THE DEVELOPMENT OF DISTRIBUTOR VALVE LEARNING MEDIA IN THE RAILROAD AIR BRAKE SYSTEM FOR PT. PINDAD (PERSERO)

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ABSTRACT

This research was conducted at PT. Pindad (Persero) with the intention of building Application of Distributor Valve Learning Media on Railway Air Brake Systems with the aim of helping workers in the Sarka department's production section in studying Distributor Valve. This research was conducted using quantitative descriptive method with stages of problem identification, data collection (using interview methods, observation, and library studies), formulation of goals and objectives, data analysis, software development using the Multimedia Development Life Cycle (MDLC) method, testing (Blackbox , User Acceptance Test, interview), conclusions and suggestions. This application contains Distributor Valve material including 3-dimensional introductory material, component assembly using animation, brake leak repair, air flow animation, and assembly exercises. Modeling the Distributor Valve object is done by using the Blender 3D application, while the application development using Unity Engine. Based on the results of Blackbox testing, User Acceptance Test (UAT), and interviews, it can be concluded that this application is enough to help workers learn about Valve Distributors.

Keywords: Distributor Valve, Multimedia, Blender 3D, Unity Engine, Multimedia Development Life Cycle.

1. INTRODUCTION

PT. Pindad (Persero) is a State-Owned Enterprise (BUMN) which was inaugurated on April 29, 1983. PT. Pindad (Persero) produces military equipment and also industrial equipment. Production of military equipment including military weapons and military vehicles, while non-military production includes Air Brake products, marine equipment and others [1]. PT. Pindad (Persero) consists of several divisions, one of that is the TCAP (Forging, Cast, and Railroad) division. The TCAP Division consists of the Department of Railway Facilities (Sarka), the Forging and Railroad Infrastructure department (Praska), and the Cast department. The Sarka Department produces Distributor Valve which functions to give and remove air automatically for braking time and release on the Air Brake System [2].

Based on the results of interviews with Mr. Murwanto as the manager of Sarka, he stated that the Sarka department made changes to workers every 3 months so that workers could master all fields of mechanics and pneumatics. With the rolling of the workers, training is conducted on Distributor Valve. Currently the training is only carried out during leisure time, which is when waiting for Distributor Valve components to be assembled to be received from suppliers. This causes the Distributor Valve material not to be conveyed entirely.

Mr. Toni Nurdara as the Junior Manager of Production 1 (Pneumatics) said that workers in the production sector did not understand which components needed to be dismantled and repaired when there was a leak Distributor Valve at a point so that the process of repairing the leak of Distributor Valve requires an average time of more than 1 hour per unit. The time needed to repair a Distributor Valve leak should only be around 30 minutes. The duration of the leak repair process affects the production target to reach 7 units per day, only able to reach 3 to 4 units per day.

The workers in the production sector said that currently the guidelines and learning media used still use conventional 2-dimensional media in the form of books. The use of books as a guide as well as learning media is not able to represent distributor Valves real form in a realistic picture. This makes it difficult for workers to align the images represented by books with the real form of Distributor Valve.

The study entitled "Learning Media Prototype Design Car Brake System Simulation for Learning of Vocational School Students Majoring in the Automotive Department" was designed to deliver material on the performance of car brakes to vocational students majoring in Automotive by using a 3-dimensional simulation model [3]. The research will be built using the same concept in the simulation model. The research entitled "Learning Media of Soft Ice Cream Maker Machine in Multimedia-Based Sekayu Polytechnic Refrigeration

Lab" resulted in a multimedia-based Soft Ice Cream Maker machine for students of Air Conditioning and Air Conditioning Engineering at Sekayu Polytechnic using the concept of tutorial models in delivering the material [4]. The research will be built using the same concept in the tutorial model. The difference from the research that will be built with 2 previous researches is that this study adds the concept of drill and practice models.

