

The Effects of Mobile Games on Male Adolescents using Data mining techniques- A Review

Deelip B. Desai

Asst.Professor, MCA Dept

KIT'S IMER, Kolhapur

Maharashtra, India

Dr. Abhijeet Kaiwade

HOD, Sadhu Vaswani Institute of

Management Studies (SVIMS) for Girls

Pune, Maharashtra, India

Abstract: In following study “The effects of mobile games on male adolescents using Data mining techniques”, various papers are reviewed. There are about 67% mobile users world-wide. Almost every mobile user has a mobile game installed on their mobile. Most of mobile users play mobile games, while adolescents are very specific and keen users of mobile games. This paper introduces mobile game usage gaming addiction among adolescents, it reviews difference between computer games, video games, console games and mobile games and it then reviews positive and negative effects of mobile games on male adolescents using data mining techniques.

Keywords: Adolescents, mobile game, PC game, console game, video game, sampling, Data mining

A. Introduction

Mobile gaming has become an integral part of adolescents over the past few years as smartphone graphics and processors have improved. Adolescents form the major users of mobile game. Assessing mobile gaming addiction in children and adolescents is important as there is maximum development in physical and psychological attributes, it appears that addictions tend to have precursors during adolescence [1] [Hawkins and Fitzgibbon, 1993] during this period of time.

In following study, reviews regarding effects of mobile games on adolescents are reviewed .various studies using various methods of sampling, data processing and results produced are presented. This study depicts difference between various video games played, different types of effects adolescents face due to mobile game play and different techniques used in various scopes.

Video Game, Personal/Computer Games, Console Games and Mobile Games

Video games are all type of electronic games played on a video screen may be a television, a built-in screen, a

computer or on mobile. It is essentially the same form of entertainment, but refers not only to games played on a personal computer, but also gamesplayed on a computer, console or mobile.Video games for home,personal use are also proved popular from the start. Adolescents are particularly attracted to them for a variety of reasons. Fantasy simulations attract the young imaginations and provide and relax from everyday routine and the stresses presented by parents, friends, and school. In addition, the games give adolescents a level of control that they do not experience in real life, as the characters on the screen respond to the children's commands. Adolescents also receive immediate rewards may be in any form for getting the success.

Computer game or personal computer (PC) game is a type of video game played on a personal computer. It is a game that you play on a computer normally with input devices like keyboard; mouse and joysticks etc .They can be played with or without an Internet connection.They have been introduced since the invention of personal computers. There is huge number of games available for the PC platform. Computer games have become most popular because they can be used for fun and for learning. There is need of specific computer software and hardware in order to play the games, in most cases, the computer's graphics card, sound card, processor, power supply and even the operating system may

need to be upgraded to play the latest specifications game. New users needs help to understand computer games. With the help of the Internet, PC-based online games have also become available online withwhich multiple players can play together or against each other.

Console game is a type of video game which uses interactive multimedia software to provide an interactive multimedia experience via a television or other display device. The game console generally consists of a handheld control device or cameras to monitor user movements and a display device that runs the game's software. A console game is also known as video game. Console game media is stored in a disk, which is inserted into the game console device. Before 90s most game consoles used cartridges, which stored the game's programming on integrated circuits. The game is usually controlled and managed using a handheld device connected to the console. The hand held device generally contains a number of buttons and directional controls such as analogue joysticks, each of which has been assigned a purpose for interacting with and controlling the images on the screen. The latest game consoles can download game content directly from the web to built-in storage devices.

Console games may also be played on specialized computers, which may be referred to as game consoles. Using audio-video output devices, video and sound are controlled by players' interactions with game characters through handheld controllers. Some of popular Consoles are Famicom, Xbox, PlayStation, Nintendo Switch, Wii etc.

