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The Decision Support System in Selecting The Characteristics of Coffee By Using Analytic Hierarcy Process Method

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Abstract — This study is to determine whether the characteristics of coffee flavor can be implemented into a decision support system. In this study, the problem is the difficulty in finding coffee experts with adequate understanding and knowledge of coffee. The purpose is to implement Analytic Hierarchy Process (AHP) method to determine the characteristics of coffee flavor and to transfer the knowledge about the taste of coffee to coffee lovers.

The expected results are to assist in making a decision support system application in selecting the characteristics of coffee, so that it can provide the advice to the common consumers who want to enjoy and the knowledge about the coffee itself as well.

Keywords: Decision Support System, Coffee Characteristics, AHP

I. INTRODUCTION

There are many coffee shops which the managers do not have the knowledge about the characteristics and the quality of coffee so that the consumers who come only enjoy the coffee without knowing about the quality and the characteristics of coffee itself.

To increase the knowledge about coffee, It is required a system that can make decisions in selecting coffee so that the consumers, especially new coffee lovers, can determine the choice of coffee criteria as they desire.

There are some problems that identify to this study. The problems are there has not been decision support system in selecting the characteristics of coffee, he limited knowledge of consumers about coffee at this time and the process in finding the characteristics of coffee is so complicated.

The decision support system to determine the characteristics of coffee is by using Analytic Hierarchy Process (AHP) method. This method can be used to determine whether the selected characteristics of coffee are appropriate or not with the required qualifications. This is due to AHP method is able to provide an assessment both qualitatively and quantitatively. AHP method also calculates the validity to inconsistency of various criteria and alternatives that are chosen in decision making. This is used to anticipate inconsistencies that might occur because humans have limitations, especially when comparing many criteria.

While the purposes of this study are to develop a decision support system to choose the characteristics of coffee that are in accordance with the desires of consumers, so that they can choose coffee with the right taste according to the chosen criteria, and to implement AHP method in the calculation to determine the best criteria in selecting the characteristics of coffee that are in accordance with the desires of consumers.

II. LITERATURE REVIEW

2.1 Decision Support Systems (DSS)

Basically DSS is a further development of a computerized management information system that is designed in such a way that it is interactive with the users. Interactive with the aim of facilitating integration between various components in the decision making process such as Procedure, Policy, Analysis, Security and Insight of managers to make better decisions.

DSS is a system which is built to solve various managerial or corporate organization problems that are designed to develop the effectiveness and productivity of managers in solving problems with the help of computer technology. The other thing that needs to be comprehended is that DSS is not to replace the duties of managers but only as the material for managers to determine the final decision.

In determining a decision, there are many factors that influence the decision making of a decision maker, so it is necessary to identify various important factors and to consider the level of influence from one factor to the others before making a final decision. Therefore, specifically the authors will discuss one of the problems in selecting coffee with step by step using DSS method to produce a final decision which is called the solution to a problem. [1][2]

2.1.1 Basic Concepts of Decision Support Systems

DSS concept was first introduced in the 1970s by Scott Morton. Scott Morton defines SPK as "an interactive computer-based system, which helps decision makers to use data and various models to solve unstructured problems". SPK is designed to support all stages of decision making starting from the stage of identifying problems, selecting relevant data, determining the approach that are used in the decision-making process, to evaluating alternative choices. [3]

2.1.2 Components of Decision Support Systems
According to [4] DSS component is:
1. Data Management
   It is a component of SPK as a data provider for the system, where data is stored in a Database Management System (DBMS) so that it can be retrieved and extracted quickly.
2. Model Management
   It involves the model of financial, statistical, management science, or other various quantitative models so that it can provide the system with the analytical capabilities and software management which are needed.
3. Communication (Dialog Subsystem)
   Users can communicate and give commands to SPK through this subsystem. It means providing an interface
4. Knowledge Management
   This optional subsystem can support other systems or act as stand-alone components.

2.2 Analytical Hierarchy Process (AHP)

AHP is a functional hierarchy with the main input of human perception. With hierarchy, a complex and unstructured problem is solved into groups and it is arranged into a form of hierarchy. Analytical Hierarchy Process (AHP) which was developed by Thomas L. Saaty was first used in 1970 in dealing with military planning problems in the United States. AHP model uses human perceptions which are considered "experts" as the main inputs. The "expert" criteria does not mean that the person must be genius, smart, hold a doctorate degree and so on but it more refers to a person who really understands the problems that are raised, feels the consequences of a problem or has an interest in the problem. [5]

2.2.1 Basic Concept of Analytical Hierarchy Process (AHP)

AHP is a general theory of measurement which is used to find ratio scales, both from discrete and continuous pairing comparisons. AHP describes multi-factor problems or complex multi criteria into a hierarchy.

Hierarchy is defined as a representation of a complex problem in a multi-level structure of which the first level is a goal, followed by the levels of factor, criteria, sub criteria, and so on down to the last level of the alternative.

With hierarchy, a complex problem can be broken down into groups which are then organized into a hierarchical form so that the problem will appear more structured and systematic. [6]

2.3 Types of Coffee
In the world, coffee is divided into 4 types, namely [7]:
1. Arabica
   Arabica has various flavors. This cannot be denied that many people can find it out with sour but rich in taste different from Robusta. Arabica is not tasteless but it has various flavors in one cup of coffee.
2. Robusta
   Robusta has the highest levels of caffeine from other types of coffee and has strong enough of bitter taste such as dark chocolate to crispy taste like peanuts but Robusta is tasteless, in other words while it is served hot or cold, the taste which is produced does not change.
3. Liberica
   Liberica has many flavors the same as Arabica but the sour taste which is produced tends to be like sour taste of fruits.
4. Excelsa
   Excelsa has a distinctive sour taste that is like berry such as cherry, strawberry and so on. However, this type of coffee is very difficult to find because it grows independently in the forest.

III. RESULTS AND DISCUSSION

3.1 AHP model

The stage for completing AHP method is analyzing the current event, modeling AHP method, lvl 1 AHP of weight and percentage from characteristics of coffee value, M1 paired comparison matrix, total values for M1 paired comparison matrix, percentage of weight from M1 characteristic values, percentage of M1 consistency test, lvl 2 AHP of weights and percentages of coffee types according to characteristic values, M2 Aroma paired comparison matrix, percentage of M2 consistency test, M3 paired comparison matrix, percentage of M3 consistency test, M4 Aftertaste paired comparison matrix, percentage of M4 consistency test, M5 acidity paired comparison matrix, percentage of M5 consistency test, M6 Mouthfeel paired comparison matrix, percentage of M6 consistency test, M7 overall paired comparison matrix, percentage of M7 consistency test, calculation of coffee types for characteristic values, percentage results for consumer input.
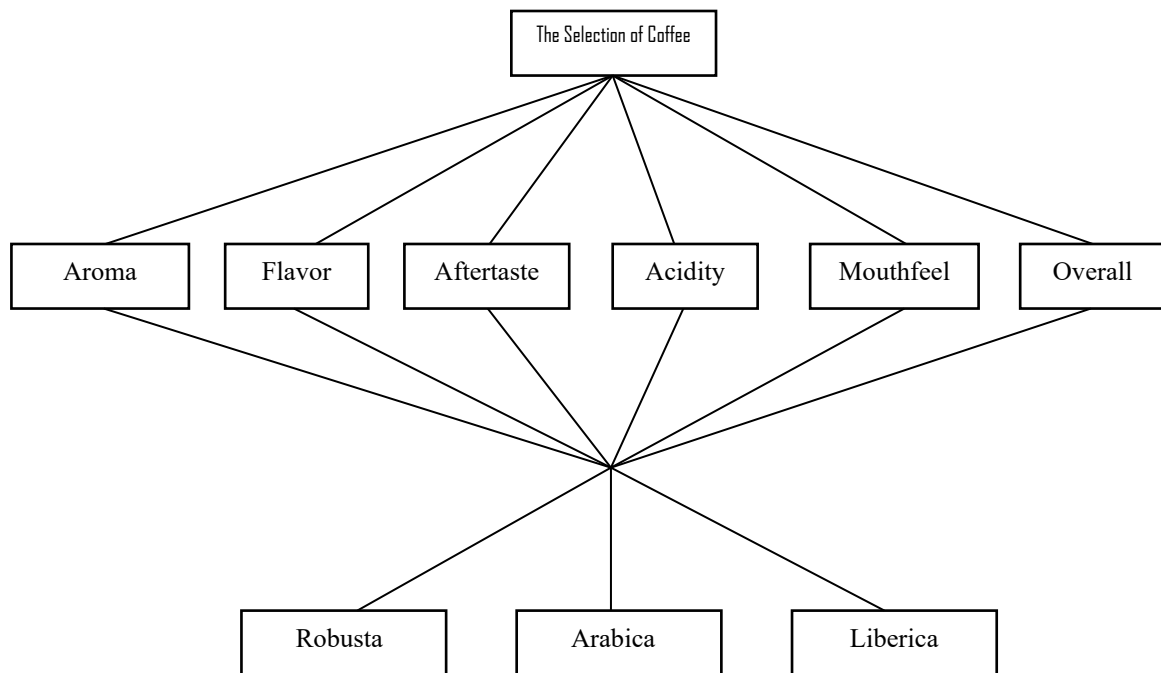
Figure 1 AHP Model

3.2 Calculation Results of AHP Model
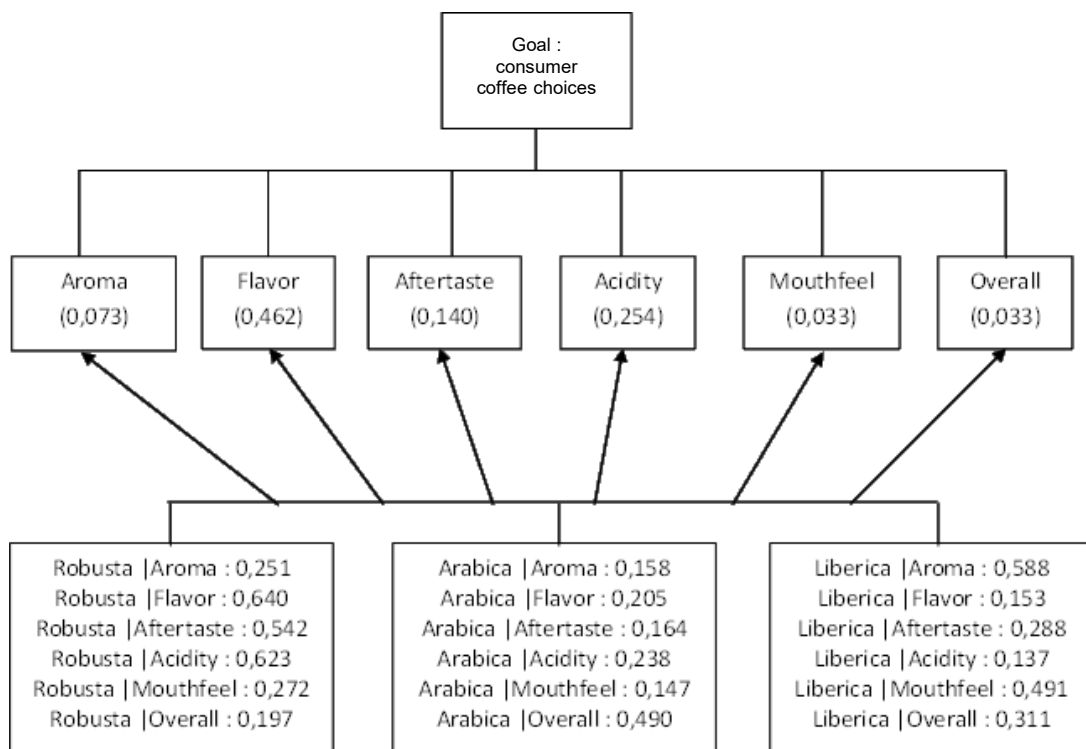The following are the calculation results of AHP model:

Figure 2 Calculation Results of AHP Model

3.3 Results of Evaluation and Recommendation

The characteristics of coffee that are desired by consumers and the basic knowledge of consumers to coffee are almost 44.6% of them do not know about the characteristics of coffee. And for the common consumers about the characteristics of coffee can be seen from Table 1 Percentage Calculation of the Coffee Types. The company provides recommendations for selecting Robusta coffee that is expected to be suitable for common consumers.

Table 1 Percentage Calculation for Coffee Types

	Aroma (M1*M2)	Flavor (M1*M3)	Aftertaste (M1*M4)	Acidity (M1*M5)	Mouthfeel (M1*M6)	Overall (M1*M7)	Total
Robusta	0,073 X 0,251	0,462 X 0,640	0,140 X 0,542	0,254 X 0,623	0,033 X 0,272	0,033 X 0,197	0,56
Arabica	0,073 X 0,158	0,462 X 0,205	0,140 X 0,164	0,254 X 0,238	0,033 X 0,147	0,033 X 0,490	0,207
Liberica	0,073 X 0,588	0,462 X 0,153	0,140 X 0,288	0,254 X 0,137	0,033 X 0,491	0,033 X 0,311	0,212

IV. CONCLUSIONS AND SUGGESTIONS

4.1 Conclusions

The conclusions from the results of the discussion about the decision support system in selecting the characteristic of coffee using AHP method are as follows: .

1. AHP model (Analytic Hierarchy Process) can help in selecting the coffee types. When consumers determine which coffee types is suitable, with AHP the percentage in selecting coffee types can be obtained based on the weights of characteristic value.
2. Questionnaire is used to find out the desires and knowledge of consumers about coffee. The results of the questionnaire analysis provide information on the percentage of desires and knowledge that is positive and negative in selecting coffee types.
3. Decision Support Systems to choose the characteristics of coffee can provide information about which coffee types that are in accordance with the desire of consumers. This information can be used as material for consideration and further learning to coffee consumers.

4.2 Suggestions

In the decision support system on selecting the characteristics of coffee, the authors have several suggestions as follows:

1. Study can be further developed to make the Decision Support System application in selecting the characteristics of coffee.
2. Study can be further developed with the process of drying the coffee beans, where they come from, what varieties are used, and calculating the coffee brewing methods that are used.
3. Study can be further developed by involving the Ph level of water that is used, and using other methods.

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Naïve Bayes Anomaly Detection System Design On Openflow Network

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Abstract— **One of the generally launched attacks is Distributed Denial of Service that renders its target unable to provide its service. Gaussian Naïve Bayes Classifier is one out of several techniques used in detecting those attacks by classifying network traffic in a window as an attack or a normal traffic based on normal distribution previously calculated from normal and attack traffic datasets. This research focuses on mitigating SYN Flood Type DDoS attacks on OpenFlow Network using Zodiac FX as a switch. The developed system utilizes OpenFlow Protocol to apply flow rule in switch's flow table in order to detect and mitigate SYN Flood attacks in real-time. Applied mitigation procedure is to divert incoming packets into SYN Proxy so that only legitimate TCP packets are able to reach the server. The results show that the system has a bandwidth of up to 60Mbps under normal condition and 5,03Mbps under attack. Maximum malicious packets that could reach server before it is diverted to SYN Proxy is estimated to be 400 packets and not affected by the number of attacks, assuming that the flow rule sent by the controller are enacted immediately.**

Index Terms— DDoS Mitigation, Naïve Baye, OpenFlow Protocol, SYN Proxy, Zodiac FX

I. INTRODUCTION

With the development of services and content available on the internet, network security has become a very important part in it. The advancementin network security is due to increasing number of various crimes in cyberspace. One type of attack that is well known and is still frequently launched is Denial of Service (DoS) which is renders its target unable to run its services [1].

Symantec Corporation in its annual report, 2017 Internet Security Threat Report, published in April 2017 describes a new trend of DDoS attacks that utilize various Internet of Things (IoT) devices that have a low level of security as a tool to launch DDoS attacks. One of the notable incidents was when Mirai (botnet consisting of IoT devices) managed to do DDoS on a DNS company called Dyn, which resulted in obstruction of access to several well-known websites such as Netflix, Twitter and Paypal [2]. Another report on DDoS attack fromKasperskyLab for the fourth quarter of 2017 stated that among all DDoS attack methods, SYN Flood was reported as the most frequently launched attack method with a percentage reaching 55.63% of all existing DDoS attacks as shown in Figure 1 [3].
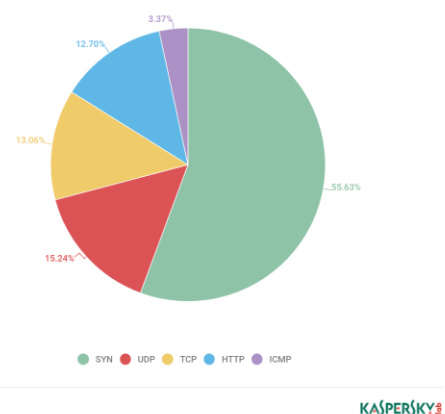
Figure 1.Distribution of DDoS Attacks by Type in Q4 2017 [3]

Various solutions for detecting DDoS attacks, especially the type of SYN Flood attack have been developed and one of them is "Implementation of Count-Min Sketch on Naïve Bayes Anomaly Detection System". The research compares the performance of an anomaly detection system using a count-min sketch data structure with a data structure linked to the Naïve Bayes Classifier to read patterns of captured network traffic and determine the occurrence of attacks. Another related research is [4] which has successfully implemented Bloom Filter to detect DDoS on OpenFlow networks. In addition, [7] has conducted research on HTTP Flood detection using Naïve Bayes and can detect SYN Flood with 99.8% accuracy. Lastly, [6] utilizeOpenFlow controller's ability to mitigate attacks by diverting and enforcing special actions against the suspected maliciouspackets. By manipulating incoming packets to be sent to its destination and detection system simultaneously, each incoming packet can be analyzed and forwarded concurrently.If analyzed packets found to exceed the calculated threshold, it can be concluded that the flow is an attack.This research proposed to do mitigation based on current network condition so that under normal circumstances, all incoming packets can directly access the server, otherwise it will be filtered before reaching the server.

With those goal in mind, this research is built on OpenFlow protocol which in recent years have been gaining more attention and is predicted to be the future of network technology. While still being under continuous development, this protocol is fully functional. Using this protocol, user can manipulate switches behavior by programming flow tables in various switch that supports this protocol [6] and [7] and consistently produce identical behavior.

In order to detect SYN Flooding, this research used gaussian naïve bayes classifier, a machine learning technique to classify a sets of data based on their feature. Before used to classify, it needs to be trained using existing data belonged to specific classes. While assuming each feature is has no corelation or independent from one another, most cases were violating this assumption, but even with corelation or dependencies between its feature, Harry Zhang proves in his research [4] that naïve bayes could still work optimally. In gaussian naïve bayes, it used normal or gaussian distribution in representing its probabilistic value from each feature for each class. First, estimating normal distribution from training data sets by calculating mean(μ) and variance(σ^2) for each feature, then prior probability($p(C_n)$) of each classes.

$$p(C_n) = \frac{N_c}{\Sigma(N_C)} \quad (1)$$

$$p(X_i|C) = \frac{1}{\sqrt{2\pi\sigma_C^2}} exp\left(-\frac{(x_i-\mu_C)^2}{2\sigma_C^2}\right) \quad (2)$$

$$p(X|C) = p(X_1|C) * p(X_2|C) * \dots * p(X_n|C) \quad (3)$$

$$P(C_n|X) = \frac{p(X|C_n) * p(C_n)}{p(X|C_1) * p(C_1) + p(X|C_2) * p(C_2) + \dots + p(X|C_n) * p(C_n)} \quad (4)$$

Equation (1) represents prior probability of a class based on its training data sets, where C is class and N is number of event for each class. Equation (2) shows probability of a feature(X_i) for class(C). Equation (3) shows probability of a data(X) for class(C), where based on naïve bayes assumptions of independencies, every feature for class from equation (2) is multiplied. Equation (4) is the final probabilistic value, predicting the percentage of a class(C) for the data(X) where the result from equation (3) is multiplied with its classes prior proability from equation (1) and divided by the sum of every result from equation (3) multiplied with equation (1) for each class. The class probability with highest value is the predicted class for the data.

$$Multiplier = \frac{2}{TimePeriods + 1} \quad (5)$$

$$EMA = (CurrentValue - PreviousEMA) * Multiplier + PreviousEMA \quad (6)$$

While to produce a false-positive-proofed system, exponential moving average could be used to determine current trends while keeping track of several previous record of current condition, but put

extra weigh on current condition as seen in equation (5) and (6).