Referring to the description presented, it can be concluded that PT. Pindad (Persero) requires supporting media in learning about Distributor Valve. Therefore, a 3-dimensional learning media application is made about Distributor Valve.

2. THEORY BASIS

The theory basis aims to provide an overview of the theories relating to research and development of this application. The theory basis discussed is about Multimedia, Interactive Multimedia, Computer Assisted Learning, Multimedia Development Life Cycle (MDLC), used programming languages, Unity, and Blender 3D.

2.1. Multimedia

According to Vaughan, multimedia is a combination of text, art, sound, images, animation, and videos that are delivered on a computer or digitally manipulated and can be delivered and / or interactively controlled. In general, multimedia relates to the use of more than one type of media to present information [5]. Multimedia is divided into 3 namely interactive multimedia, hyperactive multimedia, and linear multimedia.

a. Interactive Multimedia is multimedia where users can control when and what elements will be displayed. Examples of this type of multimedia are interactive learning multimedia, game applications, and more [6].
b. Hyperactive multimedia is multimedia that has many links that connect one element with other elements directed by the user.
c. Linear multimedia is multimedia where users act only as viewers of the multimedia products presented. This multimedia runs sequentially. Examples are TV and Film [6].

2.2. Interactive Multimedia

Multimedia components are characterized by the presence of elements in the form of text, images, sounds, videos, animations, etc. which are organized into matching programs. While interactive components are obtained from the process of empowering users to empower the multimedia environment that usually uses computers [7]. Interactive multimedia has 4 strengths, that is:

a. Mixed Media, is a multimedia from a mixture of several media both text, image, sound, video, and animation.
b. User Control, allows users to view material according to their needs.
c. Simulation and Visualization, allows users to get more real information.
d. Different Learning Style, where multimedia supports the learning process that is different for each user.

2.3. Computer Assisted Learning

Computer Assisted Learning is divided into four models, that is [8]:

a. Tutorial Model, where the program acts as a teacher for the user. This model contains explanations, concepts, materials, and exercises.
b. Drill and Practice Model, is a teaching technique that serves to teach material repeatedly with the aim that users can remember the material taught in order to gain skills.
c. Simulation Model, is a simplified picture or event so that it approaches the real situation.
d. Problem Solving Model, similar to Simulation model, but this model aims to teach problem solving strategies.

2.4. Multimedia Development Life Cycle (MDLC)

The method of building MDLC software consists of 6 stages, that is:

a. Concept, starting with determining the purpose of building the application, it also determines the user of the application.
b. Design, done by making detailed specifications regarding project requirements, architecture, style, and appearance.
c. Material Collecting, collection of materials suitable for software needs, such as material, images, animations, videos, and so on.
d. Assembly, the entire material collected in the previous stage, then processed into an application based on the design made at the design stage.
e. Testing, testing is done to ensure that the results of the application are in accordance with the plan.
f. Distribution, i.e. an application that has been finished stored in a storage media which will then be distributed to the parties concerned.

2.5. Storyboard

Storyboard is a sketch of a picture arranged sequentially according to a text that can convey story ideas to others more easily. This is because the storyboard can lead someone's imagination to follow the images presented so as to produce the same perception as the story idea [9].

2.6. C# Programming Language

C# programming language is an object-oriented programming language developed by Microsoft as part of the .Net Framework framework initiative [10].

2.7. Unity

Unity is a game engine developed by Unity Technologies. Unity is a game development tool with integrated rendering capabilities in it [11].

2.8. Blender 3D

Blender is software that is used to create 3D designs. The design is not only in the form of a static image, but also in the form of animation [12].

3. RESEARCH METHODS

This research uses descriptive quantitative methods. Quantitative descriptive research is a conscious and systematic effort to provide answers to a problem and / or obtain more in-depth and broad information on a phenomenon by using research stages with a quantitative approach [13]. The flow of research used in this research can be seen from Figure 1.

