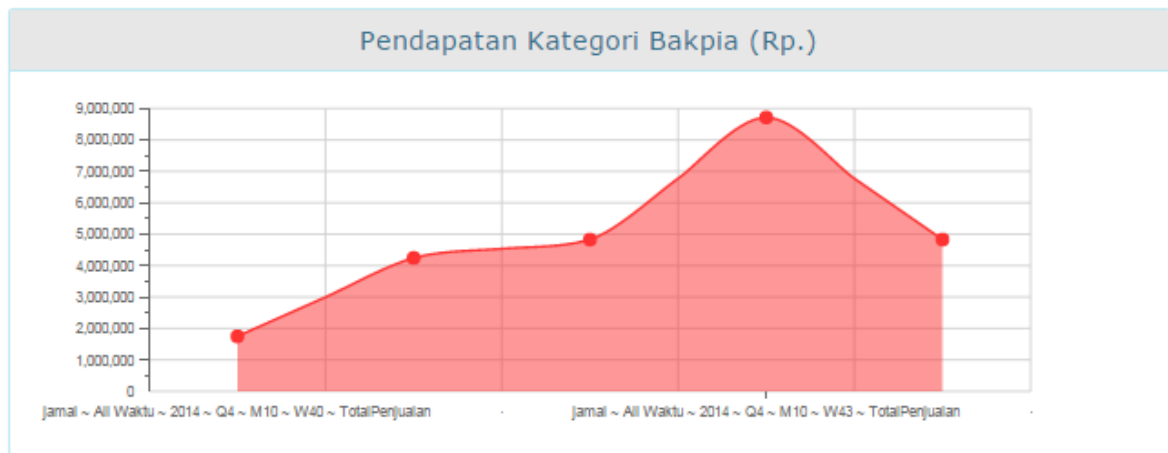


Fig. 8. Total Revenue Trend

Figure 8 shows trend for total revenue. Line chart indicates fluctuation of sales revenue during specific period of time. This line chart also bring an analysis to sales trend based on time dimension (day, week, month, and quarter). Management can read the data and analyze the sales position.

By developing dashboard business intelligence, sales manager and management has an independent access to the information [10]. The information generated in the dashboard are vary: (1) Top 10 product sold for every store; (2) Total revenue for each store and accumulative; (3) Revenue for each product category.

The system has some advantages for user, especially for sales manager and owner. Those advantages are: (1) Multidimensional model that are generated help owner to summarize the data into pivot table and can be monitored from some perspective through dimension; (2) Information are able to be drilled down into smaller dimension; (3) Sales data visualization and graphics are able to deliver sales information to sales manager and owner. But this system also has a disadvantage. System is unable to calculate company profit. To analyze company profit, it needs expenditure data.

## V. CONCLUSION

Based on system implementation and analysis, there are some points as conclusion:

1. Sales transaction data dimensional model has been developed using 3 dimensions: time, outlet, and product category based on fact table which has information of sales transaction detail.

2. Dimensional model can be used to help making of executive reporting. The report is presented in table and converted into graphic.
3. Dashboard can be used based on dimensional model using multidimensional expression. Sales data can be derived and seen from many dimensions.
4. Business intelligence system and dimensional modelling can bring information and present it into dashboard visualization. This will help management to understand and analyze sales condition fast. This analysis will bring good and quick business decision.

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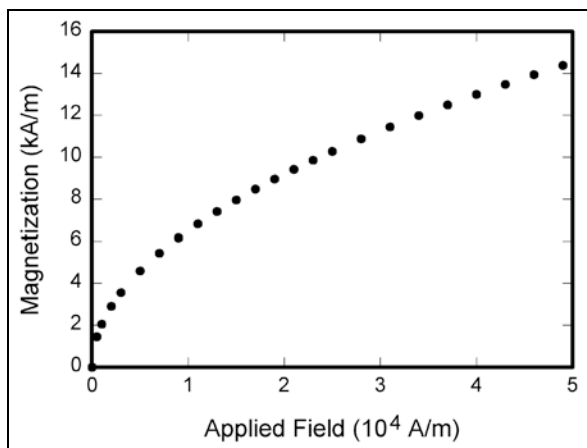


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