II. RESEARCH METHOD
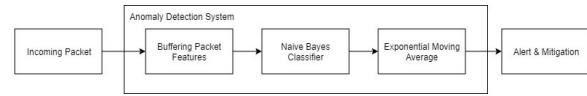
Figure 2. System Block Diagram

Figure 2 shows system's block diagram. Incoming packet will be copied and forwarded to anomaly detection system to be analyzed by extracting its features in buffer. Buffered packet features will then sent to naïve bayes classifier to be classified as normal or malicious flow. If the number of malicious flow is greater than normal flow, the buffer would be concluded as an attack attempt and vice versa. This current condition would then further calculated in exponential moving average module so that the final outcome of current condition would have less false positive. This final outcome will determine which rule enacted by the OpenFlow switch.
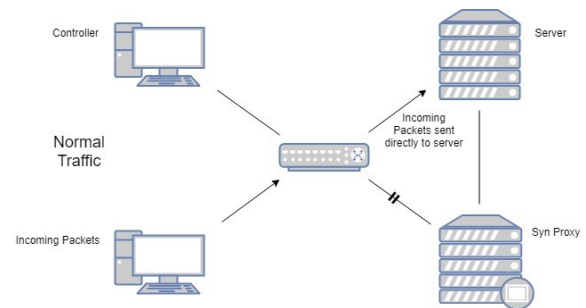
Figure 3. Packet Flow Under Normal Condition

Figure 3 shows incoming packetswill be forwarded directly to server by OpenFlow Switch and there is no means to communicate with SYN Proxy directly from the switchunder normal condition.
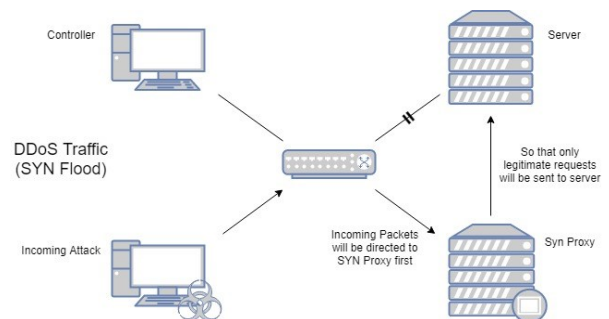
Figure 4. Packet Flow Under Attacked Condition

However, when under attack, a new set of rules will be enforced, preventing all incoming packet from directly communicating with server by diverting those packets to a SYN Proxy server as shown in figure 4. SYN Proxy server would be filtering all incoming packets and forward legitimate request only so that legitimate user can still access the server and the server wouldn't receive devastating number of

malicious packets that potentially exhaust its resources and crashes the server, resulting in greater loss.

```
Main()
    set UNDER_ATTACK = false
    set BUFFER_TRESHOLD = 100
    set MOVING_AVERAGE_VALUE = 0
    set MOVING_AVERAGE_TIME_PERIOD = 10
    set MOVING_AVERAGE_MULTIPLIER = 2/(MOVING_AVERAGE_TIME_PERIOD+1)
    switch.start()
    controller.start()

switch.onPacketReceived(incomingPacket)
    forwardBasedOnRule(incomingPacket)

procedure forwardBasedOnRule(packet)
    if(packet is tcpPacket)
        cloneToController(packet)
    if(UNDER_ATTACK)
        forwardToSYNProxy(packet)
    else
        forwardToServer(packet)
```
Figure 5.Handling Incoming Packet Pseudocode

This research utilize OpenFlow Switch capabilities to forward packets based on enforced flow rules. Figure 5 shows how system is initialized and handles incoming packet events on switch. If the packet is a tcp packet, it will be cloned and forwarded to controller while simultaneously forwarded it to its destination based on system UNDER_ATTACK state (to server if UNDER_ATTACK set to false and to SYN proxy if true).

```
procedure BufferTCPPacket(packet)
    set flow (packet.srcIP, packet.destIP, packet.dstPort)
    buffer[flow].append(packet.features)
    increment bufferSize

controller.on(packetReceived)
foreach packet receivedBy controller
    BufferTCPPacket(packet)
    if(bufferSize == BUFFER_TRESHOLD)
        AnalyzeBufferWindow(buffer)
        reset buffer
```
Figure 6. Buffering Packet Pseudocode

Figure 6 explains how cloned TCP packets is buffered in controller. Each received packet's feature will be buffered and when buffer size reach predetermined threshold (BUFFER_TRESHOLD in Figure 5), buffer will be analyzed and then resetted.

```
procedure AnalyzeBufferWindow(buffer)
    set normalFlow 0
    set anomalyFlow 0
    foreach flow in buffer
        set class = GaussianNaiveBayes(flow.features)
        if(class == anomaly)
            increment anomalyFlow
        else
            increment normalFlow
    if(anomalyFlow > normalFlow)
        condition = anomaly
    else
        condition = normal
    set UNDER_ATTACK = ExponentialMovingAverage(condition)
```
Figure 7. Analyze Buffer Pseudocode

Figure 7 shows how buffer is analyzed by classifying each flow in buffer using Gaussian Naïve Bayes Classifier. Condition will be set to anomaly if anomalyFlow counts more than normalFlow, and vice versa. System UNDER_ATTACK state will be determined by ExponentialMovingAverage calculation based on current condition as shown in figure 8 below.

```
procedure ExponentialMovingAverage(condition)
    if(condition == anomaly)
        set currentValue = 1
    else
        set currentValue = 0
    set MOVING_AVERAGE_VALUE = (currentValue-MOVING_AVERAGE_VALUE)*MOVING_AVERAGE_MULTIPLIER + MOVING_AVERAGE_VALUE
    if(MOVING_AVERAGE_VALUE>0.5)
        return true
    else
        return false
```
Figure 8.Exponential Moving Average Pseudocode

Figure 8 shows how system determined UNDER_ATTACK state by calculating current MOVING_AVERAGE_VALUE using exponential moving average. If current MOVING_AVERAGE_VALUE is more than 0.5, UNDER_ATTACK will be set to true and if less than 0.5 to false. By setting MOVING_AVERAGE_TIME_PERIOD to 10 event and BUFFER_TRESHOLD to 100 packets, maximum number of anomaly packets received by server can hypothetically be calculated as shown in Table 1 below.

Table 1. Exponential Moving Average Calculation

Event #	anomaly_value	EMA	condition	anomaly_packet	anomaly packet received by server	anomaly packet diverted
1	False	0	Normal	0	0	0
2	True	0.181818	Normal	100	100	0
3	True	0.330579	Normal	100	100	0
4	True	0.452292	Normal	100	100	0
5	True	0.551875	Anomaly	100	100	0
6	True	0.633352	Anomaly	100	0	100
7	True	0.700015	Anomaly	100	0	100
8	True	0.754558	Anomaly	100	0	100
9	True	0.799184	Anomaly	100	0	100
10	True	0.835696	Anomaly	100	0	100
11	True	0.865569	Anomaly	100	0	100

Assuming incoming attacks is a bursting 1000 TCP SYN packets with the speed of 10 packets per second and all flow rules sent by controller are enacted immediately, then maximum number of anomaly packets received by server can be estimated to 400 packets or 4 anomaly events before flow rule to divert incoming packets to syn proxy enactedas shown intable 1. Event #2 up to #11 is an attack, on event#5, EMA value pass over 0.5 and acknowledged as an anomaly. This change on condition triggers controller to enact a mitigation rule on OpenFlow switch and from event #6 onward, all packets is diverted to SYN Proxy until EMA value return under 0.5 and triggers controller to revoke mitigation rule on OpenFlow switch.

This research use HPING3 to generate SYN Flood attack to be used in training naïve bayes classifier as anomaly traffic dataset and testing. Testing will be conducted real-time by client accessing a http server under normal condition and under attack by HPING3 SYN Flood condition. System throughput will be tested using iperf on normal and mitigation rule. Testing will be conducted using a laptop with specification Intel core i7 processor, 8GB RAM running Ubuntu Linux VMWare on top Windows10 as OpenFlow controller, 2 PC with specification Intel core i5, 8GB RAM running Windows10 as client and server and another PC with same specification as client/server running Ubuntu Linux VMWare on top of Windows10 as SYN Proxy, and a Zodiac FX as OpenFlow switch.

III. RESULTS AND ANALYSIS

A. Mitigation

Using HPING to generate SYN Flood attacks with random source IP designated to the server, the results is shown in figure 9 and 10 below.

Figure 9. Captured SYN Flood Received by Server

Figure 10. Captured SYN Flood Diverted to SYN Proxy

Out of 1000 SYN flood packets sent, 394 packets received by server and the other 604 packets was successfully diverted to SYN Proxy. This results may vary depending on initial configuration on BUFFER_TRESHOLD and MOVING_AVERAGE_TIME_PERIOD as calculation in table 1 will change accordingly.

B. Equations

Using iperf, system's throughput is estimated under normal rule and mitigation rule as shown on table 2 below.

Table 2. System Throughput Test Result

Condition	Speed (Mbps)
Normal	60
Under Attack	5.03

This results shows the system have a throughput of 60Mbps on normal condition and the results mainly caused by Zodiac FX specification which has a 10/100Mbps ethernet port. Another factor that affects this result is the complexity of the flow tables at the time as more complex rules enacted, the slower transfer rate on OpenFlow switches gets. When mitigating attacks, the system has a throughput of

5.03Mbps. This gap between normal and under attack system performance is affected by Network Address Translation applied by SYN proxy to connect client and server when under attack. This results may vary when using SYN proxy, controller or OpenFlow switches with different specifications.

IV. CONCLUSION

From this research developed system can detect and mitigate SYN Flood attacks on OpenFlow networks in real-time. The developed system has a throughput of 60Mbps under normal conditions and 5.03 Mbps when under attack. This speed can vary by using switches or controllers with different specifications. And maximum number of SYN Flood packets that can reach the server is estimated to be 400 packets without being affected by the number of attack packets sent with the condition that all flow rules sent by the controller are immediately applied and the rest will be transferred to SYN Proxy. This number can be tweaked to accommodate user preferences by changing buffer size treshold and moving average time period. Further development can be carried out to detect and mitigate other attacks on OpenFlow networks and use other classification method.

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Re-design Business Process at Forwading Company Based on Enterprise Architecture Planning

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Abstract—**To be able to become a service company that is superior to other service companies, it requires assistance from the application of IS / IT in its business processes. Both main activities and supporting activities. Enterprise Architecture Planning or EAP helps make planning for the implementation of IS / IT more mature and better, so that the implementation of IS / IT in the company's business processes can run and work in accordance with the company's vision and mission. Therefore, this research is expected to be able to provide input to companies that are the object of research to implement IS / IT in accordance with business processes and vision and mission. Later the results of this study will be in the form of proposals for new business processes both supporting activities and the main activities of companies that use the application of IS / IT in them.**

Index Terms—**Business Process, Enterprise Architecture Planning**

I. INTRODUCTION

Along with the development of the times, there is no doubt that information technology has also developed increasingly advanced. Every time there will always be technological developments that affect various aspects of life [1-3].

One of them is the aspect of the economy that has a positive impact on the company. Therefore, every company that aims to improve the effectiveness of its business processes and who wants to become a company that is far superior to other companies in a business competition, seeks to be able to implement information technology in its business [4-5]. Forwading company is one of them.

Forwading company is an Indonesian trucking company that is committed to high integrity to be able to provide transportation services to many areas in JABODETABEK, Semarang, Bali and Lombok. This company, which has been established for more than 35 years, has a lot of experience that has sharpened their professionalism in carrying out goods delivery activities to arrive safely and on time. At present, this company is only implementing a small part of IS / IT to support its business, so there are still several business processes that are done manually. Therefore, to be able to improve the business process of this company in order to be better, a strategic information system planning is needed for its business.

Strategic planning of information systems has the main objective, namely to prepare plans for the management of analysis, design and development of computer-based systems [6]. This plan, if done accurately, can support better business planning and development, and minimize problems that may occur in the implementation of the system [7-8]. In addition, planning must also be able to have harmony between IT and business, and consider the weaknesses and strengths of the company. This is intended so that the planning results can support the achievement of the company's vision and mission, and provide tangible results for the company [9].

One of the first steps to determine information system strategy planning is to understand the organization's business processes first. Understanding the organization's business processes can be done by doing business modeling. The purpose of business modeling is to provide a complete, broad and consistent knowledge base that can be used in defining the architecture and implementation plan. Business modeling in EAP (Enterprise Architecture Planning) can be done by defining the main function area using the value chain concept from Michael Porter. The value chain idea of Porter is a chain consisting of a series of activities that create and build a value that can produce an added value margin for the organization [6].

Thus, this study will discuss the design (planning) of enterprise architecture based on the stages of EAP.

II. LITERATURE REVIEW

A. Enterprise Architecture

Enterprise architecture is the fundamental organisation of an enterprise, described with its components and the relationships to each other and to

the environment. Enterprise architecture is a possible organizing structure of the business processes and IT infrastructure in an enterprise. The main idea behind enterprise architecture is the need to a primary enterprise logic in order to review, maintain and control the whole operation of the enterprise. Enterprise Architecture (EA) is a scientific discipline in IT that has the following meanings [10] :

- EA is an explanation of the plan for building one or a set of systems.

- EA is a logical, comprehensive, and holistic approach that is used to design and implement the system and its components simultaneously, which includes management of IS / IT infrastructure.

- EA can affect management and the area of organizational technology especially in the development of SI blueprints from various disciplines both theoretically and practically.

From these definitions, enterprise architecture can be used as a reference or guideline when developing information and communication systems because enterprise architecture is a blueprint.

III.   RESEARCH METHODOLOGY

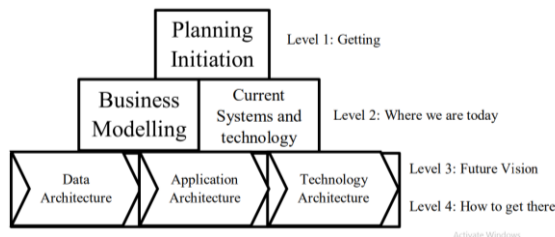This study uses the following stages of research methods.

Fig. 1. Research Steps [12]

From Fig 1., it can be seen the stages of the research carried out which are in accordance with the planning stages of EA [13]:

- Planning Initiation, determining the place of case studies, studying previous research journals, and so on.

- Business Modeling, analyzing the company's business models currently using value chains and SWOT

- Current Systems and Technology, analyzes the system conditions and technology used in the company today.

- Data Architecture, observes and determines the data architecture that is suitable for the company.

- Application Architecture, determines the design of applications that are in accordance with the business processes running in the company.

- Technology Architecture, determine the design of technology that is suitable for the company.

IV.   RESULTS AND DISCUSSIONS

A.   Planning Initiation

Forwading Company is a trucking company that commits to serve with high integrity for providing transportation service to many areas in JABODETABEK, Semarang, Surabaya, Bali, and Lombok. With more than 35 years of experience, we sharpen our expertise and experience to ensure that every delivery arrive safely and on time as promised. Many kinds of truck are ready for your transportation business needs, such as 2-axle trucks (fuso), 3-axle trucks (tronton), trailer, and semi- trailer. As part of your business transportation solution, we always guarantee the entire fleet of trucks in top condition in accordance with the prerequisite of safe and convenient transportation. This company has the following vision and mission:

- Be one of the trusted truck expedition providers that is reliable and professional in every service provided

- Prioritize on-time delivery truck service

- Keep and grow the synergic and cooperative relationship with new and existing consumers

- Keep the company's reputation by giving professional service in every business line

- Keep increasing the service quality and working professionalism of all the staffs and drivers

- Increase the integrated truck operational system's performance that relevance to the recent technology

B.   Business Modelling

This section will show the current business model found in the company that was used as the case study. Can be seen in Fig 2.
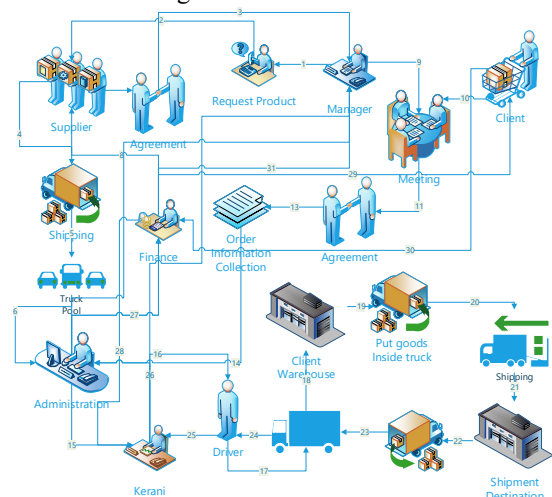
Fig. 2. Current Enterprise Business Model

From Fig 2. above it can be seen the form of business processes currently running in the company in general. From the overall business process, only six processes will be taken in this study, including:

- Marketing, the company will do marketing services it does to other companies. The marketing process is currently still using the usual way, namely, by 'door to door' where the party from the company will hold a meeting to discuss the services it has with prospective customers, in addition, the company will offer services via telephone or email.

- Order scheduling and supervision, for now, the order execution process is done manually. Scheduling the order is still done by sorting it manually by its employees. Also, oversight of order operations still often uses the telephone to communicate with truck drivers.

- Recording daily cash transactions, company cashiers are still recording manually using a notebook. Also, recording daily transactions are still delayed because of the company's cashier negligence.

- Payment of debt owned by the company, at present the payment schedule made by the company is still done by relying on human capabilities. Payment is made if the company remembers or has been invoiced by the debtor. Payment of debt installments (remaining debt) also has not been tracked automatically.

- Employee salaries, company leaders pay permanent employees by using a salary card or salary book as a reminder.

- Truck maintenance, currently the data collection of truck maintenance is still manually (using notebooks).

C. Current System and Technology

This section will explain the current systems and technologies found in companies using the value chain.This model divides business processes into two activities, namely the main and supporting activities. The results of the business mapping can be seen in Fig 3.
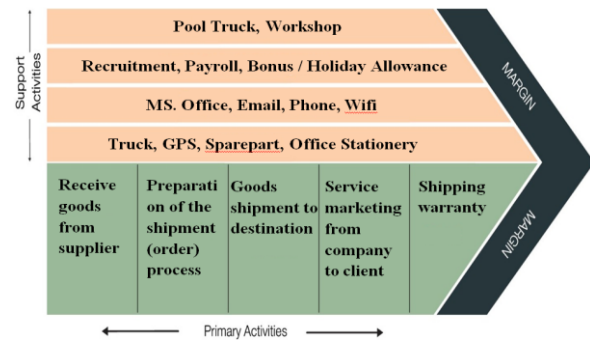
Fig. 3. Company's Value Chain [14]

From Fig 3., it can be seen if the existing business processes in the company can be explained as follows:

- The Inbound Logistics, company activities related to storage and receipt of goods obtained from suppliers.

- The Operation, the company's activities in arranging the shipping order scheduling, along with the maintenance of the trucks used.

- The Outbound Logistics, company activities related to the process of delivering goods to their destination.

- The Marketing and Sales, the company's activities in terms of marketing their business.

- The Services, services provided by the company to clients, so that they remain faithful in using company services.

- The Firm Infrastructure, infrastructure that supports the running of a company's business processes.

- The Human Resource Management, activities carried out by companies to manage their human resources.

- The Technology Development, all technologies used by companies, both software, and hardware, to help their business processes run.

- The Procurement, things or equipment needed to exist, to help the business process.

After knowing the main and supporting activities that are owned by the company, the next is the result of the SWOT analysis:

a) The Strength, the company has a pretty good reputation, has high expertise and experience in the shipping business, strong funding, the strategic location of the company, more than one branch of the company.

b) The Weaknesses, companies only use a little IS / IT in their business processes, most business processes are done manually, truck maintenance

is not organized, financial accounting is a bit sloppy.

c) The Opportunity, the company has a good relationship between clients and suppliers, suppliers provide cheap and high-quality spare parts prices, many goods transportation services are needed by many companies.

d) The Threat, there are delivery services from other companies, if they do not implement IS / IT in their business processes, they will be left behind.

D. Data Architecture

This section will explain the data architecture needed to support the running of business processes and applications that will be created later. Can be seen in Table I.

TABLE I. ENTITY CANDIDATE DATA

Business Entity	Data Entity
Marketing	General corporate data, contact us message data, website account data
Order Management	Order data, client data, driver data, data truck, account data
Daily Cash Controll	Cash in and out data, account data
Bill Payment	Payment installment data, important date data, account data
Payroll	Permanent employee data, employee performance data, salary data, account data.
Truck Maintenance	Data truck, truck damage data, truck repair data, account data.

E. Applicaton Architecture

Application Candidates

This section will mention the application candidates proposed to help with the business processes in this company. Can be seen in Table II.

TABLE II. APPLICATION CANDIDATES

Business Process	Application Code	Application Candidates
Marketing	App1	Company Profile Website
Order Management	App2	Order Application
Daily Cash Control	App3	Cash Day Application
Bill Payment	App4	Account Payable Application
Payroll	App5	Payroll Application
Truck Maintenance	App6	Truck Maintenance Application

Relationship of Candidates for Applications with Business Processes

From Table II, it can be seen if there will be six applications that will help run the proposed

company's business processes. These six applications are adjusted based on the six processes that have been taken previously. The following is an explanation of the role of applications in company business processes:

- Company profile website, this application will help in the marketing process of company services. So companies don't have to do 'door to door' anymore. Prospective customers can easily find out the services offered by the company through this website.

- Order application, this application will assist in scheduling and monitoring the delivery of goods. So that the delivery schedule will automatically be arranged neatly and regularly, as well as provide clear information by whom the delivery of the goods is carried out and company expenses. In addition, this application can also facilitate the supervision of the delivery of goods via GPS installed on trucks and smartphone drivers.

- Daily cash application, this application will help in supervising and tidying up cash transaction data collection every day. In addition, this application will help to generate reports automatically. Managers can easily monitor the entry and exit of cash transactions.