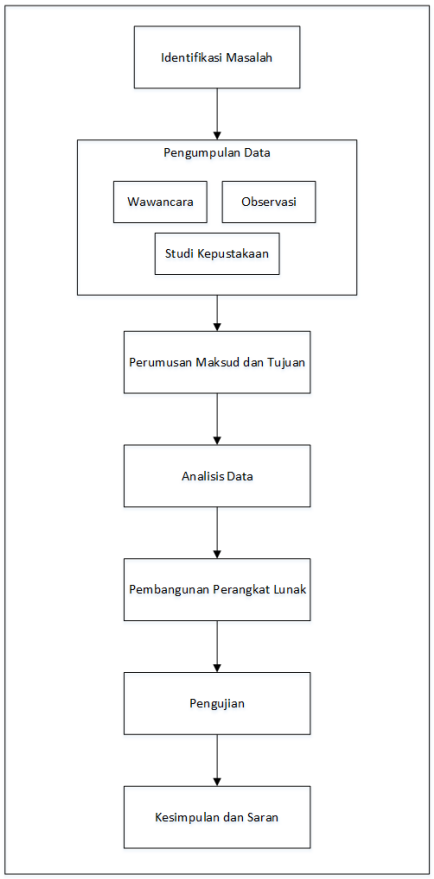

Figure 1

3.1. Identification of Problems

This stage is done to find out what problems are faced by workers in the Sarka department at PT. Pindad (Persero).

3.2. Data Collection

In this research, data was collected by means of interviews, observations, and literature studies. Interviews were conducted at the Sarka Department Manager, Engineering, the workers in the production and testing department. Observations were made by direct survey to PT. Pindad (Persero) TCAP division, precisely the Sarka department. While the literature study was conducted by collecting data from previous research journals, books, and electronic articles related to the topic of this study.

3.3. Formulation of Purpose and Objectives

At this stage, an analysis is carried out which determines the intent and purpose to be answered in the conclusions and suggestions section.

3.4. Data Analysis

At this stage, data analysis is carried out which includes problem analysis, current system analysis, analysis of system requirements both functional and non-functional. This stage is supported by data that has been taken through interviews, observation, and literature studies.

3.5. Software Development

At this stage, software development is carried out using the MDLC method which consists of 6 stages, namely Concept, Design, Material Collecting, Assembly, Testing, and Distribution. The steps in the MDLC method are explained in Figure 2.

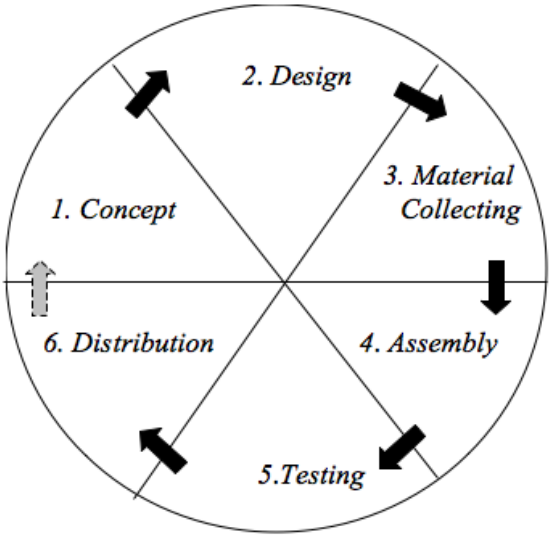

Figure 2

3.6. Testing

At this stage, results of the research are tested to find out whether the objectives of the research have

been achieved. The types of tests chosen are functional testing using Blackbox, User Acceptance Test (UAT), and interviews.

3.7. Conclusions and Suggestions

The last stage in this research is to draw conclusions and suggestions from the results of the research.

4. RESULTS AND DISCUSSION

4.1. Analysis and Design

4.1.1. Problem Analysis

The first problem that was found was that rolling workers were done every 3 months makes the workers need training on Distributor Valve which ideally carried out intensively for 1 week. Unfortunately, due to time constraints, the training is held only when there is free time, such as 30 minutes before work time. This causes the material about the Distributor Valve to be conveyed only in the form of theory, while the practicum is not conveyed.

The second problem is that workers are not given sufficient knowledge in repairing Distributor Valve leaks. So often workers do not understand the problems that cause leaks and which components need to be dismantled and repaired when a leak occurs.

The third problem is the learning media used by workers is books. Books represent Distributors Valve in 2-dimensional form. This caused the workers having difficulty aligning images in books with the real form of Distributors Valve.

4.1.2. System Architecture

Analysis of the system architecture will be built can be seen from Figure 3.

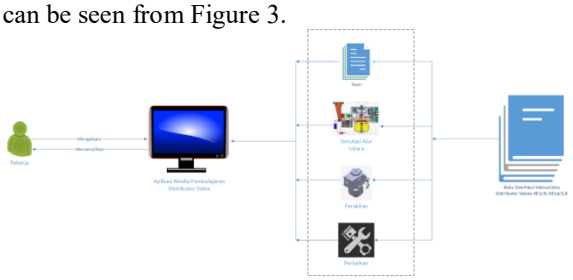

Figure 3

The application will be built serves to help workers in the Sarka department at PT. Pindad (Persero) in studying and remembering material about Valve Distributors. This application is built based on desktop, which in its use the workers simply use a computer to access this application.

4.1.3. System Modeling

4.1.3.1. Non-Fungsional Requirements Analysis

This Non-Functional requirements analysis is done to determine the limits of a system that includes hardware analysis, software analysis, and user analysis.

a. Hardware Analysis
Hardware analysis can be seen through table 1.

Table 1

No	Hardware	Spesification
1	Processor	1.8 GHz
2	Memory	RAM 2 GB
3	Storage space	1 GB

b. Software Analysis
The software needed by users is the Windows XP or Windows 7 Operating System.

c. User Analysis
The users involved are workers. Workers in charge of studying the available material include Distributor Valve introductory material, Distributor Valve component assembly, leak brake repair at Distributor Valve, and conducting Distributor Valve assembly exercises. Workers as users of this application must have the ability to operate the computer properly.

4.1.3.2. Functional Requirements Analysis

Analysis of functional requirements in this research uses the Unified Modeling Language (UML) model which includes use case diagrams, activity diagrams, class diagrams, and sequence diagrams.

a. Usecase Diagram
Usecase diagram in this research can be seen through Figure 4.

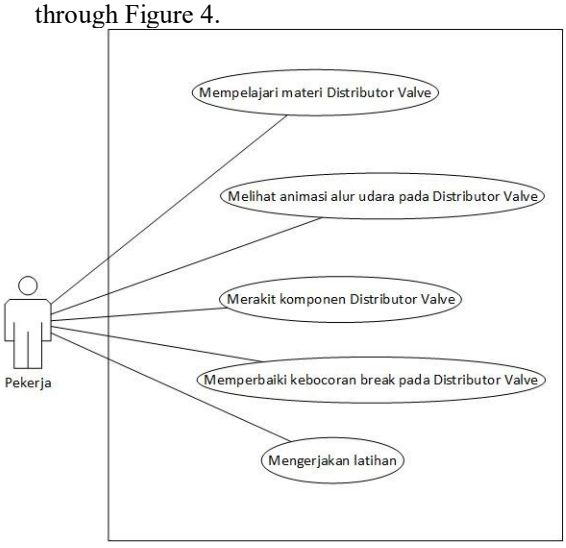

Figure 4

b. Definition of Actor
The definition of actor is explained through Table 2.

Table 2

No	Actor	Description
A-01	Pekerja	Users on Distributor Valve learning media applications

c. Definition of Usecase
Definition of usecase diagrams are explained through Table 3.