- Account payable application, this application will help in recording the things that must be paid by the company and some other important events. This application can also provide an alarm to remind the company cashiers to pay debts owed by the company and can track installments made by the company.

- Payroll application, this application will help the permanent employee data collection along with payroll. Leaders can see the full profile of employees and add employee performance. This can help leaders in giving rewards or sanctions to permanent workers fairly.

- Truck maintenance application, this application will help in managing trucks owned by the company. This application will store truck data and generate reports on maintenance activities carried out on a truck and its costs.

Application Candidate Decomposition

This section will explain each of the features that the application candidate has. Here's the explanation:
- Company profile website

  - Post information about company (Input, Update, Delete, Print, View)

  - Contact Us (Input, Delete, Print, View)

- Order application

  - Client (Input, Update, Delete, Print, View)

- Order (Input, Update, Delete, Print, View)

- Truck (Input, Update, Delete, Print, View)

- Driver (Input, Update, Delete, Print, View)

• Cash day application

- Cash (Input, Update, Delete, Print, View)

• Account payable application

- Debt (Input, Update, Delete, Print, View)

- Important Date (Input, Update, Delete, Print, View)

- Collector (Input, Update, Delete, Print, View)

• Payroll application

- Worker (Input, Update, Delete, Print, View)

- Performance (Input, Update, Delete, Print, View)

- Gaji (Input, Update, Delete, Print, View)

• Truck maintenance application

- Truck (Input, Update, Delete, Print, View)

- Error (Input, Update, Delete, Print, View)

- Repair (Input, Update, Delete, Print, View)

Candidates for Applications based on Portfolios

This section will display the application candidates based on the application portfolio. can be seen in Table III.

TABLE III.   CANDIDATES FOR APPLICATIONS ARE BASED ON PORTFOLIO

Strategic	High Potential
Cash day application, truck maintenance application, account payable application	Order application
Key Operational	**Support**
Company profile website	Payroll application

From Table III above, it can be seen if the application will be divided into four categories. The following is the explanation:

• Strategic, which is a critical application for the sustainability of business strategies in the future.

• Key operations, i.e. applications that are currently used or relied upon by the enterprise for success.

• High-oriented, applications that may be important in achieving success in the future.

• Supporting, a valuable but not critical application for success.

Applications contained in strategic and key operational categories will be implemented first. After that, only followed by applications that are categorized in high-oriented and supportive.

F. Technology Architecture

This section will display the results of the design of the technology proposed to be applied to the company, in order to support the course of the application that has been proposed previously. Can be seen in Fig 4. and Table IV.
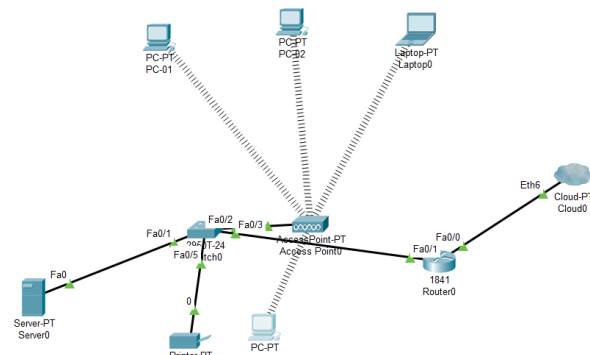
Fig. 4. Proposed Network Map

TABLE IV.   PROPOSED TECHNOLOGY EQUIPMENT

Equipment Name	Specification
Mikrotikrouterboard	RB 750 G
Switch TP-LINK	SG108E
Network Cable	CAT 6E
Web Server	
- Processor	Intel Core I5 2.4 GHZ
- Motherboard	Q150
- Memory	16 GB
- Harddisk	1TB
- Lan Card	Gigabyte
Printer	EPSON LQ-310

G. Implementation / Migration Plans

This section will list the order of application implementation in the company. the order can be seen in Table V.

TABLE V.   PLAN THE ORDER OF IMPLEMENTATION

Application	Information
Company profile website	New Development
Cash Day Application	New Development
Truck Maintenance	New Development
Account Payable	New Development
Payroll Application	New Development
Order Application	New Development

V.   CONCLUSION

From the research that has been done, it can be concluded if the Enterprise Architecture Planning can be used to help plan the development of corporate architecture. In addition, based on the planning result, there are six new application designs that have been produced so that the planning of the information system that will be built can run well. These six applications represent the six parts of the business process discussed in this study, namely marketing, order management, daily cash management, bill

payment control, payroll, and truck management owned by the company. In implementing it, it is recommended that companies also conduct training so that their employees can follow changes in new business processes. It is also recommended to do research again using other methods and selecting the best enterprise architecture planning results.

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Warehouse Management System for Smart Digital Order Picking Systems

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Abstract—The purpose of this paper is to identify problems in the identification picking process that lead to consumer dissatisfaction and provide solutions to the issues that exist in the company, especially in warehousing, supported by analysis of the running system to obtain the information needed. The decision-making system used to be able to produce reports regarding picking orders in adjusting the number of requests, availability of pickers and distribution to consumers. The research method uses the PIECES analysis and technology acceptance model method to determine the user's acceptance of the system builded. The smart digital order picking system was able to significantly accelerate the order picking business process from the ones that previously took a long time after implementation could meet consumer needs quickly.

Index Terms— digital picking, order picking, warehouse management system.

I. INTRODUCTION

The article from www.gooto.com stated that "PT Wahana Makmur Sejati, the primary dealer of Honda motorcycles in Jakarta and Tangerang which is also a subsidiary of Wahana Artha Group, throughout 2018 to April achieved sales of 127,000 units, an increase of about 5 percent compared to the period the same as last year ". From the pieces of the article, it can be concluded that the sales of Honda motorcycles increased at the beginning of 2018. With the increase in sales of Honda motorcycles also had an impact on the sale of Honda Genuine Part spare parts. And based on the article, too, throughout 2018 from January to April, sales of spare parts reached IDR 143 billion.

Availability of Honda motorcycle spare parts at PT. WMS is very influential for dealers and AHASS (in the warehouse system of PT WMS, dealers and AHASS referred to as dealers) because of dealers or AHASS as consumers of PT. WMS will undoubtedly supply their goods from PT. WMS to be sold to consumers. With many consumers providing, then ordering spare parts to PT. WMS will be even higher. With this, it will also affect the spare part warehouse management of PT. WMS located in Cimanggis or more precisely on Jl. Tapos Depok. In this four-story

warehouse, it is capable of storing up to 456,000 spare parts to supply orders for up to 350 dealers.

Like the warehousing management system in general, PT. WMS performs five main activities, namely receiving (a receipt of goods), storing (storing goods by following the shelf), order picking (taking products based on requests), order packing (packing goods based on size), and shipping (shipping). Order picking is the most costly activity in warehousing and can reach 55% of the total cost of warehousing operations, so it is considered a top priority in increasing productivity (Tompkins, White, Bozer, & Tanchoco, 2010). That way, the order picking process must maximize existing resources and technology to be able to reduce costs and speed up the process of taking goods. But in the warehouse of PT. WMS, the condition of order picking still uses steps that require a long time and relatively high costs. The amount of time needed for the picking order process is due to the many steps in the process of preparing the pecking order so that many orders that are not picked-up which result in the fulfillment of orders to consumers, become longer. As in Fig.1, many picking lists are canceled rather than done. That is, due to limited working time and also due to the preparation process of the old picking list document. And also, the process of validating the picking list by sorters to cut stock in the system using only two computers, which resulted in a picking list queue that had been done by the picker and made the sorter sometimes overtime to do it.

In Fig.2, every day, the picking list is an average of 500-600 picking lists. And all the picking lists are printed then the document is grouped according to the location of the picker and distributed to the picker for the collection of the items.

Fig.1. Picking Amount in August and September
(Source: PT WMS data)

The printed picking list document only used until the picker is sorted and collected, and after that, the report not reused, which results in a buildup of paper every day.
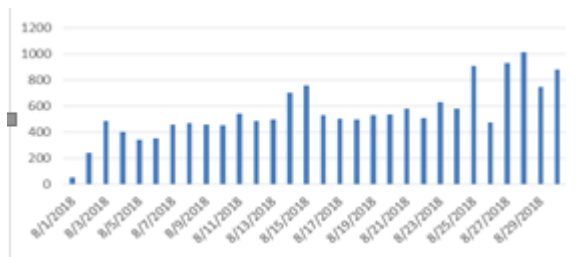

Fig.2. Picking amount per day

And from the process that is currently running, the warehouse head also has difficulty measuring the picker's performance. This is because the order picking process only uses paper-based documents, so the picker time is not visible and recorded.

From such conditions, the author will analyze and develop a system of order picking spare parts in the warehouse of PT. WMS can optimize the order picking process so that the warehouse outbound process not hampered.

II. THEORY

A. Warehouse Management System

Warehouse Management System (WMS) or warehouse management system (A, N. Subramanya, & M. Rangaswamy, 2012) aims to control the movement and storage of materials in the warehouse and process related transactions, including shipping, receiving, cancellation, and retrieval of goods. A warehouse management system (WMS) is a database-based computer application, to improve warehouse efficiency by directing cutaways and for maintaining accurate inventory by recording warehouse transactions. The system also directs and optimizes stock based on real-time information. After data is collected, there is batch synchronization with or real-time wireless transmission to the central database. The database can then provide useless reports about the status of goods in the warehouse.

B. Order Picking

Order picking defined as the process of retrieving the right number of products from a specified storage location to fulfill customer orders. The entire pick area can be divided into picking zones so that each picker dedicated to selecting items only in their respective zones (Jane & Laih, 2005). This order picking process is an everyday activity in the warehouse. A recent study in the United Kingdom revealed that 63 percent of all operating costs in a warehouse could be linked to the order taking a process (Frazelle, 2002).

C. Previous Research

Research [Atoilah et al.] [Hannes et al.] [Gaspar et al.] used android as a means of recording goods. Their research results produce a mobile system that can reduce the difficulties of warehouse workers in carrying out their duties, such as filing products and monitoring products in real-time. This mobile system can overcome the challenges of warehouse workers in carrying out their tasks such as recording goods and monitoring products in real-time. An Android information system that has designed to be able to log goods in and out and monitor the expenditure and receipts and inventory of products in the company.

This study correlates with Gaspar's research regarding business processes in the warehouse. However, the study discusses all the business processes of dispensing goods from the storage rack related to the transfer of goods and taking orders, while this research only focused on taking orders (see fig3). As well as in consideration of the device, which research uses a PDA or Personal Digital Assistant, which is a Mini Personal Computer that can be carried everywhere. However, the PDA is a reasonably expensive device of approximately 7-9 million, and this considered by management. Therefore, the solution so that the price is more affordable is to use a mobile device that is a tablet or smartphone.

Fig 3. The picker takes the order

III. RESULT AND DISCUSSION

PIECES analysis was carried out in 2 stages, beginning and at the end of the study. In the beginning, the PIECES analysis study was carried out as follows:

Analysis of	Current condition
Performance	-Presentation of information needed requires a long time because it must first download the outstanding picking list, then print it and must group the document picking list based on the floor. This process takes approximately 24 minutes. -Submission of picking list documents to pickers counts for two minutes because of the location of the administrative office with a warehouse area of around 200m. -When collecting items by sorter and sorter, do a validation picking list using a PC, and it takes 2 minutes to validate one picking list number. -The picker's performance hampered due to the process of preparing a picking list document that takes 26 minutes, which results in the picker having to wait to start the job. -In the morning, there is no sorter work because you have to wait for the picker to start his job. -The number of picking lists was canceled because of limited working time
Information	-Submission of picking list documents to pickers on each floor is often confused with other levels because they still grouped manually so that the information delivered is irrelevant. -Presentation of information about the number of items the picker has taken is sometimes unclear because it is still handwritten on the picking list document so that the data is inaccurate.
Economics	-It costs a lot to print a picking list document that requires paper and printer ink. A5 paper fee (1 month 25 reams) = Rp. 875,000, - and the cost of ink (1 month 3 pcs Toner) Rp. 2,670,000, -
Control	-One picking list number can be pages and pages. Because the picking list document to be scattered or tucked away during the order picking process and the sorting process.
Efficiency	-Time picker wasted when preparing document picking lists. -There is a process of copying the data in the picking list document that has been crossed by the picker copied to the system for cutting stock. -Significant expenses for purchasing printing equipment such as paper and ink. -The picking list document is not reused so that there are buildup, disposal, and waste of paper.
Service	-Picker and sorter must carry ballpoint pens and picking list documents that are so many that their traveling activities are felt to be uncomfortable.

From the PIECES analysis above, the problem that arises can be concluded that the order picking process does not run optimally and requires a relatively long time so that it can result in the fulfillment of consumer orders being hampered and requiring high operational costs. Therefore, the process of digitizing picking orders feels crucial in supporting the smooth order picking process in the spare part warehouse of PT. WMS. And this is the basis for developing a user requirement for building a new business process.

With the proposed business process, a business process that initially goes through 10 steps will summarize in just past tree steps. With that, the process of retrieving ordered items will be faster so that it can minimize the cancellation of order taking and be able to maximize the time working correctly.

The system to facilitate the proposed business process was developed based on the analysis and needs of users. The development of this system aims to change, improve, and add features to the existing system so that it can better measure and monitor the productivity of pickers and sorters and can accelerate the outbound process in the spare part warehouse of PT. WMS. This development includes changes in the process of preparing the picking list and validating the picking list based on the stock in the system. The system that I developed given the name Digital Order picking system, which means that information about the list of items picked up and validation of picking lists based on stock in the system can be done directly by the picker using web-based digital media that can be accessed via a browser on a smartphone.

In its implementation, in the morning, the picker can immediately start the job, starting with logging into the system and taking the goods according to the item picking instructions listed on the system. Then the picker takes the goods and supplies the number of items received according to the spare part number. Then the picker stores the transaction per picking list number and the status of the picking list number changes. Furthermore, the sorter monitors the status of the picking list by accessing the system as well and must pass the system login. From that sorter system, sorters can find out directly the picking list that has all the items complete. And then, the sorter does his job by collecting items from each end of the shelf to be given to the packing process. From this activity, the activity of taking goods can be monitored by the head of the warehouse by accessing a progress picker monitoring dashboard which looks like several pie charts according to the number of login pickers registered in the master picker.

A. Supporting material

Tablet (fig. 4) used for pickers and sorters in accessing the Digital Order picking system which will always be handled by pickers and sorters to view picking list information for instructions for retrieving and collecting ordered items.

Fig 4. The tablet

However, this tool is not carried by a picker and sorter but placed and taped to a trolley of goods such as fig.5.
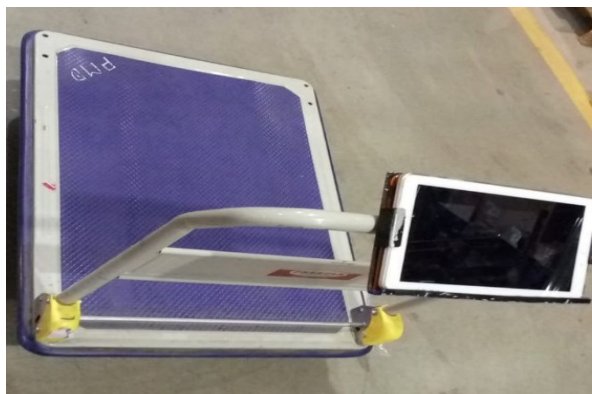

Fig 5. Goods Trolley

B. How the application works

When the login process is complete, the display for login picker directed to the home page which contains information about the progress picker on that day. And the left side contains menus that can be accessed by the picker (fig. 6). If the red, blue, and yellow boxes are selected, it will give information about the picking data according to the color chosen.

Fig. 6. Picker Detail

Next is information about picking lists per picking number that have shelves according to the login picker (Fig. 7). This page contains information about alias numbers for picking numbers, picking numbers,

consumer names, picking dates, regions, order numbers, spare part numbers, spare part names, shelf names, quantity to be taken, and also the text field that must be filled by the picker the actual quantity or quantity made by the picker and picker must check the checkbox per detail to ensure that every aspect has been done correctly. For color textboxes, if the input quantity is the same as the quantity that must be taken, the textbox color will change to green, but on the contrary, if the input quantity is not the same as the quantity to be taken, the textbox will turn red.

Then, if the picker has done the existing picking details, the picker must submit the form. Submit form will process picking to update picking data and change picking status. In one picking list number, it can be accessed by several pickers if the items ordered are on different shelves. In the previous system, the validation process of picking list raises all the details per picking list number which consists of several parts that have different shelves which result in one part of the picking list being unable to validate part of the details, even though the picker has taken the item from the storage shelf. And that makes the picker have to return the item.
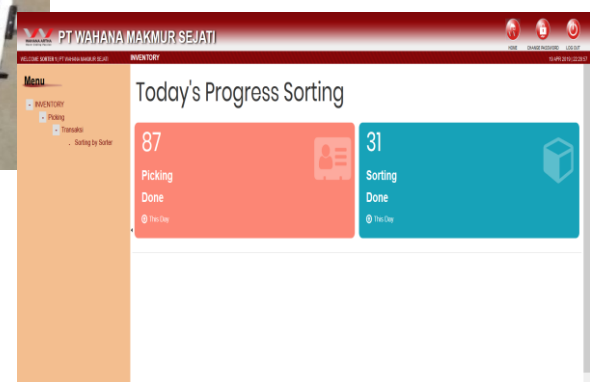
Fig. 7. Today's progress sorting

And on the system built, the validation of picking lists can be done in part, where one picking list number can be accessed by several pickers and can be directly validated (see figures 4.19 and 4.20). And it makes direct picking lists partially validated by the picker so that the sorter can find out the items that have been taken by the picker and can be collected immediately for packing. As well as items that have not been collected by the sorter because the work time is up, it will not be canceled automatically by the system but can be done the next day.

At the login sorter, after the login process will direct to the home page. This page contains information about the work progress of the sorter. Picking Done which means picking has been completed but sorter has not been collected. And the Sorting Done amount, which means the number of collections that have been done by sorter on that day. In the system developed, sorters only have the authority to access one menu, namely the Sorting by

Sorter menu. When this menu is selected, a section will appear for filtering or data search, and below that will perform a list of data picking lists and their status.

Filtering section, there is a sequence number parameter alias unique number from the picking list number and also the status. This filtering is useful for facilitating sorters in finding picking lists that are complete and ready to be collected. On this page, there is also a view button from each picking list number. If the switch is selected, then the picking list status will change to 'sorted' and will move to the next page (fig.8).

Fig 8. View Sorter

Meanwhile, the menu that can be accessed by the warehouse head is the Monitoring progress picker menu, Report picking, and Master Picker.

There are red, blue, yellow, green, and gray. The red color provides information about the number of picking lists that day. The blue color provides information about the picking list that is worked on. The yellow color provides information about the number of picking lists that have been taken and validated. Green gives information about the packing picking list, and the gray color offers information about the canceled picking list. If you select one of the colors will display the details of the packing list information. (fig. 9).
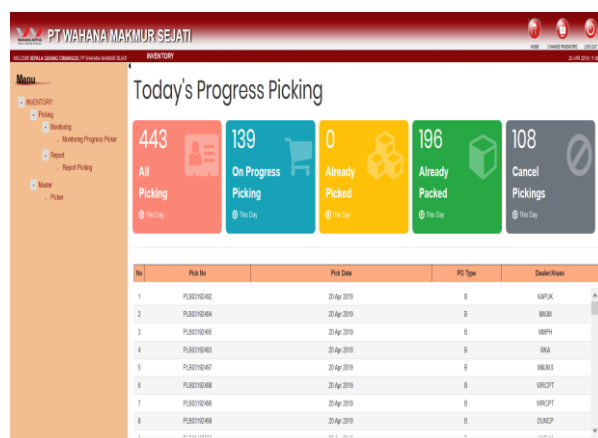
Fig 9. Monitoring by the head of the warehouse

There are red, blue, yellow, green and gray. The red color provides information about the number of picking lists that day. The blue color offers information about the picking list that worked. The yellow color provides information about the number of picking lists that have been taken and validated. Green gives information about the packing picking list, and the gray color includes information about the canceled picking list. If you select one of the colors will display the details of the packing list information. (fig. 9).

The system that we built is very smart because it implemented correctly, quickly and in realtime and has several indicators that make the user's work much more comfortable. Like the Monitoring Progress Picker (Fig. 10).
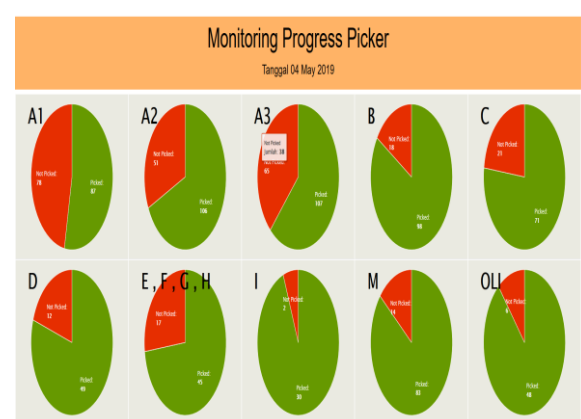
Fig 10. Monitoring Progress Picker

The Progress Picker page contains information on the number of spare part numbers that must be taken by the picker who uses a pie chart to represent the number and grouped according to the login picker. Each pie chart informs you about the amount of picking that has been done by the picker and which has not been done by the picker.