Table 3

No	Usecase	Deskripsi
SKPL-F-001	Study the material of Distributor Valve	The worker presses the Materi button, then the application will display the material page regarding the Valve Distributor in detail.
SKPL-F-002	See the visualization of Air Flow at Distributors Valve	The worker presses the Alur Udara button, then the application will display a visualization of the air flow that occurs inside the Distributor Valve
SKPL-F-003	Assemble Distributor Valve components	Workers press the Rakit button on the material page, then the application will display the assembly material for the Distributor Valve
SKPL-F-004	Repair Brake Leaks at Distributors Valve	The worker presses the Perbaikan Material button, then the application will display the Distributor Valve repair material page
SKPL-F-005	Doing Exercises	The worker presses the Latihan button, then the application will display the training page.

4.1.4. Interface Design

a. Interface of Main menu (T010)
The interface design of the main menu can be seen through Figure 5.

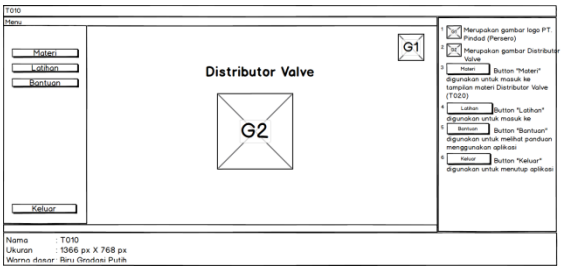

Figure 5

b. Interface of Material(T020)
The interface design of the material menu can be seen through Figure 6.

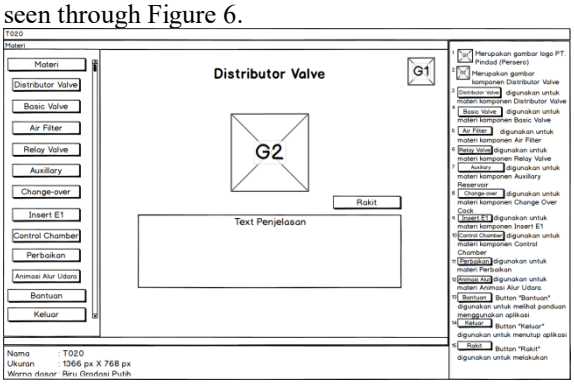

Figure 6

c. Interface of Component Assembling (T021)
The interface design of the component assembling menu can be seen through Figure 7.

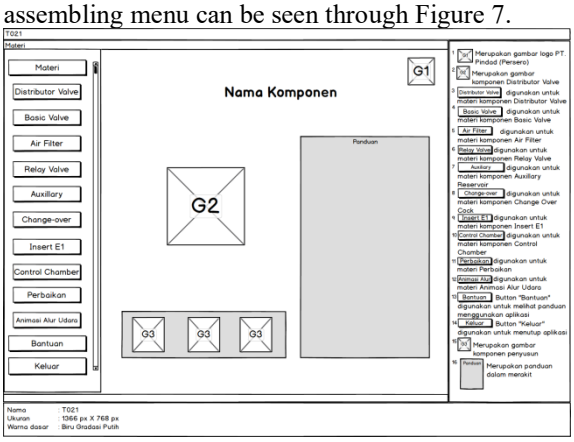

Figure 7

d. Interface of Distributor Valve Brake Leak Repair (T022)
The interface design of the Distributor Valve brake leak repair menu can be seen through Figure 8.

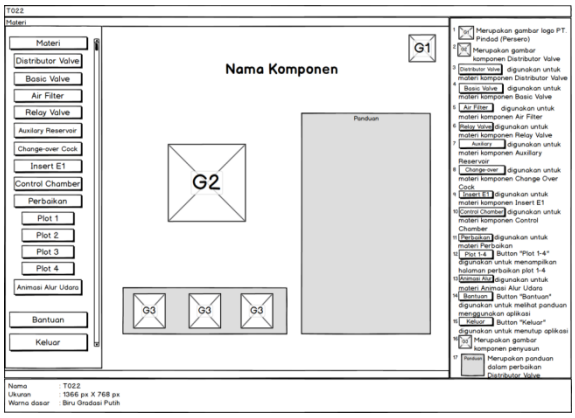

Figure 8

e. Interface of Airflow Animation (T023)
The interface design of the air flow animation menu can be seen through Figure 9.

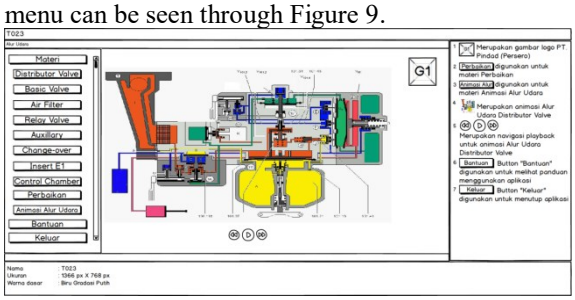

Figure 9

f. Interface of Exercise (T030)
The interface design of the exercise menu can be seen through Figure 10.

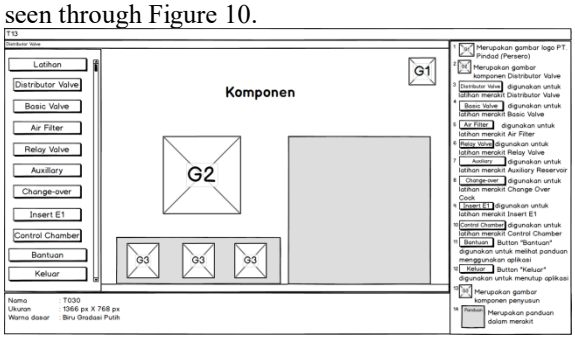

Figure 10

4.1.5. Menu Structure Design

The menu structure designed in the development of this application can be seen through Figure 11.

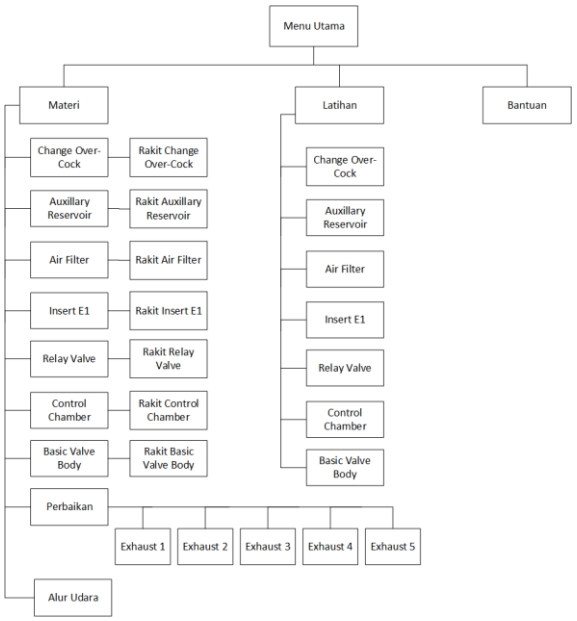

Figure 11

4.1.6. Semantic Network Design

The semantic network designed in the development of this application can be seen in Figure 12.