The test results for the system that was built eventually were measured based on the effectiveness of its use using the technology acceptance model method and found the results as follows:

		Perceived Usefulness	Perceived Ease of Use	Attitude Toward Using	Behavior Intention of Use	Actual Use	Perceived Risk	Perceived Enjoyment	Trust
N	Valid	10	10	10	10	10	10	10	10
	Missing	0	0	0	0	0	0	0	0
Range		1.00	2.00	2.00	2.00	3.00	2.00	2.00	3.00
Minimum		23.00	18.00	13.00	18.00	7.00	8.00	8.00	7.00
Maximum		24.00	20.00	15.00	20.00	10.00	10.00	10.00	10.00

Fig. 11. Tabulation of data

With the cumulative details of each variable:

- Variable Perceived Usefulness → minimum number = 23.00 and maximum number = 24.00 and range = 1.00.

- Variable Perceived Ease of Use → minimum number = 18.00 and maximum number = 20.00 and range = 2.00.
- Attitude Variable Toward Using → minimum number = 13.00 and maximum number = 15.00 and range = 2.00.
- Intention of Use Behavior Variable → minimum number = 18.00 and maximum number = 20.00 and range = 2.00.
- Actual Use variable → minimum number = 7.00 and maximum number = 10.00 and range = 3.00.
- Variable Perceived Risk → minimum number = 8.00 and maximum number = 10.00 and range = 2.00.
- Perceived Enjoyment variable → minimum number = 9.00 and maximum number = 10.00 and range = 2.00.
- Trust Variables → minimum number = 7.00 and maximum number = 10.00 and range = 3.00.

The validity test conducted states that the eight components are valid. The following are the results of one part, namely "trust."

Trust_1

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	3.00	1	10.0	10.0	10.0
	4.00	1	10.0	10.0	20.0
	5.00	8	80.0	80.0	100.0
	Total	10	100.0	100.0	

Trust_2

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	4.00	1	10.0	10.0	10.0
	5.00	9	90.0	90.0	100.0
	Total	10	100.0	100.0	

The reliability test results carried out also state that all parts are reliable. With Cronbach alpha, the maximum is 2 to 5.

Reliability Statistics

Cronbach's Alpha	N of Items
.625	5

IV. CONCLUSION

From the results of the analysis of ongoing business processes, it is known that the order picking business process has several problems so that all these problems can lead to a long order picking process and the fulfillment of orders to consumers hampered. So, in the research carried out obtained several results, namely:

1. presentation of data in realtime and presenting smart data makes the system that we build very useful and significant to some positive things, including data speed, system response speed, data accuracy on the information generated and quick calculation of picker and sorter performance.
2. Web Application-based system that can support order picking processes faster than before users can access that via smartphones.
3. The previous order picking business process takes 24 minutes to prepare the picking list document and 2 minutes for the validation picking list, which in total takes approximately 28 minutes. However, in the proposed business process with the system that has developed, it accelerates the process of order picking for about 26 minutes.

However, it should be stressed that there is one key factor that also affects the speed of the picking order process, namely: the condition of the user of the picking, the system in this case, the picker, sorter and warehouse head in carrying out their work. This study emphasizes the factor of digital order picking systems that can support the order picking business process by choosing the application of systems that can be accessed on smartphones and can be easily used for traveling or moving places.

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Brand's Cool Dimension Effect on Customer Satisfaction and Its Implication to Visual E-WoM

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Abstract

As Word of Mouth (WOM) progress as one of the most potent marketing instruments, millennials are a vital contributor to the growth of eWOM. Considering how powerful eWOM is and the significance of millennials as the generation that derives the transformation of eWOM as the primary source of information for the customer, it is important to know the variables that drive millennial customers desire to provide information about product and service through their own social media account. This study then employed structural equation modeling to analyze the data. This study finds that out of the two, cool factors only hedonic cool is proven to have a positive and significant influence on customer satisfaction. The other finding is that active Visual eWOM activity of customer are positively influenced by customer satisfaction.

Keyword: *Hedonic Cool, Utilitarian Cool, Customer Satisfaction, Visual eWOM*

1. Introduction

Word of Mouth (WOM) has been the focus of numerous researches in the marketing field. One of the pioneering studies in this subject defines WOM or personal influence as a market/product related information exchanging activity among the customer [1]. The definition of WOM since then has evolved to the informal suggestion from and to the customer that normally interactive, brief, and bias-free [2].

Whitler [3] suggested that WOM is the most valuable marketing tools that customers trust the most and most likely will increase sales. Katz and Lazarsfeld [1] believe that it is seven times more effective than newspaper advertisement, four times more effective than direct selling, and two times more effective than radio advertisement. WOM is the primary factor that influences 20 to 30 percent of all purchases [4]. Meanwhile, according to Nielsen [5], 88% of South East Asia's customers believed in WOM and 91% will act based on it. Nowadays the amount of WOM exchange is likely increasing along with the development of digital and mobile platforms [6]. Digital and mobile growth also transform how WOM is distributed among customers. It used to be that WOM is an oral communication about brand between the customer [7], now WOM doesn't have to be in the form of oral communication anymore. Now the customer can distribute WOM in a digital form known as Electronic Word of Mouth or eWOM for short. Hennig-Thurau et al. [8] define eWOM as all positive or negative expressions about a product or company that is made by the customer, potential customer, or ex-customer directed to several people or institution through the internet.

As its progress one of the most potent marketing instrument, the millennial is a vital contributor to the growth of eWOM. According to [9], 60% of millennials talk about product and service more than the overall population that is only 29%. Furthermore, Smith [10] stated that millennials are more willing to provide information about products and services for their colleagues. In order to be positively talked by millennials through eWOM, product and service must meet several standards. Those standards are, it has to be cool both from its functional (utilitarian) and emotional (hedonic) aspects.

Considering how powerful eWOM is and the significance of millennials as the generation that derives the transformation of eWOM as the primary source of information for the customer, it is important to know the variables that influenced the drives millennials customer desire to provide information about product and service through their own social media account. The social media platform chosen to be the object in this research is Instagram. The primary reason for using Instagram as the object is in recent years Instagram has grown significantly to 22 million users [11] and 89% of its users in Indonesia aged 18 – 34 years old [12].

Considering the characteristic of Instagram as the social media platform that primarily an image sharing social media, therefore in this research the type of eWOM that will be studied will be specific only about Visual Electronic Word of Mouth (V-eWOM). As for the product, this research will use sneakers as a product. This research is expected to give an understanding of the behavior of the millennial regarding their activity of sharing positive expression about products through their social media account. The findings hopefully can be implemented into the company's marketing strategy in order to enhance the company's capability to engage the millennial based customer.

2. Conceptual Foundation

2.1. What is "cool"?

As the word "cool" nowadays might no longer cool, but it is still the best word to describe something that is elusive, an exclusive quality that makes behaviors and objects so hip, desirable, and symbolic of 'being in the know' [13]. Kerner and Pressman [14] said that cool is about achieving relevance—to a particular group, small or large. Gladwell [15] defined cool as doing something that nobody else is doing. A Cool brand can also be defined as one that has a cultural value in it [16]. In this study, we follow Runyan et al. [17] definition of cool that is, an emotion or feeling about a product, which is the hedonic value (hedonic cool) and utilitarian value (utilitarian cool) in nature. The hedonic dimension is defined as the pleasure potential of a product class and utilitarian described as the ability to perform functions in the everyday life of a consumer [18].

Furthermore, Runyan et al. [17] also decided hedonic cool into three aspects (Singular Cool, Personal Cool, and Esthetic Cool) and utilitarian cool into two aspects (Functional Cool and Quality Cool). Singular Cool is achieved when the purchased products are unique enough to make the customer establishes him/herself as a unique individual [17]. Personal Cool products are the kind of products that able to represent the customer's self by transferring it's symbolic meanings to the user [17]. Esthetic Cool according to Runyan et al. [17] is products that are designed to benefit the user's lives and have a well-design appearance. Functional Cool is defined as the consumer's perceived practicality of product usage to fulfill

its intended function [17]. Where Quality Cool is defined broadly as product superiority or excellence if compared to its competition [19].

2.2. Customer Satisfaction

Customer satisfaction can be defined as an overall evaluation of the post-consumption experience of products or services in the mind of the customer [20]. In short Oliver [21] synthesize that customer satisfaction can be described as the consumer fulfillment response. This response of fulfillment is a judgment that a product or service features, or the product or service itself, has provided (is providing) a pleasurable level of consumption-related fulfillment [22]. The evaluation process that will lead to the judgment of customer fulfillment (or not) will significantly be affected by the value provided by the product of service both the hedonic value and utilitarian value [23]. Jones et al. [24] also find that both hedonic and utilitarian value is significantly influenced customer satisfaction. Therefore, the hypothesis can be formulated as follows:

> *Hypothesis 1: Hedonic cool positively affect customer satisfaction*
> *Hypothesis 2: Utilitarian cool positively affect customer satisfaction*

2.4. Visual Electronic Word of Mouth

Word of mouth (WOM) has been approved for many years as one of major influence on what people know, feel and do. The research conducted by Buttle [25] has shown WOM is nine times as effective as advertising at changing the unfavorable or neutral perception of a product into a positive one. Visual eWOM is a visually digitized form of WOM it can be defined as an expression about a product or company conveyed by a consumer that is available on the internet [26]. In essence, the Visual eWOM is a form of Electronic Word of Mouth (eWOM). The eWOM activity involves two individuals that are the sender (writer or poster) and receiver (reader or viewer). WOM activity is a result of the post-consumption condition experienced by customers [27]. In case the product or service performance fulfills the expectation of the customer, it might trigger the customers to tell their positive experience to others [28]. Based on this rationale, we propose:

Hypothesis 3: Customer satisfaction positively affect visual eWOM activity

2.5. Research Framework

Based on the research hypotheses constructed earlier, it can be summarized that there will be two types of construct namely first order and second order. The second order variables are hedonic cool and utilitarian cool which consist of three and two dimensions respectively. On the other hand, the variables treated as the first order are customer satisfaction, brand trust, and positive visual eWOM activity. Thus, the research model proposed is:
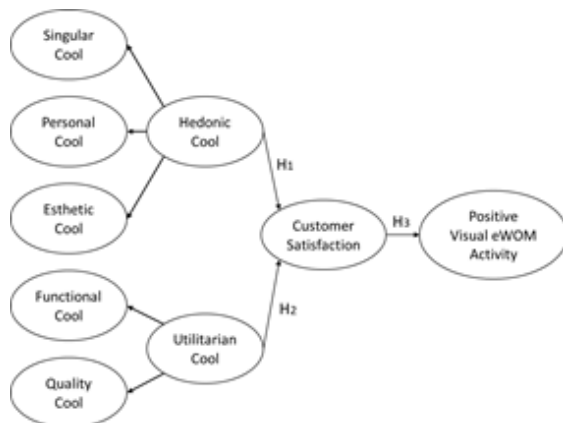

Figure 1. Research Framework

3. Data Analysis Method

This study employed structural equation modeling to analyze the data. The analysis was conducted by using Lisrel 8.5.1. For the SEM analysis, this study adopted the 2 steps approach, wherein the 1st step, the model was being specified for its validity and reliability and in the 2nd step, the structural model was formed and tested [29]. The measurement model would be considered valid if the standardized loading factor ≥ 0.5 and t-value for each indicator ≥ 1.96 [30]. Meanwhile, the measurement model will be deemed reliable for the value of construct reliability (CR) and average variance extracted (AVE) exceeds or equal to 0.7 and 0.5 respectively [30].

For hypothesis testing, this study uses a 95% confidence level where the critical value is ± 1.96. All of the hypotheses in this study are in the form of positive one-tailed, thus the null hypothesis would be rejected if the t-values for each respective hypothesis exceeds or equals to 1.96.

Besides analyzing the measurement and structural model, this study would also scrutinize the model's goodness of fit. This study would incorporate the standard where the model would be assessed by 3 kinds of categories namely absolute, parsimonious and incremental fit [30]. The model would be considered to have a good fit if at least one criterion from each category fulfills the recommended value.

4. Data Analysis and Result
4.1. Respondent's Profile
The descriptive information of the sample for this study showed that most of the respondents are within the age ranged between 18 and 20 years old (75.6%) and live in Tangerang (51.8%). The gender of the respondents in this study is spread equally, with 54% and 46% for men and women respectively. As for the number of shows owned, most of them possess 6-10 pairs (42.1%) and 1-5 pairs (39.7%). Their budget to be spent on shoes revolves around Rp. 500.000 – Rp. 1.000.000 (42.1%) and Rp. 1.000.001 – Rp. 1.500.000 (27.4%). Regarding their social media behavior, most of the respondents post 1-3 posts (51.2%) and 4-6 posts (23.1%) in the past week.

4.2. Validity and Reliability
As can be seen from Table 1, all variables are considered valid. This can be seen from t-values for each indicator, all scoring above 1.96, and the score of standardized loading factor, which exceeds 0.5. All variables are also reliable, as, from the calculation of construct reliability (CR) and average variance extracted (AVE), the scores fall above the minimum standard, which is 0.7 for CR and 0.5 for VE

Table 1 – Validity and Reliability Analysis Result

Variable	Dimension	Indicators	T-Values	SLF	CR	AVE
Hedonic Cool	Social Cool	SC1	11.02	0.77	0.836	0.563
		SC2	10.95	0.77		
		SC3	12.28	0.83		
		SC4	8.27	0.62		
	Personal Cool	PC1	10.51	0.76	0.787	0.650
		PC2	12.94	0.85		
	Emotional Cool	EC1	7.22	0.57	0.749	0.503
		EC2	10.75	0.78		
		EC3	10.48	0.76		
Utilitarian Cool	Functional Cool	FC1	10.59	0.77	0.780	0.640
		FC2	12.51	0.83		
	Quality Cool	QC1	11.11	0.78	0.766	0.621
		QC2	11.49	0.80		
	-	CS1	9.49	0.70	0.761	0.515

Customer Satisfaction		CS2	10.22	0.73		
		CS3	10.20	0.73		
Visual E-WoM	-	WM1	14.10	0.88	0.826	0.615

4.2. Path Analysis and Goodness of Fit

A structural equation modeling was conducted to test overall model fitness as well as to test the research hypothesis. This analysis was conducted by using Lisrel 8.5.1 software. The result is summarized in Table 3. For absolute fit, this study used the Normed chi-square indices, where the score is 1.84 which indicates it fulfill the recommended value of < 3. Then, for Incremental fit, this study used NFI indices, which stated that the model would be considered good if the score falls between 0 and 1. For this study, the score of NFI is 0.89 or in other words, fulfills the recommended value. As for parsimonious fit, this study used PNFI indices in which the model would be deemed good and acceptable if the score also falls between 0 and 1. The PNFI score for this study is 0.65 thus it is considered as a good fit.

For hypothesis testing, this study used a 5% significance level in which a path would be considered significant if the p-value less than 0.05. As can be seen in Figure 2, 2 out of 3 paths have been significantly supported. As for the path from utilitarian value to satisfaction (UC → CS), the null hypothesis could not be rejected as the p-value is more than 0.05.
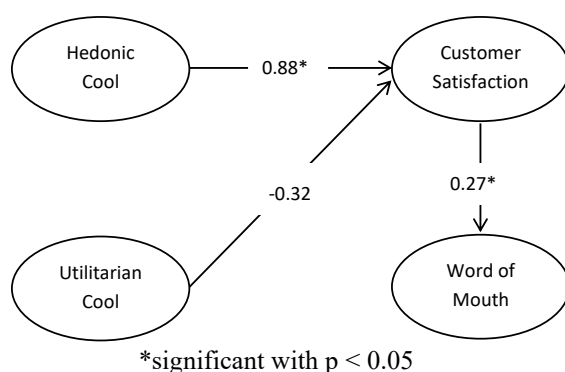

*significant with p < 0.05
Figure 2 – The Structural Model

5. Discussion & Research Limitation

5.1 Discussion

In terms of what drives the customer to be satisfied, the findings in this research are similar to the study conducted by Purwanto [31] that finds that only hedonic values or in this case are called hedonic cool is significantly influencing customer satisfaction. The argument is that

customers currently have their own expectation of the adequate level of product quality and product functionality and it has become a mandatory thing for a brand to fulfill. For a brand not to meet those minimum standards is outrageous and out of ordinary. The result of this kind of thinking is that meeting those utilitarian criteria has become an obligation for the customer that it will no longer affects their satisfaction towards the product. Another thing that might explain this is that millennials view sneakers as a fashion item or a lifestyle as the rise of sneakers popularity in Indonesia is brought by the American urban street style. As stated by Okada [32] for the people who view a product or in this case is a pair of sneakers as a fashion statement the functionality aspect of it becomes secondary. The study by Chitturi et al. [33] also finds that hedonic values give customers a greater level of satisfaction compared to its utilitarian values. On the contrary according to Yoh et al. [34] when it comes to athletic footwear the utilitarian values are more influential than the hedonic values. So, the logic is upholding that if footwear is to be perceived by the user as a fashion article the sole driver of those user's satisfaction is hedonic cool aspects of the articles.

In regard to Positive eWOM Activity, this study has found that it is positively affected by customer satisfaction. Wolny & Mueller [35] stated that customer with a higher level of satisfaction is more likely to be more active in post consumption engagement about the brand via the internet. These kind behaviors can be amplified as the hedonic cool aspects of the products increase the level of satisfaction. What most fascinating is that on contrary to popular believe, Hennig-Thurau et al. [8] found that a satisfied customer with positive emotion is more likely to actively go to the internet to create positive eWOM than a customer with negative emotion. This is important as the ability to share customer positive eWOM in the form of visual information is becoming extremely easy with the currently available technology at almost every customer's disposal.

5.2 Research Limitation

As an early stage study, this research has not yet covered many areas. Several advancements that could be made is to make the hedonic cool dimension and utilitarian cool dimension as an

individual variable. It will enable the research to further explain what is affecting a product to be considered cool or not, and whether it will affect customer behavior. Another improvement that could be made is to compare how it will work across different kinds of products not only limited to fashion items.

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The Impact of Social Network Marketing on University Students' Purchase Intention and How It Is Affected of Consumer Engagement

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Abstract - The research conducted is to know the impact of social network marketing on consumer purchase intention and consumers who become research are active students at private universities in Jakarta, and how social network marketing also affect consumer engagement (as moderate variable). The research method used in this research is quantitative research method. A method of data collection used in this research is a questionnaire distributed to 119 university students. The results of this study showed that social network marketing has a strong and significant impact on customer engagement, customer engagement has a strong and significant impact on consumer purchase intention, social network marketing has a strong and significant impact consumer purchase intention, and also there is a significant impact from social network marketing on consumer purchase intention through consumer engagement.

Keywords: Social media, social network, marketing, consumer engagement, consumer purchase intention

I. INTRODUCTION

The rapid development of digital technology has changed the lives of people in various fields as well as traditional grind. One of them is in finding information. The main difference between social media and other traditional media such as television, newspapers, magazines, billboards is that social media offers two-way communication between the company and its customers, not the one-way communication offered by traditional media.

Using social media is much easier for marketers to reach a large number of people at very cost-effective. In addition, social media offers Web 2.0 features of interactive, collaborative, knowledge sharing, and other user empowering tools.

Social network marketing is any marketing and communication effort that uses social media as its channel to promote a product, service, or brand. Social network marketing allows companies to create their own content through new web technologies and distribute them to millions of people for free.

Previous studies have identified that one factor affecting brand loyalty is students, as they comprise a significant portion of active users in social media [1].

The youth segment also consists of a segment of active buyers in various industries of products and services such as technology, sports, entertainment, clothing etc. [2]. The youth segment has emerged as a strong market segment that has the capacity to influence the purchasing and decision making of others [3]. The youth market can be considered an indicator of the surrounding cultural and social changes [4].

The use of social media may affect customer purchase intentions, [5]. In today's marketing, increased use of social media has significantly changed the way communication between sellers and buyers (the marketing field). This evolution has resulted in new potentials and opportunities in marketing and commerce that are changing the way consumers respond to purchases as exposure to different brands of products and services.

Many marketing experts have considered the issue of consumer engagement, especially those that refer to research involving social media [6]. This is stated in the research The importance of a general measure of brand engagement on market behavior: Development and validation of a scale by Sprott, Czellar, & Spangenberg [7], which states that consumer engagement as a key driver in the consumer decision making process the existence of consumer engagement can result in customer satisfaction, loyalty, trust and commitment [8].

Over the last decade, the role of social media has increased in developing countries. Social media has changed the way organizations and consumers interact. As individual consumers have a platform to improve their voice because of better access to product information and purchasing decisions [9].

The most dominant social media used in Indonesia as well as in the world is facebook, twitter, youtube, instagram and blog. Until January 2018, the number of

Facebook users from Indonesia reached 130 million accounts with a percentage of 6% of the total users.

Table 1. Facebook's Top Countries on Jan 2018

#	Top Countries	Users	%Total*
1	India	250,000,000	12%
2	United States	230,000,000	11%
3	Brazil	130,000,000	6%
4	Indonesia	130,000,000	6%
5	Mexico	83,000,000	4%
6	Philippines	67,000,000	3%
7	Vietnam	55,000,000	3%
8	Thailand	51,000,000	2%
9	Turkey	51,000,000	2%
10	United Kingdom	44,000,000	2%

Resource: We Are Social and Hootsuite research reports released on LinkedIn

Internet users in Indonesia are always increasing every year. From 1998 to 2017 there was an increase in internet users by 285.6%. Based on data from APJII (Asosiasi Penyelenggara Jasa Internet Indonesia), the majority of Internet users as much as 72.41 percent are still from the urban community and those aged 19 to 34 years and 79.23 percent are S1 and diploma graduates. At some universities and vocational colleges, the internet has indeed become an important part of the teaching and learning process.
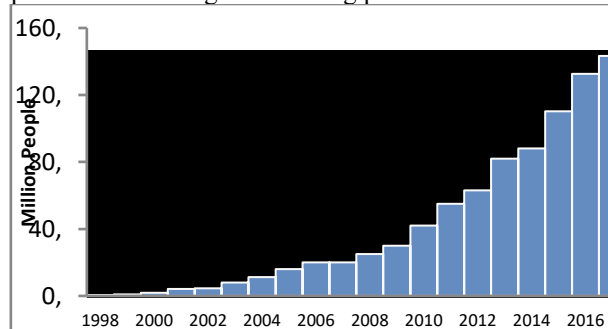

Fig 1. Internet Users in Indonesia (1998 – 2017)
Resource: Katadata Indonesia

Based on the above background, the research conducted is to know the impact of social network marketing on consumer purchase intention and consumer research into active students in private universities in Jakarta, and how social network marketing also affect consumer engagement (as moderate variable).

II.   LITERATURE REVIEW

Social media have immense influence on each stage of the consumer decision making process, to form general opinion and attitude [10]. Consumer interest in traditional media has declined and shifted to social media because of its personalized features and controls. Concluded that social media has created a bridge for businesses to communicate instantly.

As users of these social media, prospective consumers thus involve themselves as groups with particular interests and it is this aspect of their peculiarity that allows for effortless marketing strategies [11].

That most respondents are familiar with social media especially Facebook. The study further shows that perceived usefulness, perceived behaviour control and attitude as factors that could influence the users to use social media [12].

Consumer involvement is an important element and has a strong meaning. Because when there is media fragmentation due to the availability of some media options there will be a decrease in consumer devotion. Businesses must refine their marketing efforts to engage consumers because consumers are more loyal and emotionally connected with brands [13].
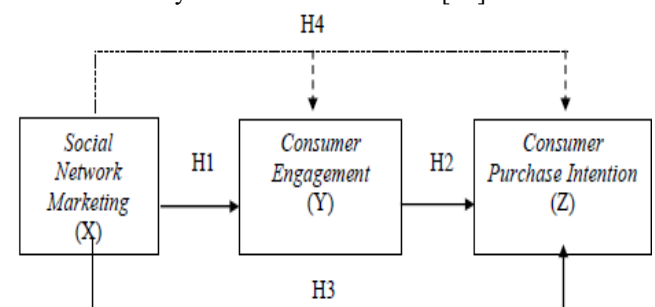

Fig. 2. Research framework

Hypotheses that can be built on the theory and previous research with the same variables:

H1: Social network marketing (X) has a significant impact on consumer engagement (Y)

H2: Consumer engagement (Y) has a significant impact on consumer purchase intention (Z)

H3: Social network marketing (X) has a significant impact on consumer purchase intention (Z)

H4: Social network marketing (X) has a significant impact on consumer purchase intention (Z) through consumer engagement (Y)

III.   MATERIALS AND METHODS

Types of data used by the authors in this study are primary data. In this study, using cross sectional research method, the primary data obtained through questionnaire with respondents is 119 active students at private universities in Jakarta. Data obtained in the form of identity and perception or opinion of respondents about the impact of social network marketing to purchase intention: consumer engagement as a mediator.

Respondents aged between 20 - 25 years old were 59 people, then the age group between 26 - 35 years old as many as 58 people, and the age group 36 - 45 years as many as 2 people.

The scale used to measure the variables in this study is Likert Scale. Likert scale is used to measure attitudes, opinions, and perceptions of a person or group of people about one's phenomenon [14]. With a score of 1-5, where the score 1 shows strongly disagree and score 5 shows strongly agree.

Questionnaire data has been done several tests, the first test is validity test and reliability test. Then after obtaining valid data then proceed with normality test,
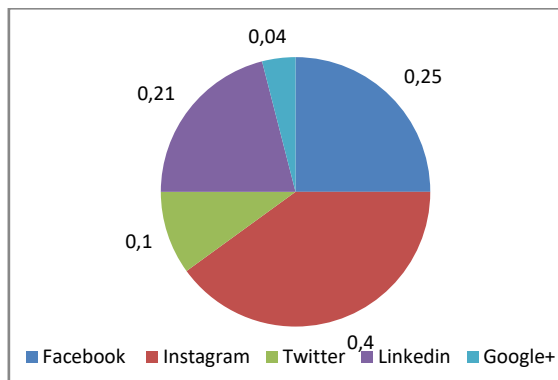
and after that the data processing is continued again by using correlation analysis. Data if using computer software, namely is SPSS (Statistical Program for Social Science) version 20.

IV. RESULTS AND DISCUSSIONS
A. Social Media

Social media distribution is often used from 119 respondents studied, most respondents use instagram as much as 40%, then facebook as much as 25%, then linkedin as much as 21%, twitter as much as 10% and google + as much as 4
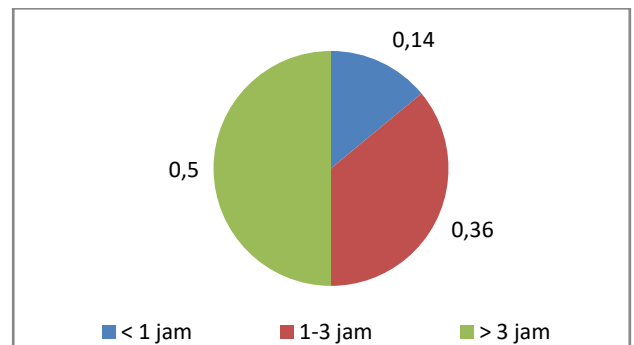

Fig. 3. Social Media is Often Used by Students

The average respondent spent time in social media, from 119 respondents studied, 60 respondents spent time in social media for more than 3 hours, 43 people spent time in social media for 1 to 3 hours and 16 people spent time in social media less than 1 hour.

B. **Testing of Research Instruments**

The validity test in this study used a confidence level of 95%, where df = n-2. The value of n in this study was 119, so the df value was 117. Thus, the value of r-table = 0,1502 was obtained. From the results of testing the validity of all indicators on social network marketing, consumer engagement and consumer purchase intention variables has the value of r-stat > r-table at n = 20 so it can be concluded that all indicators are valid.

Fig. 4. Average spend time in social media

P7	0,804	Valid	P7	0,640	Valid
P8	0,766	Valid			

The reliability test results for all variables are reliable with Cronbach's Alpha> 0.60.

Table 3. Reliability Test

Variabel	Cronbach's Alpha	Cut Off	Decision
Social Network Marketing	0,929	0,60	Reliabel
Consumer	0,873	0,60	Reliabel
Purchase	0,866	0,60	Reliabel

Significance test, it is known that social network marketing (X) and consumer purchase intention (Z) variables have a positive and significant relationship. Significance test, it is known that consumer engagement (Y) and consumer purchase intention (Z) variable have positive and significant relation. The relationship between the independent variable X to the dependent variable Y is linear with 95% confidence level. The relationship between the independent variables X and Y on the dependent variable Z is linear with 95% confidence level.

Table 2. Validity Test

Social Network Marketing			Consumer Engagement			Consumer Purchase Intention		
Indicator	r-stat	Decision	Indicator	r-stat	Decision	Indicator	r-stat	Decision
P1	0,700	Valid	P1	0,558	Valid	P1	0,701	Valid
P2	0,717	Valid	P2	0,951	Valid	P2	0,560	Valid
P3	0,795	Valid	P3	0,756	Valid	P3	0,833	Valid
P4	0,937	Valid	P4	0,801	Valid	P4	0,817	Valid
P5	0,957	Valid	P5	0,844	Valid	P5	0,850	Valid
P6	0,893	Valid	P6	0,879	Valid	P6	0,847	Valid

Table 4. Correlations

	Social Network Marketing	Consumer Engagement	Purchase Intention
Social Network Marketing	1	0.791	0.748
Consumer Engagement	0.791	1	0.779
Purchase Intention	0.748	0.779	1

Table 5. Causal Relation

Research purposes	R^2
The impact of social network marketing on consumer engagement	0,791
The impact of consumer engagement on consumer purchase intention	0,499
The impact of social network marketing on consumer purchase intention	0,353
The impact of social network marketing on consumer purchase intention through consumer engagement	0,394

V. CONCLUSIONS

The results showed that social network marketing variables and consumer engagement variables simultaneously to consumer purchase intention variables. Social network marketing is very influential on student purchasing decisions. The student is an active user of social media and internet. In addition to being in the productive age, students are also assessed as consumptive age.

Social network marketing has a positive and significant relationship to consumer engagement variables. This is because if the content offered on Social network marketing is interesting, then the student will visit it again.Consumer engagement has a positive and significant relationship to consumer purchase intention variables. Because previous experience will help students in buying goods and services needed.

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The Implementing ISO 9001 In Manufacture Industry

Case Study PT Softex Indonesia

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Abstract— **In 2015 ISO 9001 significantly reviewed and new requirements for certification were introduced. One of the new requirements is risk-based thinking. The risk-based thinking has to be addressed and managed in all aspects of quality management system processes and functions. In ISO 9001:2015 an organization required to take into those risk linked to quality and customer satisfaction. Risk management can be a guideline for the implementation of ISO 9001:2015. This research is only focused on information technology department at PT Softex Indonesia. The methodology of this implementation applies the seventh clause of ISO 9001:2015. Measurements performed by using maturity model and seventh audit stage. After the implementation, the organization needs to maintain the requirements of ISO 9001:2015 and try to continuously improve its quality performance.**

Index Terms— **ISO 9001:2015, Risk-Based Thinking, Quality Management System**

I. INTRODUCTION

Focusing on the Information Technology department of PT Softex Indonesia, the interview was achieved to find risk and opportunity. In the interviews found several risks that exist in PT Softex Indonesia. Companies hold important data that is confidential must be maintained properly. Company data that also covers all business processes is certainly important and should be kept as well as possible. Backing up data must be done and ensured that data is stored periodically. In addition to regular storage, data that is back up also should not be corrupted. Other possible risks are the occurrence of natural disasters or disruption that causes the server to malfunction and can not be used again.

In this division, employee knowledge should not be entirely controlled by one individual. If the employee that has all knowledge resign, then another employee cannot replace the job. Therefore, it is important that the documentation of the system and also the business flow. For the information technology division, there has not been any measurement of concern for awareness. The last finding of the opportunity is the manual submission process that uses

paper can be maximized by making the system. Using the ISO 9001: 2015 standard is expected to produce the quality of program output and support generated by the Information Technology division. In this study focused only on clause seven which is support. Measurement of the level of maturity made based on clause seven so that the implementation can be concentrated. Clause seven is chosen because it is the top priority of information technology division at PT Softex Indonesia to be implemented and continuous improvement in order to reduce risk.

II. STATE OF THE ART

Quality management is a way to improve sustainable performance in every process and functional area using available resources [1]. To apply the quality management required ISO 9001 as the international standard for the quality management system. This standard describes the requirements required for the implementation of the quality management system at the company. The implementation of ISO 9001, the company can produce products according to customer needs and perform continuous improvement [2].

ISO 9001 is one of ISO's series of quality management systems. ISO 9001 is standard for quality management certification [2]. ISO 9001 emphasizes the focus on procedures and standardization that aims to provide satisfaction to consumers. The main focus of the quality management system is the result of a product of good quality and delivering more than just the needs of the customers [3]. In ISO 9001: 2015 the risk is used as the basis for decision making that can not be separated from the system [4]. Companies or organizations are expected to be more proactive in preventing and also reducing existing risks and making sustainable improvements [5].

ISO 9001: 2015 explains that there are system changes occurring in accordance with the requirements of ISO 9001: 2015 [6]. The ideas and suggestions gained from surveys synced with ISO 9001: 2015 standards have reached the conclusion that managers

gain a more concrete picture of the functioning of systems in a company and apply that knowledge to the company [7].

The motivation of a company to get 9001 certifications can result in better performance. The Company that focuses on improvement will develop better strategies, structures and performance processes [8]. Therefore with the implementation of ISO 9001 shows that affect innovation positively and significantly [9]. The company that once got the ISO 9001 certificate and then lost the certificate was still able to run well. Funds allocated for certification are then allocated to other needs that add to the company's profit [10].

III. METHODOLOGY

In order to carry out the implementation, firstly done the measurement using maturity level. In the maturity model, there are 6 maturity scales from 0 to 5 which means different levels. To calculate the maturity level will be made a questionnaire. Calculation of the questionnaire will be done based on this model maturity method. After the questionnaire has been calculated the capability and maturity of the information technology management process will be known the level of maturity is.

After the implementation of the quality management system by using the standard of ISO 9001: 2015 seventh clause which is support. Support intended to achieve quality management is:

1. Resources

An organization must establish and provide the resources needed for the establishment, implementation, maintenance and continuous improvement of the quality management system. At PT Softex Indonesia will be measured whether there is a risk to existing infrastructure. The intended infrastructure may include buildings, hardware such as servers, software, work environment and so on.

2. Competence

A company must determine the required competencies of the employed employee that impact on the performance and effectiveness of the quality management system. In this study will be measured whether the employee knowledge is evenly distributed or not. The number of programs used to support and run business programs should be known evenly by the IT division.

3. Awareness

In this sub-clause will be measured awareness of Information Technology division employees about how important the quality management in order to achieve customer satisfaction. The number of programs created by the IT division should be able to improve the existing quality management.

4. Communication

Measurements will be made on how to communicate, what is communicated between divisions whether it is done well or not. Internal and external communications should be relevant to existing quality management systems.

5. Documented information

All documented information will be measured in this research is the form of information in the form of hardcopy will be maximized so that the use of paper can be minimized. With the reduction of the use of hardcopy or paper, it will minimize the risk of loss of documentation that can be caused by fire.

IV. ISO 9001:2015 IMPLEMENTATION

A. Measurement Result

Table 1. Maturity Level Result

No	Clause	Result
7.1	Resources	3.98
7.2	Competence	4.00
7.3	Awareness	4.02
7.4	Communication	3.96
7.5	Documented information	3.97
	Average	3.98

After obtaining the average value per subclause, then to get the value of the total maturity level of clause seven is calculated the mean value of subclause. From the calculation of the average subclause then found the value of maturity level of clause seven is 3.98. According to respondents who are employees of the division of Information Technology PT Softex Indonesia with eight members. In this measurement, the lowest result is in the communications sub-clause. Results that show the second lowest result are documented information. While the highest value obtained in subclause 7.3 is awareness.

In the measurement through the questionnaire, awareness gets the highest value that is known from the respondent's assessment. Communication is still at level three which means that continuous improvement should be done so that communication can run better. Documented information is deemed to be an improved procedure by replacing the commonly used hardcopy into an automated system. While the concern is at level four because employees consider all the procedures have been run well. In this level of maturity, PT Softex Indonesia on this scale is at the level of define which means the procedure has been standardized, communicated and also documented but still, potency detected irregularities.

After findings of three risks and an opportunity, then the next step is to make recommendations. Recommendations on these findings will then be undertaken to minimize existing risks and also

maximize opportunities. Here are the recommendations:

Table 2. Findings and Recommendations

No.	Findings	Recommendations
1.	Server malfunction caused by sabotage and also natural disasters	Created back up transaction data every day. Back up the server
		Create a mirrored server
2.	Uneven employee knowledge	Create system documentation for each existing application system
3.	The Absence of measurement of quality management quality awareness	The measured level of achievement of application quality management
4.	Changed the form of leave / slicing off the hardcopy into an automated system	Created a system to apply for permission, sickness, leave. Not only that, in the system added features pay slips, employee absences, and employee data

Servers that are not working due to natural disasters may occur. In addition, server sabotage may occur either from human negligence, weak firewalls, or weak security procedures. Natural disasters such as earthquakes are disasters that occur outside of the human will. Therefore backing up transaction data or any important data is done every day. Data that has been backed up must also be considered in order to ensure data that has been stored there is no corrupt. In addition, there are two options for server recovery plan by creating a backup server or mirrored server. Recovery plan for the important server is made because if one of the servers does not work then the operational activities can still be done and the previous transaction data is stored.

A second recommendation is to make documentation of a system that has not been documented. This documentation is made to make employee knowledge more equitable. Documentation created in the form of specifications in the form of use case, activity diagrams, user manual for program applications created and also a flowchart for documentation process of making data management report visualization made by information technology division.

The third finding is that there is no measurement of quality management quality of employees. So that will be given recommendations made a measurement of awareness of quality management by making the target form that contains the request from the user, the progress of the program made and the achievement of making the application and its features whether in accordance with the application requests requested by the user. The benefits of the program for the business process that runs and also for the customer will look

and be a good report for the IT division to see the progress of their work. If the target of the expected application in accordance with the expected it can be seen that the IT division aware and care about quality management.

Recommendations that can be given further which is a recommendation to maximize opportunities is the creation of information systems for human resources. License leave and illness can be done by the system. In addition, arrival time and employee return can also be seen in this application. Not only that, employee data will be stored here as well as employee salary slips will be provided through this application. With the system, it will provide, facilitate and even provide data that can be accessed wherever and whenever. The time required to obtain information also becomes shorter than the manual system. In addition, the ranks of manager leaders will also be easier to access information from the center considering the branch offices that exist in PT Softex Indonesia more than one.

B. Implementation

The following is the result of implementation iso 9001: 2015 which is done on PT Softex Indonesia:

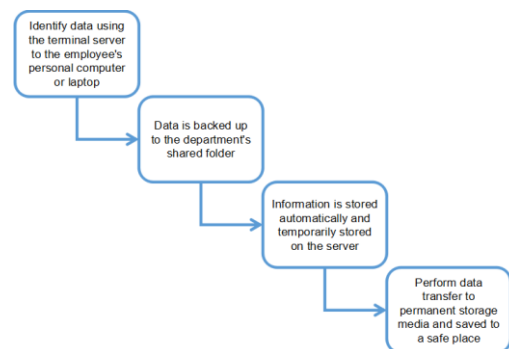1. Back Up Data Transaction and Back Up Data Monitoring

Figure 1. Back Up Data Procedure

This data backup procedure runs every day. First, the relevant departments of all departments in PT Softex Indonesia will be identified using terminal server data on all personal computers and laptops employees. After that, the data will be entered into the share folder department by ITSP. Existing data will then be backed up automatically every day on the server. Backing up temporarily stored data will then be transferred to a permanent storage medium at the end of each month and then stored to secure storage.
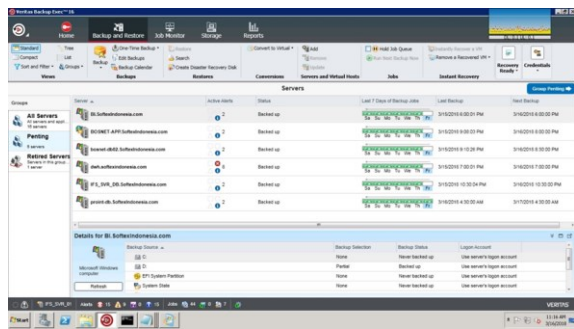
Figure 2. Backup Data Monitoring

Data transactions and employment of employees in the form of data, text, and images are important assets of the company that must be maintained. All data is of course very important because the data will be processed into a report management that will be shown to the Board of Directors for decision making. Of course, besides that, there are still many reasons why corporate data is important and should not be lost. Therefore, to minimize the risk on every day at 20:00 pm employee data backed up to servers located on the server farm. In addition, also confirmed to the IT Support Person (ITSP) that the data in the back up no one is corrupted. In addition to backing up employee data to the server, the information technology division of PT Softex Indonesia purchased a backup server and placed it in a factory located in Sidoarjo Surabaya. The information technology division team of Sidoarjo will work together to maintain the servers that are there. Data server in the head office will be backed up to the server located in Sidoarjo. In addition to backing up data in accordance with the specified time, ITSP should also report back up results not corrupted per month as documentation for reports to the internal audit team.