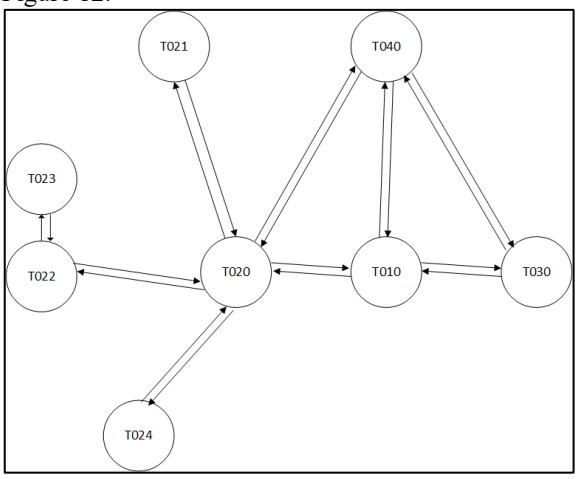

Figure 12

4.2. Implementation and Testing

4.2.1. Class Implementation

Distributor Valve learning media application on the Air Brake System for PT. Pindad (Persero) consists of the classes described in table 4.

Table 4

No	Class Name	File Name	Description
1	AnimController	AnimController.cs	To run animations on objects
2	ControlObjek	ControlObjek.cs	To call an animation by clicking on an object

3	Scenes	Scenes.cs	To call a page
4	Zoom	Zoom.cs	To adjust the zoom level of an object
5	DragHandler	DragHandler.cs	To drag and drop objects
6	Slot	Slot.cs	As a place to drop objects
7	Preview Object	PreviewObject.cs	To rotate on 3-dimensional objects

4.2.2. Blackbox Testing

Functional requirements contained in the system are checked through Blackbox testingThe steps taken are making a Blackbox testing scenario, then testing based on the test case. The results are accepted if the Blackbox test results are in line with expectations.

4.2.2.1. Blackbox Test Results

The conclusion of the Blackbox test results is the Distributor Valve learning media application on the Air Brake System for PT. Pindad (Persero) in functionality has produced output that is in line with expectations.

4.2.3. Testing of User Acceptance Test

This User Acceptance Test (UAT) is done directly to the respondent or user to find out how the results of the user assessment of the application.

4.2.3.1. User Acceptance Test Results

Conclusions that can be drawn from this UAT test, that is:

1. The tested menu is in accordance with what is expected by prospective users, that is the production section workers in the TCAP division at PT. Pindad (Persero).
2. Operation of the application of Distributor Valve learning media can be accepted by prospective users.

4.2.4. Interview Testing

The testing of this interview was conducted by interviewing users, that is workers in the production section of the Sarka department at PT. Pindad (Persero) directly.

4.2.4.1. Interview Test Results

The conclusions from the interview tests that have been made that this application helps complete the material that was not delivered during the training. This application helps workers understand the causes of brake leaks at Distributor Valve and also how to repair leaks. This application also describes Distributor Valve in a 3-dimensional form that resembles the real form of Distributor Valve, so the workers are not confused in aligning the form of Distributor Valve in applications with real forms that make workers easier to learn about Distributor Valve materials.

5. CONCLUSION

After conducting the testing phase, the conclusions obtained are:

a. Distributor Valve Learning Media Application contains all material about Distributor Valve to help deliver Distributor Valve material that has not been delivered during the training.
b. This Distributor Valve Learning Media Application helps workers in the TCAP pneumatic division production section at PT. Pindad (Persero) in understanding which components need to be dismantled and repaired when a leak occurs at a point by submitting material about repairing the Distributor Valve leak using a simulation model.
c. This Distributor Valve Learning Media Application represents the material Distributor Valve use 3-dimensional visualization so that workers are easier to harmonize existing material with the actual situation.

Based on the results that have been achieved, as for suggestions that can be used as a reference for the development of Distributor Valve's learning media applications on the Air Brake System so that applications can operate more optimally, that is:

a. The development of interface design is more user friendly.
b. The increase has become a 3D animation for air flow animation.
c. There is an application development in order to rotate objects on the x axis and y axis.
d. There is application development so that the application uses 3-dimensional background.
e. There is an application development so that the object drop points on the repair and training pages are more accurate.
f. The application development by changing the position of the object becomes explode position so that it is easy to give animation and clarify the material.
g. The application development does not only discuss Distributor Valve's components on the Air Brake System, but also discusses other components contained in the Air Brake System.

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