2. System Documentation

Documentation of the system is essential to ensure application developers can see well and correctly the purpose of using certain functions created by the previous developer team. In addition, documentation can also be made as a means of liability if any time is required. Here is the system documentation:
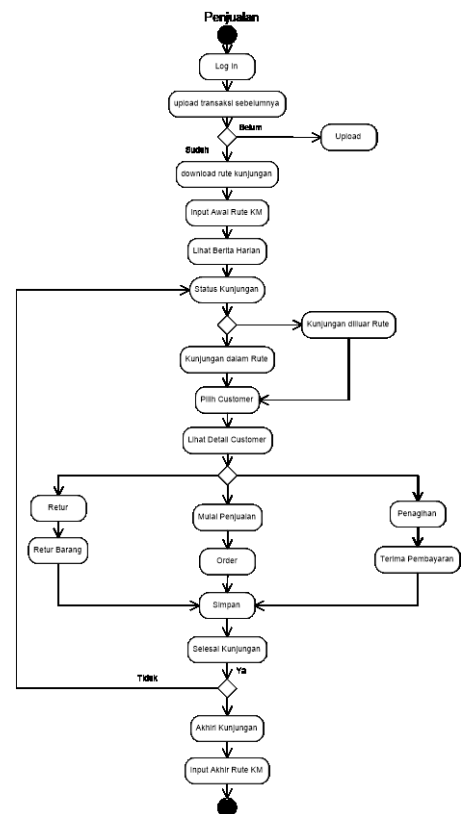

Figure 3. Documentation System

Everyday salesmen have to come to the distributor's place to get directions, and after getting directions the salesman will download the route through the internet connection provided by the distributor. When a salesman enters an SDS application, the system will read whether the salesman has uploaded the data stored in the application. If not, the salesman is required to upload while when it is uploaded then the salesman is allowed to download the trip route on the same day when downloading. After the download route is completed, the salesman will start his journey by entering the initial mile that is on the vehicle salesman speedometer. Furthermore, the salesman will go to the visit status page where the salesman can choose to visit the visits in route or out route. Visits in the route are visits to outlets that are required to be visited and excursions outside of the route are visits that are not required to be visited.

After logging in to the visits page in the route, it will allow the salesman to see which outlets to visit. After selecting one of the outlets you want to visit, the salesman will see the customer details containing information such as the last date of purchase, address, and credit limit. The salesman can do goods sales, return goods and billing. If all outlets have been visited then the salesman will end the route of the visit by entering the Final kilometer on the vehicle's speedometer.

3. Making Measurement Form Employee Concern for Quality Management

Figure 4. Measurement Form

In the measurement form of quality objectives, there are applications created and targets to be achieved in making the application. In addition, the achievement of the target application that is in the form of user login that comes in every day, the number of transactions on the application and also any report that can be presented in the application created must be filled percentage of the target, the steps taken to achieve the target and also the real achievement.

A quality goal measurement form should be created for each new app creation. With this form, it is expected that the quality of the application made by the information technology division of PT Softex Indonesia can be achieved well. With this form, then there is also the documentation that any application that made can be used well.

4. Making Human Resource Information System PT Softex Indonesia

To change the manual leave system or the usual manually made human resources will be made Human Resource Information System so that the filing of leave or illness can be through an automated system. Of course, this HRIS placement not only facilitates the filing of leave and sick but also transactions related to the human resource department. With this application is expected to transactions associated with the department of human resources is to be automated and easier because it can be accessed from anywhere and anytime. The following modules exist in the HRIS application:

4.1 Log In Module

To access this application, employees can first open the application and also log in by entering the username and password. Employee username in the form of employee identification number while the password is the date of birth of employee with YYYMMDD format. For new employees, must submit account creation to human resource department

4.2 Main Page Module

On the main page, employees can access the ESS (Employee Self Service) and MSS (Management Self

Service). Also on the main page, the user can change the password and log out of the application. On this main page, there is also some information that is related to company policy, HRIS policy, news about appeal, announcement, bulletin, and information about delayed activities to be completed.

4.3 Self Management Service Module

Management Self Service is a module that is used for the boss of certain employees to perform various approvals of requests from employees associated with employment of employees such as applying for leave, overtime, social benefits and so forth. In this module the boss has submenus are:

a. Workforce Administration

is a menu that is used to make promotional or mutation submissions, and also the submission of demand for labor needs.

b. People Development

is a menu used to evaluate employee appraisals and view the results of employee assessment history.

c. Approval

is a menu that is used to perform approval of leave, permits, and absenteeism. In addition, the boss may also approve the submission of promotions, mutations, and approval of labor requirements.

d. My Team

is a menu used to view data such as personal data, attendance data, attendance etc?

4.4 Employee Self Service Module

Employee Self Service is a module used to give employees access to update personal employee data, apply for leave, watch attendance data, view overtime data, view pay slips and apply for social benefits. In this module submenus are as follows:

a. Personal Data Change

is a menu used for employees to update personal employee data or complete personal data that has not been filled at the time of receipt of new employees.

b. Leave

is a menu that is used for employees to apply for leave and absent. In addition, employees can also see the rest of the leave and see the history of employee leave

c. Salary Slip

is a menu used for employees to see their own paychecks in the last few months. To view the paycheck, employees need a pin to be distributed by the human resource department to employees.

d. Attendance & Overtime

is a menu used for employees to view the attendance schedule, overtime schedule, and the accumulation of the number of absences.

e. Claim Social Allowance

is a menu used for employees to apply for their own social benefits.

V. CONCLUSION

ISO 9001: 2015 makes a tangible contribution to the company delivering customer satisfaction. After making the measurement, the findings are then given improvement recommendation. Implementation of the recommendations was made at the information technology department of PT Softex Indonesia. After implementing the improvement of information technology department ready to be re-measured with the same method that is ISO 9001: 2015.

VI. FUTURE RESEARCH

The information technology department at PT Softex Indonesia has been re-measured using the same measurement of ISO 9001: 2015. The re-measurement is done in order to know the value of the new capability.

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Preliminary Assessment of Telemedicine Systems using Virtual Testbed

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Abstract—**Telemedicine is the use of ICT (Information and Communication Technology) infrastructures to provide medical services. It is needed in Indonesia, particularly in remote areas where the number of medical facilities and specialist doctors are limited. BPPT has developed telemedicine systems which can provide tele-ECG, tele-USG, and tele-Consultation. Its feasibility requires some verification on its intended operations. This paper presents a virtual testbed for testing telemedicine systems, and shows some assessment results on their security and performance aspects.**

Index Terms— **digital signature, load testing, performance, securiy, telemedicine, virtualization**

I. INTRODUCTION

Telemedicine is a system which makes use of ICT (Information and Communication Technology) infrastructures to deliver health services, without physical constraints on distance and location. This is needed in Indonesia where the distribution of specialty doctors is not uniform, mostly concentrated in big cities, and some populations live in remote areas far away from state hospitals. Fig. 1 shows an example of health services which can be provided by implementing telemedicine. It can be seen that the system consists of three parts: 1) primary/community care where patients are treated and their bio-signals are recorded by primary care doctors; 2) central system or hospital where specialty doctors can remotely analyze patients' status and diagnose; 3) ICT infrastructures, namely, communication networks, data centers, and other computing resources needed.

In general, there are various medical instruments used to capture patients' bio-signals depending on their condition, e.g. ECG (Electrocardiography), USG (Ultrasonography), stethoscope, vital sign monitor, etc. Those instruments are then connected to an aggregator, as an interface to the ICT infrastructure, and the bio-signals measured can be stored locally or in remote servers using specified standard formats. In addition to sharing medical records which include patients' bio-signals, medical doctors participating in a telemedicine session need to interact to discuss patients' status and the necessary actions; thus, the system needs to provide teleconference for tele-

Consultation. Based on services currently in-demand, only tele-ECG, tele-USG, and tele-Consultation are considered, and they become focal-points to be explored in this paper.
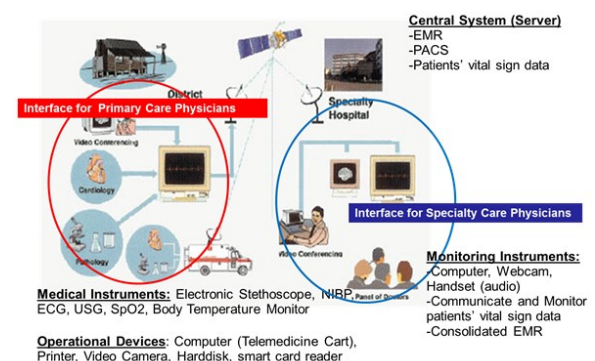

Fig. 1. Health services using telemedicine [1].

The successful implementation of telemedicine system depends on users' acceptance, where users may involve medical people, medical organizations, and patients. One aspect which drives acceptance is their experience in using this system, where it is known that users' experience depends on the level of quality offered by the system. However, providing a certain level of quality is challenging for telemedicine, due to non-uniformity regarding the parameter thresholds that contributes to the quality assessment [2]. Thus, the telemedicine services need to be classified before deriving each service's characteristics and its performance.

Telemedicine system relies on well-tested software, which ensures various aspects of usability, accessibility, security, and performance under various operational loads. Thus, appropriate software testing for verification and validation is needed to assess a telemedicine system. In this case, it involves observing the execution of the software on various subsets of all possible inputs and setting, and providing an evaluation of the output according to certain metrics [3]. Extensive software testing on real condition is time-consuming and expensive; thus, there needs to be an alternative environment where testing can be done

in an efficient, flexible, and automated way. This is the motivation of providing virtual testbed, which in essence a controlled and software-based infrastructure which mimics the real condition.

The use of virtual testbed is common for assessing various system performances, e.g. wireless testbed [4], web security assessment [5], SFU (Selective Forwarding Unit)-based video conference [6], video surveillance [7], etc., but there is lack of reported use in telemedicine. In comparison, some field-trials of telemedicine deployment for measuring users' acceptance are reported, e.g. recent experiments presented in [8]. This paper presents an initiative to develop a virtual testbed, i.e. a flexible, scalable, and user-controlled testing environment for telemedicine.

The rest of this paper is structured as follows. Section II provides a quick overview of the telemedicine system developed by PTE-BPPT. Section III describes the virtual testbed set-up that mimics the real telemedicine system. Experimental results conducted on virtual testbed, for validating some aspects of security and performance, are presented in section IV. Finally, this paper concludes with some insights and future work.

II. TELEMEDICINE SYSTEM

PTE-BPPT has developed a telemedicine system with its tele-ECG, tele-USG, and tele-Consultation services that are currently being trialed in Tangerang regency, South Tangerang city, and BPPT's own clinic. An overview of this telemedicine system is depicted in Fig. 2, where some blocks related to discussion in this paper are shown.
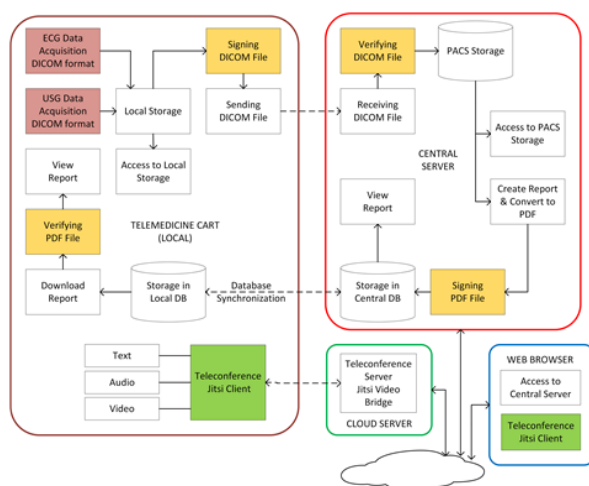

Fig. 2. Block diagram of a simplified PTE-BPPT's telemedicine system.

It can be inferred that there are three major parts in this system, i.e. 1) Telemedicine cart/workstation (local), 2) Central server, and 3) Remote users accessing the system via web browsers. Telemedicine cart/workstation is a device positioned at the patients'

site, and it functions as an aggregator to various medical devices that measure the patients' bio-signals. Fig. 2 shows blocks for ECG and USG data acquisition and storage inside telemedicine cart. Both ECG and USG data are stored in DICOM (Digital Imaging and Communications in Medicine) format, as waveform and image, and they are signed digitally by the doctor who measures them. Note that when network bandwidth and local storage are limited SCP-ECG (Standard Communication Protocol for Computer-Assisted Electrocardiography) format is the preferable option for ECG data.

The ECG and USG data are sent reliably to central server, and their validity is verified before being stored in the PACS (Picture Archiving and Communication System) storage. This central server can be implemented in the hospital's data centre or in the cloud, and becomes the target point for remote access, e.g. by the specialist doctor who will analyse patients' status in a tele-Consultation session. It can be seen that patients' report, which includes diagnose and recommended action, is stored in pdf format, signed digitally by the specialist doctor, and then disseminated back to the patients' site (local) via database synchronization. Applying digital signatures to data in DICOM format and medical records in pdf format for telemedicine system is discussed in [9].

In addition to dealing with medical data to support tele-ECG and tele-USG services, the system also provides multimedia communication facility for tele-Consultation. It is based on SFU (Selective Forwarding Unit) teleconference using Jitsi media server, which provides end-to-end communication supporting text, audio, video streams routed via Jitsi video bridge. The choice of media selected during tele-Consultation depends on the available network bandwidth.

It can be seen that users simply use web browser to use this telemedicine system as message interactions involved are based on web technology. This ensures flexibility in software development and inter-operability.

From discussion above, it can be seen that there are two kinds of network traffic that need attention, i.e. medical data traffic and multimedia (video, audio, text) traffic. Each of them requires different objective which may result in different transport protocol used. Medical data traffic requires reliability; hence TCP (Transmission Control Protocol) is used. On the other hand, multimedia communication (particularly video) prefers minimum delay; hence UDP (User Datagram Protocol) is preferred. How these traffic flows mixed in the network and behave will affect system performance, and it requires specific assessment before deployment.

The description above mostly involves software and network protocol, so that this telemedicine system

is suitable for a virtual testbed. Furthermore, detailed assessment on its function and performance can be done effectively in this environment.

III. VIRTUAL TESTBED

The design of telemedicine virtual testbed aims at creating a scalable testing environment, which can also be used for future development. The virtual testbed is essentially a software package which allows the deployment of some major parts of the system in a single computer (or a cluster) using some virtual machines and a virtual network. In this work, the virtual testbed has been developed in one Dell PowerEdge R920 server, equipped with 1.8 TB virtual disks data with 2x10 core CPU and 8x16 GB memory. This server supports up to 10 NIC cards. The virtualization layer was created by VMWare ESXi 6.7 and it is horizontally scalable, i.e. it can support many hosts with additional vCenter management platform.

As discussed in the previous section, there are three major roles in the developed telemedicine system: 1) telemedicine cart/workstation, 2) telemedicine central server which provides PACS services, and 3) teleconference server. Each role has a specification in virtual domain as shown in Table 1.

TABLE I. ROLES IN TELEMEDICINE SYSTEM AND THEIR SPECIFICATION.

Telemedicine Cart	
CPU	4 x 2 core CPU
Memory	8 GB
Hard disk	466 GB
NIC	2 NIC (connect to private switch)
Telemedicine Central Server	
CPU	4 x 2 core CPU
Memory	8 GB
Hard disk	279 GB
NIC	1 NIC (connect to public switch)
Teleconference Server	
CPU	2 x 1 core CPU
Memory	2 GB
Hard disk	30 GB
NIC	1 NIC (connect to public network)

The virtualized system was converted from the real system by using p2v (physical to virtual) technology from VMWare vCenter Converter Standalone version 6.2. This software supports the operating systems used in PTE-BPPT's telemedicine system, i.e. Windows 10 for telemedicine cart and Ubuntu 16.0 for telemedicine server. Both of them were virtualized by a hot-clone method, i.e. the target machine was in online mode (power on) [10]. The teleconference server, used in

tele-Consultation, is hosted in BPPT's cloud, and can be accessed from the other virtual machines via BPPT's local area network.

Fig. 3 describes the virtual testbed configuration. One component inside the telemedicine virtual infrastructure needs further attention, i.e. Mikrotik virtual appliance. This virtual appliance acts as a router which connects the telemedicine cart's network to other networks managing telemedicine central server and teleconference server. This router will play the role in managing allocated bandwidth, ingress and egress telemedicine cart's network. In essence, this provides the model for various access problems at patients' site, which may have limited connectivity. During system testing, bottlenecking bandwidth can be applied to assess its impact on the performance.
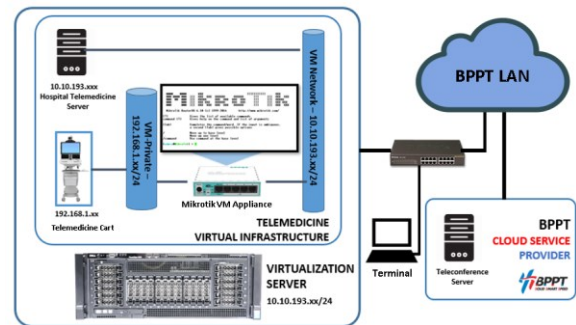

Fig. 3. Virtual testbed configuration.

There are various software functionalities involved in the telemedicine system, and they are also functional inside virtual testbed. However, discussion in this paper only relates to two functionalities: transmission and security. For transmission, scp (secure copy) tool (using TCP) is used to send ECG and USG data reliably from telemedicine cart to telemedicine central server, whereas video transmission relies on Jitsi's WebRTC messages (using UDP). For security, focusing only on validating data, the system utilizes dcmsign version 3.6.3 as a module to sign DICOM (EKG and USG) files with digital signatures [9].

IV. EXPERIMENTS

Two kinds of experiments were conducted with focus on security and performance aspects. Each experiment requires specific requirements and analysis, thus it is described separately as follows.

A. Security Validation

Medical data needs a system that can ensure three targets of security: confidentiality, integrity, and availability. This paper only discusses one of them, i.e. the use of digital signature to ensure data integrity. In this experiment, the integrity target concerning ECG and USG data in DICOM format was tested. The

system must ensure those data that are transported via network are valid.

The system relies on some security validation modules; and in this case the focus in on signing and verification modules. These modules rely on DCMTK (DICOM toolkit), an open-source software package that implements large parts of DICOM standard. This package is integrated into the system, which involves various software integration and automated scripts. The signing module is installed on telemedicine cart and the verification module is installed on telemedicine server. All transaction processes related to signing and verification are recorded in the logging systems using text format.

The signing module calls the dcmsign function that creates a digital signature inside the DICOM file. Dcmsign adds (FFFA, FFFA) tagging from DICOM data dictionary comprising a digital signature sequence and its attributes needed for DICOM files' digital signature. The signing module is constructed by three classes: signing DICOM, creating transaction log, and sending DICOM file to the telemedicine server. The DICOM file will be signed by the doctor's digital certificate at patients' site (e.g. at local health center) and every signing process will be recorded in a transaction log. The transaction log records signing results, either "success" or "failed", and it is based on the dcmsign's OFLOG documentation. Fig. 4 shows a snapshot of signing DICOM class diagram.
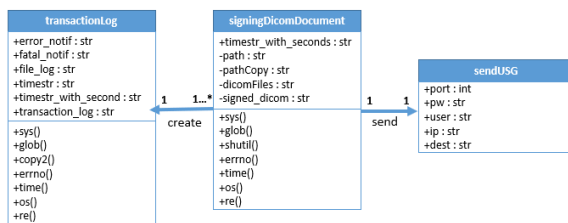

Fig. 4. Signing DICOM class diagram.

In the telemedicine server, DICOM files are validated before being uploaded to the PACS server. The verification module uses the same tool as the one in the signing module, but it was compiled in Linux environment, considering the telemedicine server uses Ubuntu 16.04. The module calls dcmsign function to verify the digital signature and records the validation results. Fig. 5 shows a snapshot of verifying DICOM class diagram.
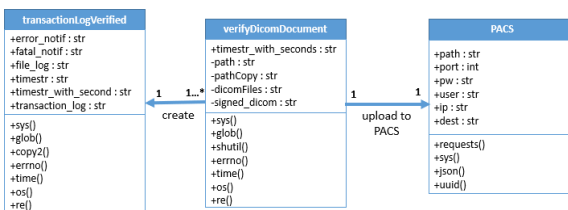

Fig. 5. Verifying DICOM class diagram.

To simulate a situation where data integrity is violated, the testing scenario involves modifying DICOM data and verifying them. In this experiment, the modification was carried out by changing DICOM tagging using dcmodify; e.g. modifying the patient's name by changing DICOM tagging (0010,0010). The modified DICOM was re-verified by the verification module in the telemedicine server. All activities were recorded in the transaction log to see whether the verification processes succeed or not. The files with "success" status were uploaded to the PACS server and the files with "failed" status were transferred to the archived folder in the server. This mechanism facilitates future investigation. Fig. 6 shows an example of USG file (created in October 23th 2019) that was successfully uploaded to the PACS server.

Fig. 6. USG file in PACS server.

Fig. 6 shows the file that was signed in October 29th 2019 with Digital Signature UID: 1.2.276.0.7230 010 .3.1.4.675205373.13308.1572333577.436. This file was then modified and re-verified using the verification module. To cross-check whether the file was already changed or not, viewing DICOM file was needed. In this experiment, MicroDicom viewer was used, and Fig. 7 shows an example of the modified USG DICOM file, where the patient's name was changed to "Changed Name to John Doe". The "failed" status can be seen from the transaction log shown in Fig. 8.
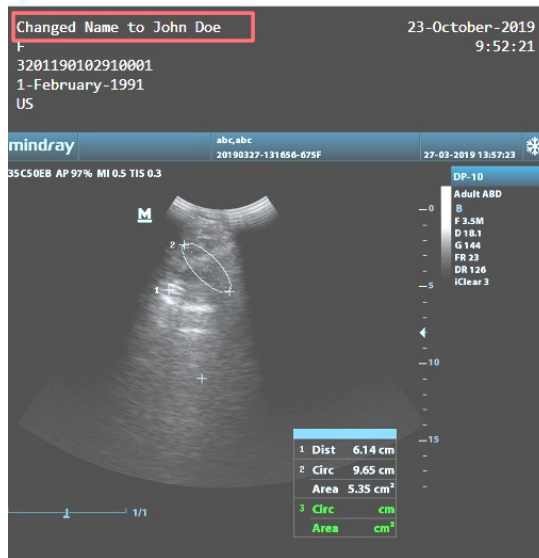
Fig. 7. Patient's attributes after modification.

Fig. 8. Transaction log.

B. Performance Tests

Lack of network qualities may impact telemedicine services severely. It is usually assumed that network infrastructures in remote areas contribute to the problems. This is represented by the network connecting the three major components, i.e. telemedicine cart, telemedicine central server, and teleconference server. Thus, the virtual testbed is set-up so that there is a user-controlled network connecting these three components. From Fig. 3, the user-controlled network is modeled by Mikrotik VM appliance whose bandwidth can be varied with a simple queue technique. This is referred to as bottleneck bandwidth.

In this experiment, the bottleneck bandwidth was varied from 64, 128, 256, 512, till 1024 Kbps. Each instance of bottleneck bandwidth was the basis for performance measures. The focus was on measuring transmission latency and achievable throughput (used bandwidth) for sending medical data. Source data used were the ECG and USG DICOM files whose sizes are around 140 Kb and 1.4 Mb respectively. Fig. 9 shows visualization of these ECG and USG data used in this experiment.
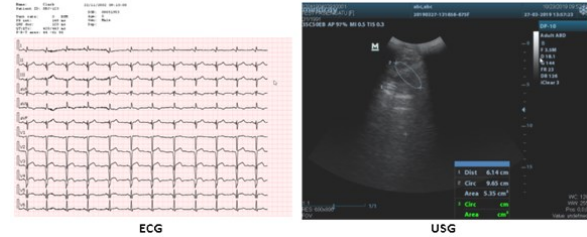

Fig. 9. ECG and USG data used.

Medical data transmission was conducted periodically for the duration of each measurement. This represents a worst-case scenario, as typically only one transmission is needed for each session. Other transmissions may include video streams, by playing a video file containing two people's conversation. This represents a video session in tele-Consultation. For each instance of measurement, the same video stream was required, and this was achieved by playing the same video file utilizing fake-media feature of WebRTC and Jitsi media server [6]. The fake-media is in y4m format, and mainly used as a substitute to webcam. This teleconference is considered a modern SFU (Selective Forwarding Unit) teleconference technique, with features such as scalable video coding, efficient video stream forwarding based on audio activities, and effective used of computing resources [11].

The performance tests were conducted in 4 different scenarios: "ECG", "ECG and Video", "USG", and "USG and Video". Each of them represents tele-ECG only, tele-ECG with tele-Consultation, tele-USG only, and tele-USG with tele-Consultation. How bottleneck bandwidth and mixed traffic affects the performance of medical data transmission is the current research interest. Thus, the measurement objectives were their transmission latencies and achievable throughputs, and the results are shown in Fig. 10 and Fig. 11.
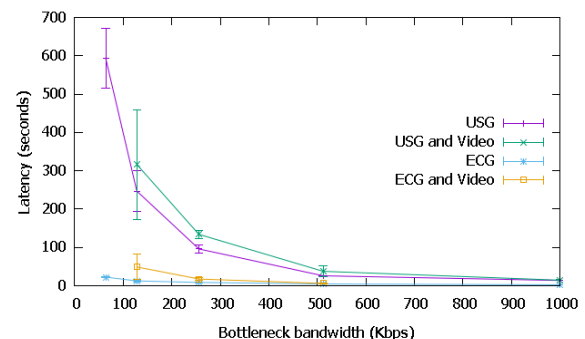

Fig. 10. Transmission latency.

From Fig. 10, it can be seen that for bottleneck bandwidths above 512 Kbps all latencies are acceptable as they are mostly below 30 seconds (0.5 minutes). However, they are worse-off sharply for lower bandwidths. More latencies and higher variabilities are observed for scenarios which include video transmission. This shows "UDP dominance" and

"TCP starvation" phenomenon, where UDP traffic (video) competes with TCP traffic (medical data) in using network bandwidth. In this case, UDP traffic dominates, and TCP traffic needs to back-off. TCP traffic is reliable as long as the communication path is still connected, and if there are losses it requires retransmission to ensure the data reach destination correctly. This increases latency, and worse-off for lower bottleneck bandwidths.

From Fig. 10, it can be seen that tele-ECG is still acceptable for lower end of bottleneck bandwidths, with latency around 22 seconds at 64 Kbps bandwidth. However, since video transmission alone normally requires 256 Kbps bandwidth, then tele-ECG with tele-Consultation is recommended for bandwidth above 256 Kbps. For bandwidth below 256 Kbps, tele-Consultation should fallback to audio or text-based communication.

It can be seen that tele-USG might still be acceptable for 256 Kbps bandwidth, with latency around 96 seconds (1.6 minutes). At 64 Kbps and 128 Kbps bandwidth, the latencies are too high, i.e. around 600 seconds (10 minutes) and 240 seconds (4 minutes). They may be considered for offline mode version of tele-USG, i.e. the doctors are not waiting for USG data to arrive while communicating using audio or text. Tele-USG with tele-Consultation is recommended for bandwidth above 512 Kbps.
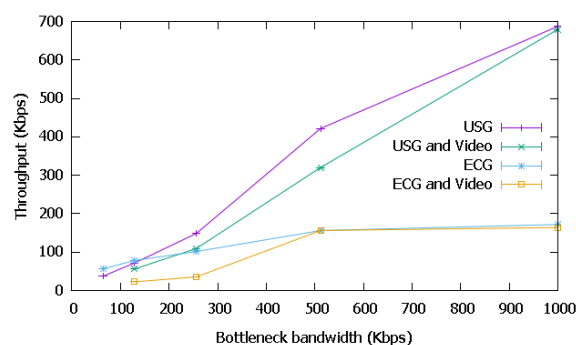

Fig. 11. Achievable throughput (used bandwidh).

Traffic behavior from the four scenarios can be further inferred from Fig. 11. It can be seen that higher latencies correspond to lower achievable throughputs, and in mixed traffic scenarios ECG and USG traffic lost some of their throughputs due to dominating video traffic.

V. CONCLUSION

This paper has presented a virtual testbed which can be used as a model for telemedicine services. Some experiments were conducted to verify the validity of medical records' transmission and to assess the expected performance related to tele-ECG, tele-USG, and tele-Consultation. It is shown that digital signing-related modules work well, and experiment

results provide some insights on the required network bandwidth.

This virtual testbed provides a scalable and controlled environment for extensive testing, and to verify the telemedicine system's effectiveness and robustness prior to deployment.

ACKNOWLEDGMENT

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E-commerce Design Interaction with Voice User Interface using User-centered Design Approach

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Abstract—**The rapid expansion of e-commerce has encouraged many platforms to serve their consumers better, including by providing state-of-the-art user interaction. Voice user interface is integrated in the e-commerce in order to allow users doing multitask while having handful activities and simplify features whose discoverability is low. The interface is designed using user-centered design approach, specifically ISO 9241-210:2010 methodology. In addition, the interface is verified by usability testing conducted in three iterations for two personas. Verification process of the design shows that high-fidelity prototype is 83.0% helpful and 70.0% effective.**

Index Terms—e-commerce, human computer interaction, speech recognition, speech synthesis, voice user interaction

I. INTRODUCTION

Total e-commerce transaction in Indonesia is predicted to increase eight times from 2017 to 2022 [1]. In worldwide, the pervasiveness of e-commerce has driven Amazon and Google to integrate voice user interface in their e-commerce platform. The purpose of the research to identify a desired voice user interface for e-commerce in Indonesia.

There are several reasons why people are using voice user interface in online buying, such as busy hands, mistyping, and feature discoverability issues [2]. At a glance, research methodology conducted by the authors includes validating problem, designing, and testing. Those three processes are repeated throughout three iterations.

Based on questionnaire spread across 116 respondents in Indonesia, there are two types of e-commerce users, i.e. elder and youth group. The elder group is dominated by the age of 36-45 years old while the youth group is dominated by the age of 21-35 years old. These two groups are facing different kind of problem sets.

For elder group, the use cases are they want to input words into textbox easily and find some hidden features faster. In this research, elder group tends to have more mistyping words than youth group and therefore they want to be able to input the correct words faster. In addition, elder group also finds it painful to find several hidden features like track order, give review, and chat with seller. Whereas, in youth group, users tend to have online shopping while doing another handful activity, which is renown as multitasking. As a result, design process is aimed to answer problems from both elder and youth group by identifying the correct voice user interface in e-commerce.

II. DESIGN CONCEPT

Design approach used for the interface is user-centered design (UCD), instead of activity-centered, system, or genius design. Among other three approaches, UCD has the closest relation with users; therefore, this approach is considered as the most relevant approach for this use-case [3]. When implementing design with UCD, there are several methodologies that can be used, e.g. ISO 9241-210:2010, Albani-Lombardi, and Lowdermilk. ISO methodology is chosen as it is one of the most standard methodology used widely [4]. The methodology consists of planning, analyzing scope of work, analyzing users' needs, designing, and evaluating.
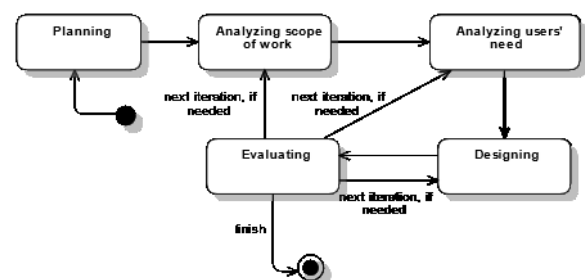

Fig 1. ISO 9241-210:2010

As seen in Fig 1, design process at least includes five main stages. As a result of evaluating stage, there will be several comments based on users' feedbacks. Feedbacks can later be categorized into three types of negative findings, i.e. minor, serious, and catastrophic. Serious and catastrophic negative

findings are then analyzed to improve prototype in the next iteration.

III. DESIGN IMPLEMENTATION

Design process took three iterations. In first iteration, the main goal is to acquire functionality and its corresponding command. In second iteration, the main goal is to design and test helpfulness of the prototype. In third iteration, the main goal is to design and test effectiveness of the prototype. Second and third iteration are done by following interaction design guidelines [5].

A. First Iteration: Functionality and Command

Methodology used in first iteration is questionnaire and interview. Questionnaire is conducted to gather functionalities to solve pain points, which are busy hands, mistyping, and low level of feature discoverability. There are seven identified functionalities which are closely related to those pain points, i.e. search product, hear review, chat seller, add to cart, make order, track order, and give review. Meanwhile, interview is conducted to acquire as many choices of word as possible for each functionality. From the list of words, the majority words are chosen to represent each command as below.

TABLE I.   CHOICE OF WORDS FOR MAIN FUNCTIONALITIES

Functionality	Command
Search product	search [product's name]
Hear review	[hear/play/start] review
Chat seller	chat seller
Add to cart	add to [cart/trolley]
Make order	[checkout/proceed/next]
Track order	track [order/status]
Give review	submit review

B. Second Iteration: Helpfulness

After the functionalities and commands are gathered, design process is started. Design process in the second iteration starts from searching functionality. Searching can be done through typing a product's name to search bar or tapping microphone icon on the right side of search bar. Microphone icon is used to insert product with a long name. By saying the words rather than typing down, user can input the words faster. There is no difference between the search result from standard graphical user interface and this voice user interface. Else than tapping the microphone icon, user can also say keyword 'search', followed by product's name, in every page to let user search a product.
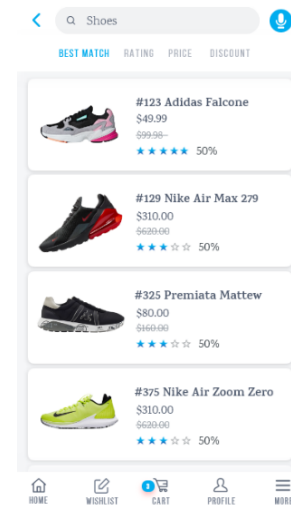
Fig 2. Search product

After search product, design process continues to give and hear review. Users who can give review are those who already have bought the product. The same design concept is taken from search product. Users can type down their reviews by tapping the text field. Another way, users can also tap a microphone icon in the right side of text field to say their reviews instead of type it down. Review itself consists of comment and rating. Initially, users give their comments, then system asks user to give the rating. After that, user can say the command 'submit review' to send their review about the product.

Reviews about product are presented in reviews tab. Not only rating and comments exist, but only a playback button. The button is used by other users to hear the previously recorded review. As a result, review becomes more real since users can also hear intonation during the recording.

Fig 3. Give & hear review

After give and hear review, design process continues to chat seller that can be seen in the Fig 4 below. Design concept used is similar to give review. Users can type down or say the words. There are also two option users can pick to get them into the chatroom, first by tapping the chat seller button in the

product detail or say the command 'chat seller' in the product detail page as well.

Fig 4. Chat seller

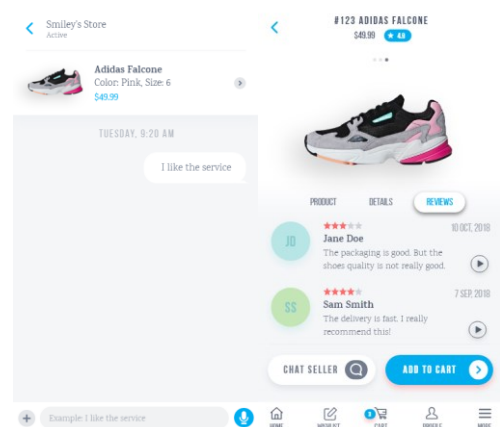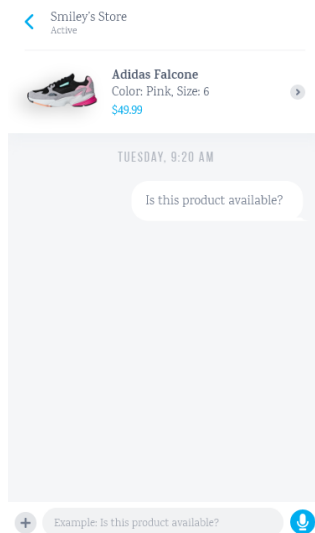After chat seller, design process continues to add to cart and make order. There are two options for users to find add to cart page, first by tapping add to cart button from product detail page, second by saying the command 'add to cart' in product detail page. In add to cart page, users can adjust the quantity of the product by saying 'minus' to decrease the number, and 'add' to increase the number.

From add to cart page, users can go to make order page. There are also two options for users to reach the page, first by tapping checkout button from add to cart page, second by saying the command 'checkout' in add to cart page. In make order page, users can change their payment methods either by tapping or saying 'change payment method' followed by saying their desired payment method. To finally make order, users can tap make order button or say 'make order'.
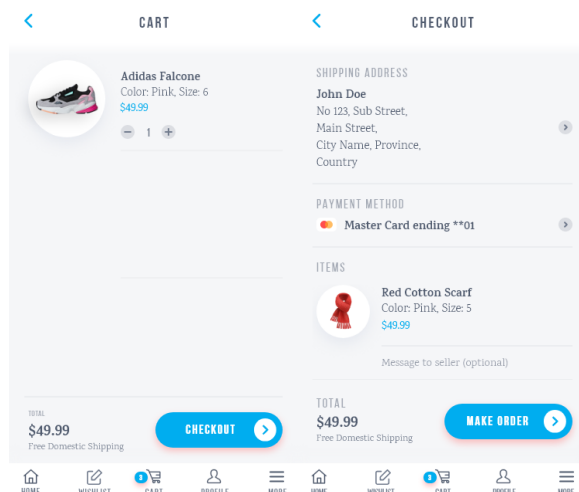
Fig 5. Add to cart & make order

After the add to cart and make order, design process continues to track order. The easiest way for

users to get into the tracking page is by saying the command 'track order' from any other pages. If there is only one tracking status, then system directly shows the page. However, if there are more than one tracking status, system will show all tracking status and let users say their desired tracking status.
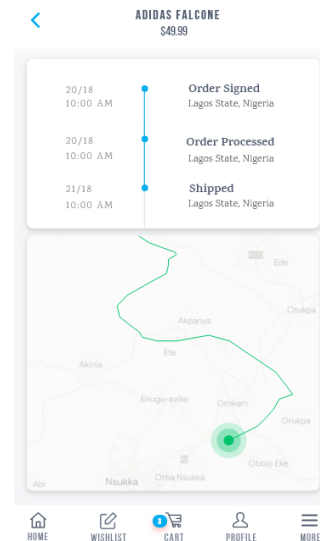
Fig 6. Track order

C. Third Iteration: Effectiveness

After helpfulness has been achieved in the second iteration, there is a need to make sure that this voice user interface effective to use. Therefore, there are three supporting functionalities, i.e. onboarding session, help page, and error message. Each supporting functionality is explained as below.
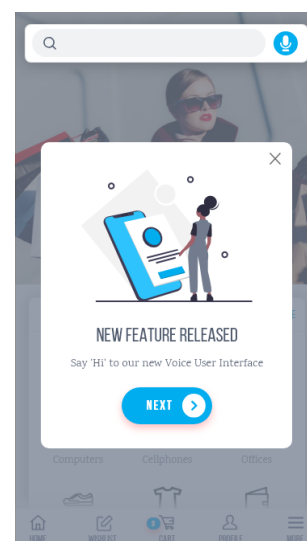
Fig 7. Onboarding Session

Fig 7 above shows onboarding session. This session is only shown once to all users. The onboarding session contains steps to highly important information, i.e. where to activate microphone and where to access help page. The onboarding session

drives users to do those actions. As a result, users are encouraged to get into the help page where information about all commands are located as shown
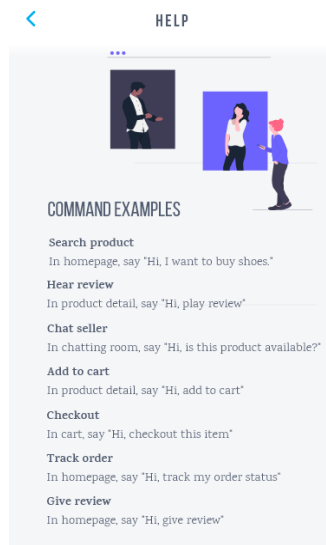
below in Fig 8.

Fig 8. Help page

Other than help page, there is also a helping page to direct users saying the right command, i.e. error message. This error message is highly customized depending on users' active page. The command suggestion is related to users' current page in order to bring users to the most relevant page.
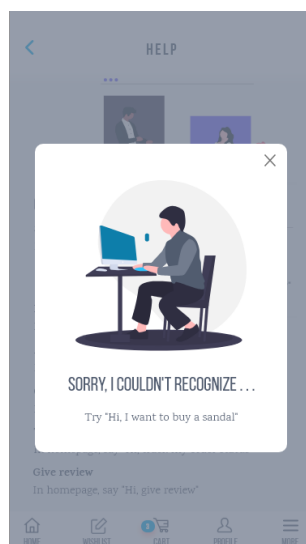
Fig 9. Error message

IV.   VERIFICATION OF DESIGN GOAL

The design goal is divided into two types of goal, usability and user experience goal [6]. For usability goal, Single Easy Question (SEQ) is used to calculate the score of effectiveness. For user experience goal, System Usability Scale (SUS) is used to calculate the score of helpfulness. These SEQ and SUS are

evaluated during first, second, and third iteration. However, in first and second iteration, SEQ and SUS responses are gathered from each persona. Whereas, in third iteration, SEQ and SUS are taken from five respondents regardless their persona, since the focus in third iteration is to evaluate only supporting functionalities that interact the same way with both personas. Therefore, the final score is taken from the second iteration, as third iteration's focus is mainly about supporting functionalities, instead of the main functionalities. Final score for SUS is 83.0% helpful and for SEQ is 73.0% effective, as shown in the diagrams below.
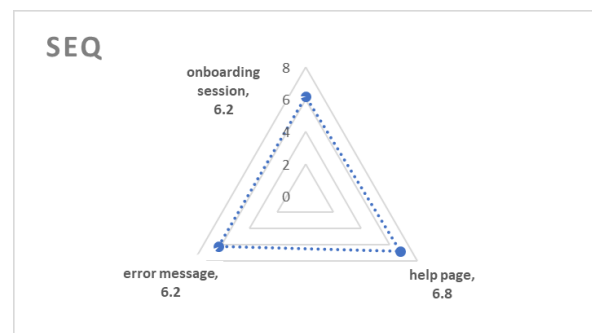
Fig 10. Average SEQ score
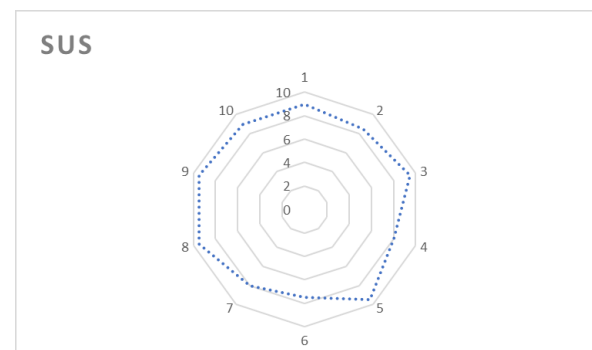
Fig 11. Average SUS score

V.   CONCLUSION

Voice user interface for e-commerce in Indonesia is desirable with effectiveness as its usability goal and helpful as its user experience goal. The desired interface consists of seven main functionalities, which are search product, hear review, chat seller, add to cart, make order, track order, and give review. In addition, it also covers three supporting functionalities, which are help page, error message, and onboarding session.

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E-Government Integration of Sidoarjo Regency using Service Oriented Architecture (SOA)

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Abstract— the slow process of government services is a major problem of current government service systems (e-government). This is due to the lack of integration between e-government systems with regional governments. The application of data integration can accelerate the process of interaction and communication between agencies in the regional government. This study aims to develop an integrated e-government from various services that exist in government services in Sidoarjo Regency. The architecture used in developing this integration is using the Service Oriented Architecture (SOA). In the e-government development process has 3 main stages, namely: database creation, service creation, and service implementation on the frontend. The results of this study are in the form of conclusions on the architectural capabilities used in e-government integration accompanied by the speed of services produced.

Keywords— *E-government, Integration, Service Oriented Architecture (SOA).*

I. INTRODUCTION

The development of Information and Communication Technology (ICT) changes human life. This development changed the relationship between human relations, business, and changed relations between government and society. Rapid information needs make the government need to develop information technology. Like providing the best service for the community, internal government,

partner government, and entity government. This service is commonly called E-Government.

According to the Ministry of Communication and Information, E-Government is an internet-based application of information technology and other devices managed by the government for the purpose of delivering information from the government to the public, business partners, and other institutions online [1]. E-Government Needs in Indonesia have become very important since the issuance of Presidential Instruction No. 3/2003 concerning National E-Government Development Policy and Strategy [2], which requires every regional region, institutions, government agencies, etc. to take advantage of the rapid advances in communication and information technology. For the sake of achieving efficiency, effectiveness, transparency and accountability in the administration of the government as well as the opening of opportunities for accessing, managing and utilizing information in large volumes quickly and accurately.

At present the development of E-Government in Indonesia is not yet maximal. Based on the 2016 survey, the United Nations (UN) published that Indonesia received a rating of 116 E-Government Development Index (EGDI) [3]. This is proven by 85% of the number of E-Government websites in Indonesia that can be accessed. While other websites are still inaccessible due to several factors, such as being repaired, server errors, failing to connect to the database, etc. And there are still many E-Government in Indonesia that have not implemented the Integration

System between services. Which results in a lack of effectiveness and efficiency of E-Government services.

Many regions in Indonesia have not implemented E-Government Integration, one of which is E-Government in Sidoarjo Regency. In Sidoarjo Regency in almost every service provides its own E-Government services. However, due to the absence of an integration system between E-Government services, the service process for both cross-official transactions and communication still uses manual methods so that it is less effective and efficient in terms of speed and accuracy.

Therefore E-Government in Sidoarjo Regency needs an integrated system to overcome these problems. With this system, it is expected that services in the government sector can run more effectively and efficiently. So that it can increase community satisfaction with government performance.

Based on the above background, the problems that can be formulated in this paper are as follows:

a. There is duplication of data on the E-Government server in Sidoarjo Regency which causes data swelling and depletion of storage space. Data duplication occurs because there are several tables with the same field between one application with another application.

b. The existence of data that is not synchronized between one service with another service due to user input errors. Because there is still a large amount of data that is not yet integrated, input data from users can result in differences when inputting to different applications that should have entered the same data.

c. Service in a government system that still requires a long time. This is because some government services must interact with several other agencies, and the interested community must go to the service.

II. ORIGINALITY

The purpose of this paper is that researchers will develop an integration system that is implemented in E-Government, Sidoarjo Regency using service oriented architecture (SOA). Where this integration system will connect various E-Government to different government agencies. So that later can accelerate and simplify the process of transaction and data communication as a form of service to the community. In addition, the aim of this paper is to utilize technological advances in the field of ICT with maximum management. With the aim of producing a service that is beneficial to the government and the people of Sidoarjo Regency.

III. RELATED WORK

As'ad [4] explained that integration between services is one of the most important problems affecting E-Government implementation throughout the world. Providing integrated services for citizens, businesses, and stakeholders involved in E-Government on a 'one stop portal' is considered a great opportunity for the government to improve the efficiency and effectiveness of their services. Successful E-Government is based on two factors. First is the availability of E-Government websites and services that are available not only during government working hours. The second is accessibility, which means that E-Government sites and services must be accessible to users everywhere. Dennis. et al. [5] explain to the government that there is a spread of data and information at each unit of the managing agency and the organizing agency of the activity. So with such cases there is data redundancy and difficulties in accessing data from one another. The uncoordinated data source is one of the problems that can be solved by using systems development that is integrated with e-Government. Data integration can only be carried out in certain physical scope, for example: the availability of a database management system, applications and databases connected to a computer network. Kayode, Ajibade Ibrahim [6]. Service Oriented Architecture (SOA) can radically change the order of application integration. Visibility, interaction, and effectiveness are the main concepts of implementing SOA. Besides that, SOA has gained high popularity in recent years because of its functions and services that make it possible to improve and expand existing software applications. In this paper it aims to integrate pharmaceutical information systems based on the concept of SOA with website services through a central service bus. The system from the database from the drug store will be integrated through the service bus so that the drug can be easily searched and the results will be displayed based on availability. From this paper the researcher concludes that SOA is very suitable for integrating software services in order to add effective and efficient software that is built. Hai, Henry. Et al [7]. The use of the Software as a Service (SaaS) application by the company is considered to be less than optimal.

Because companies require to buy and deploy infrastructure, paying for expensive resources for customization, upgrading and ongoing maintenance. Many find that SaaS applications require little or no infrastructure and maintenance, can be used quickly and have a cost model that can be predicted to have less risk and a faster return on investment. New demand has driven rapid innovation in SaaS applications, SaaS platforms, and SaaS integration tools. However, the company still has the burden of integrating this application with the back-office system and applications at their location. Complex corporate integration requirements even challenge the current best SaaS solution provider; there are still limitations and pitfalls to watch out for. In this paper the researchers describe some of the best practices of SaaS integration, present case studies, and highlight emerging integration technologies that can help ease the burden of integrated SaaS applications themselves. Sutanta, Edhy. Mustofa, Khabib [8]. In this paper, it is explained how the implementation of Service Oriented Architecture (SOA) in Bantul Regency. Besides also discussing in detail about web services and how the concept of E-government. The developed web service has three main components. First the provider that provides information and data. Both agents / brokers who build web services. Third is the requester that can use the services of the provider. One example of a case of web service needs in Bantul district government is synchronization and exchange of data between information systems. For example, MIS (Management Information System) Monograph online which requires population data. To meet the data requirements online SIM Monographs need to access the resident master data where these needs can be met by creating a web service. The design of web services between different systems is also explained in this paper in detail with clear images.

IV. System Design

The following in Figure 1 below is an ongoing paper system design. Starting from the process of creating a database, creating a web service and finally using the web service into the interface.
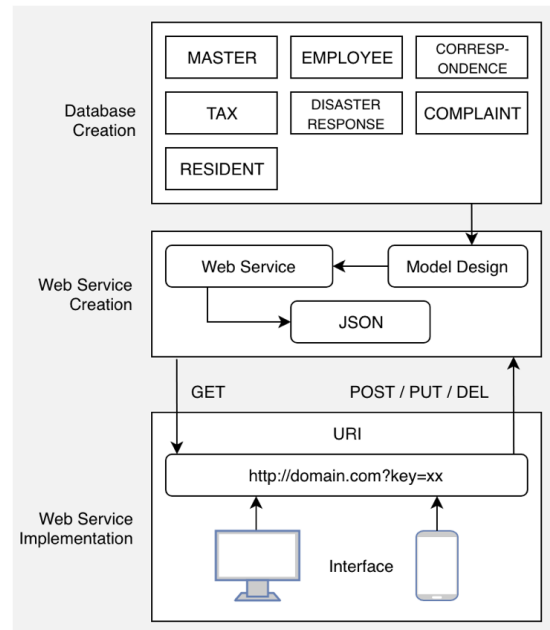
Figure 1. System Design

Making Web Services uses the Service Oriented Architecture (SOA). Namely by making service packages in the form of small units that can be developed continuously. This SOA will also be able to integrate between various other package services that have been made.

The first step to build this paper is to create a database. The researcher uses a MySQL database, because the database is a free-to-use database, and facilitates effective database management by connecting it to the database. By migrating current database applications to MySQL, many companies enjoy significant cost savings on new projects. Dependency and ease of management can save time solving problems that are wasted in fixing downtime problems and performance problems.

The second step is making a web service. At this stage, there are two stages, namely making a model design and making the web service itself. Next from the web service produces output in the form of JSON data (JavaScript Object Notation). The following is an explanation of these stages:

a) Model Design

Model design aims to represent a database in the form of code. The model built functions to connect the database with the web service for interaction in processing data.

The attributes contained in the model are almost the same as the attributes in the table, but are more specific. Figure 2 is an example of a code model that represents a table. In this paper

the researcher used the squelize library to simplify the modeling.

```
'use strict';
module.exports = (sequelize, DataTypes) => {
    const epbb = sequelize.define('epbb', {
        nik: {
            allowNull: false,
            type: DataTypes.STRING,
            validate: {
                notEmpty: true,
            }
        },
        total: {
            allowNull: false,
            type: DataTypes.STRING,
            validate: {
                notEmpty: true,
            }
        },
        jatuh_tempo: {
            allowNull: true,
            type: DataTypes.DATE,
            validate: {
                notEmpty: false,
            }
        },
```

Figure 2. Model Design in Code

From the example code above, it is initialized that the table name is *epbb*, from the *epbb* table containing the *nik* field, total and maturity. Each field has its own attributes. For example, *nik* has an allowNull attribute that is false, meaning that the *nik* field cannot be empty (must be filled). This *nik* field has a string data type or if the database is commonly called varchar. Then for validation it contains notEmpty value true, meaning that if the data entered in the *nik* field is empty then the model will automatically provide a feedback error on the service associated with the table.

For functions that support modeling, it usually depends on the library used. So it needs to be adjusted to the need for the application service creation process.

b) Web Service

After making a model the next step is to enter the core of making a web service. web service is usually called REST (REpresentational State Transfer), which is a web-based communication architecture standard that is often applied in developing web-based services. Generally using HTTP (Hypertext Transfer Protocol) as a protocol for data communication.

In the REST architecture, the REST server provides resources (data / resources) and the REST client accesses and displays these resources for future use. Each resource is identified by URIs (Universal Resource Identifiers) or global ID. The resource is represented in the form of text format, JSON or XML. Generally the format uses JSON and XML.

In this study there are several services built in the form of web services. The following is a service that will be built:

1) Correspondence

Correspondence is an application used for making correspondence, such as the making of Individual Domicile Letters, Business Domicile Letters, Hospitality Permit, Village Certificate, Poor Certificate, Cover Letter, etc.

2) Population administration information system

Population Administration Information System, to organize the system of population administration in Indonesia, this system includes population data collection and civil census. Population data include: Population Registration Number (NIK), Family Card (KK), Resident Identity Card (KTP), Birth Certificate, Death Certificate, etc.

3) Taxation

Used to see a list of taxes and tax liabilities. The following is the result of checking a tax from someone by entering a Population Registration Number) which later can display the amount of tax this year and tax history in previous years.

4) Community Complaint Service Center services to accommodate the aspirations of the Sidoarjo people which in real time will be emailed to each member of the Regional Representative Council of Sidoarjo Regency.

5) Disaster Response

Application of information systems about natural disasters and reports of natural disasters. In this waiter the public can send information related to the disaster that is happening through the website or mobile. This service is equipped with a google map platform to make it easier for people to determine the location of a disaster.

6) Employee Management Information System Service data center (data center) staffing in the Sidoarjo Regency Government that provides information about staffing.

Currently there are thousands of employee data recorded in the database.

In making a web service, must initialize how to process it. There are several methods for processing web services, namely, GET, POST, PUT / PATCH. GET functions to retrieve data, POST functions to add data and PUT to change data.

c) JSON (JavaScript Object Notation)

The output of a web service is in the form of JSON (JavaScript Object Notation) as a form of representation of the REST itself like Figure 3. JSON has a basic component, among others :

a) Objects: Objects begins and ends with curly braces ({}).
b) Object Member: Consists of strings and separated by commas (,).
c) Arrays: Arrays begin and end with square brackets ([]) and contain different values.
d) Values: Values can be string, object, array, or literal.
e) Strings: The string is surrounded by double quotes ("") and contains a colon Unicode (:). Members are separated by commas (,). Values separated by commas (,).

```
{
    "code": 200,
    "status": "success",
    "message": "Data User Found!",
    "data": {
        "name": "Adi Putra Utama",
        "gender": "Male",
        "address": "Kep"
    }
}
```

Figure 3. JSON Syntax

The final step is the implementation of web services to the user interface such as the web or mobile app. To implement a web service must go through the mechanism of using URI syntax (Uniform Resource Indentifier). The following is an explanation of the URI and the user interface that will be built.

a) URI (Uniform Resource Indentifier)

URI is a character that identifies web resources by name, location or both. In this case the resource in question is a web service. The URI has several components, namely: schema, autority (user, host, port, path), query, fragment information [9].

The following in Figure 4 is an example of URI syntax in the use of a web service that serves to retrieve population data based on unique number.
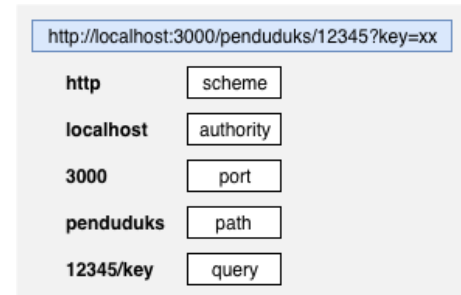

Figure 4. URI Syntax

Each URI starts with a scheme to assign identification to the character. There are many types of schemes that are very familiar, such as http, https, ftp, sftp, etc. Then for authority use localhost. This authority functions as the authority for naming URIs. Port section has a value of 3000 which is a subcomponent of authority. Usually by default the http scheme has port 80. For the path named inhabit according to the data to be retrieved through the syntax. While for parameters valued at 12345 which is the number of population data and added key as verification or permission to access the web service.

To facilitate the implementation of the web service or the use of a web service the researcher provides documentation that is complete and ready to use as an example in the Figure below which is a documentation of the use of the login function, namely by using the POST method accompanied by a body username and password.

b) User Interface

E-government will be developed in two interface platforms (user interfaces), namely on the web. This aims to achieve ease of use in e-government applications in Sidoarjo Regency.

V. EXPERIMENT AND ANALYSIS

In this experiment the researchers will measure the application process speed. To measure the speed of the application process, researchers make examples of applications that do not implement SOA and that implement SOA. In Figure 5 is an application without implementing SOA. The researcher made the application use the MySQL database and the Yii2 PHP framework.

Figure 5. Application without SOA

Whereas in Figure 6 is an application that applies SOA. The researcher uses the MySQL database and framework express Node.JS.

Figure 6. Application with SOA

From the two applications, researchers conducted a trial of input data on birth certificate services which had the same number of forms. From the experiment the researcher obtained results, namely the time needed for the application without applying SOA for data input, which is 0.24 seconds. While the time needed for applications that implement SOA for data input is 0.16 seconds. So it can be concluded that the speed of the application process is faster that applies SOA.

In addition, researchers also conduct speed trials on all services, the results of which can be seen in Table 1.

Services	Results of Experiments with SOA (in second)					Results of Experiments without SOA (in second)				
	1	2	3	4	5	1	2	3	4	5
Resident Card	0.02	0.02	0.025	0.02	0.02	0.032	0.034	0.35	0.033	0.033
Family Card	0.025	0.02	0.025	0.02	0.02	0.03	0.03	0.039	0.03	0.03
Birth Certificate	0.08	0.1	0.09	0.08	0.1	0.19	0.22	0.19	0.18	0.2
Death Certificate	0.033	0.035	0.04	0.036	0.036	0.046	0.047	0.048	0.043	0.044
Individual Domicile Letter	0.04	0.045	0.04	0.04	0.04	0.05	0.055	0.052	0.054	0.053
Individual Bussiness Letter	0.05	005	0.055	0.05	0.5	0.06	0.06	0.065	0.06	0.06
Crowd Permit	0.05	0.05	0.05	0.05	0.05	0.07	0.08	0.08	0.075	0.08
Village Clearance Letter	0.018	0.02	0.019	0.02	0.019	0.018	0.02	0.019	0.02	0.019
Certificate of Poor	0.02	0.022	0.024	0.02	0.02	0.035	0.032	0.034	0.038	0.037
Cover Latter	0.015	0.017	0.017	0.015	0.016	0.025	0.027	0.027	0.025	0.026
Taxation	0.013	0.014	0.013	0.013	0.014	0.023	0.024	0.023	0.023	0.024
Complaint	0.012	0.012	0.014	0.013	0.014	0.026	0.023	0.024	0.023	0.024
Disaster Response	0.014	0.015	0.015	0.015	0.014	0.024	0.027	0.025	0.025	0.026

Tabel 1. Speed Test Trial

From this it can be concluded that the SOA is faster than without the SOA. In terms of synchronization and lack of duplication of data, researchers make every service do not need to store data that already exists in other services. An example is the making of an resident card request. The applicant only needs to enter the number which can then be searched to the resident service to retrieve the data based on the nik. So that the data will not be duplicated and the data will always be synchronous.

In developing this governance, the researcher made how the application that was created did not cause data duplication. Data duplication is closely related to the database schema created. This means that it is very concerned about each field in the table created. As the example in Figure 7 is an example of overcoming data duplication. Complaint services and services for certificates are different services, but have the same data requirements, which both require population data. To get population data, complaint services only need to access GET web service residents. Likewise with the provision of village certificates only need to access the GET web service residents. On the other hand, applications that are built have synchronous data, because the data taken comes from the same place or web service.
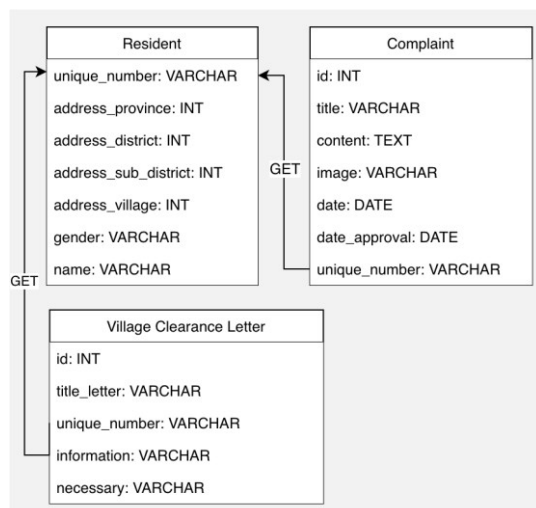
Figure 7. Database Schemes for Overcoming Data Duplication

VI. CONCLUSION

E-government is one service that can accelerate the process of transactions and communication between government officials and the community. However, due to the lack of data integration the service process of e-government has become less than optimal. Because some services also depend on other services. In addition, because there is no integration, it is possible that data can experience data duplication, which also allows for data that is out of sync.

From this research e-government applications have been integrated with the SOA. The e-government manufacturing process has three main stages. First is the database creation process. The database must be made with due regard to the correct scheme so as not to cause duplicate data. Second is the process of making web services. Making web services also pay attention to what tools are used, such as the programming language used, the web server used, etc. Third is the implementation of web services into the user interface, both in the form of a web application or mobile application.

With the development of integrated e-government applications using the SOA, the process can be run faster, because this architecture makes the application into the form of a web service. So that it can connect between one service and another. In addition, there is duplication of data and the presence of asynchronous data can be handled properly.

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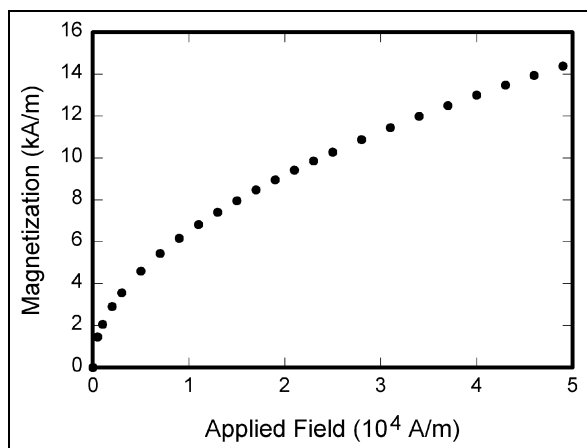| Table Head	Table Column Head		
	Table column subhead	*Subhead*	*Subhead*
copy	More table copy		

Fig. 1. Example of a figure caption

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