Mobile games are defined as games conducted in handheld portable devices with network functionality. The two key elements of this definition are portability and networkability. In this definition, mobile games are generally referred to as the games played in handheld mobile devices such as cell phones and PDAs with wireless communication functionality. In terms of portability and networkability, the characteristics of mobile games differ from other device platforms such as PC and console games; they do not have both portability and wireless capability.

Differentiation between Mobile Games and Video, Computer, Console Games.

Mobile gaming revenues are eventually more than the money generated by console and PC games. Games from tablets and Smartphone's will generate a total of \$36.9 billion in revenues or 37 percent of the total market which is expected to reach \$99.6 billion this year, according to research firm *Newzoo*. [2] In comparison, PC games will bring in \$31.9 billion while console gaming will generate \$29 billion in revenues.

Geraldus Galehantomo P.S [3] differentiate PC games and mobile games in following way .PC game is a video game in which users use computer or laptop as a tool to play. PC

games can't be portable as it is using a computer, the price of electricity the game used is expensive. Mobile gaming is a video game in which users use smart-phones or PDA media. They are easy to carry because it has a battery that can be re-charged, easy to store anywhere and the quality of its graph is less supportive than PC game. A computer game is a computer-controlled game played mostly on personal computers. A video game is played on arcade machine which generally has no interface like keyboard mouse but huge joysticks like controllers.

B. Paper Inclusion Criteria

Various criteria for inclusion were fixed for this study. The papers included for this study were the paper published in journal from January 2009 onwards because mobile revolution started in from 2009 onwards only. The various games were developed before 2009 also but rigorous games were developed since last 10 years.

Journal paper dedicated to research and published with doi ISSN, Conference proceedings were considered for this review. Books/News/Web publishing were not considered as there is no research support for findings.

There was very limited research study on finding effects of mobile games on adolescent. therefore video game effects were considered also effects on both genders were considered as their was no specific study on male related research. Also there was neither study using data mining techniques to review for this paper.

C. Review of effects of Mobile Games on Male Adolescents.

Various journal papers were reviewed and are categorized into positive and negative effects on adolescents. Almost every research study has considered effects on adolescents of online/computer games. Very few study were limited to "effects of mobile games on adolescents" and none of them were particularly on male adolescents.

Table of Journal Papers and findings.

Journal Papers with Positive Effects Findings.

Sr. No	Researcher & Publication Year	Research Methodology Used	Findings
1	Christopher J. Ferguson , Adolfo Garza,	Participants in the current study included 333 youth	They concluded that results from both sets of analysis revealed that exposure to violent

	Jessica Jerabeck, Raul Ramos & Mariza Galindo. [8] Year-2012	between the ages of 10 and 17 (M = 12.76, SD = 1.88). Participants were equal in regards to gender distribution (51.7 % female). Main analyses consisted of hierarchical multiple regression	game had neither short-term nor long-term predictive influences on either positive or negative outcomes. Results did not differ across age categories of older children, preadolescents or adolescents. Results suggest that the influence of video game violence on children and teen's development across outcomes is both stable and negligible.
2	Sri Kurniawan. Marilyn Walker, Sonia M. Arteaga [9] Year-2012	A survey of 28 participants with an average 17 years old, Analysis through statistical tool.	Mobile games can be used to promote positive behavioral beliefs. In teenagers They can be used to promote positive behavioral beliefs.
3	Zahra Khak sari, Mehdijavanmard, Javadyarahmadi. Year-2014. [12]	Morgan's table and random stratified sampling, statistical density of research sample of 184, 122 which constitutes of guidance and high schools respectively. Statistical indexes such as t-test, descriptive statistics and Pearson's correlation test was used.	Results showed that 85 percent of students play 2 to 3 hours a day. findings demonstrated that there is significant difference between guidance school students and high school students in psychological motives such as refreshment ,compete with others and win ,relaxation ,like the guns & other weapons, creativity ,forgetting problems, discharging aggression ,imitation of friends, educate others and make new friend.

	Year		
1	Olson, C. K., Kutner, L. A., Baer, L., Beresin, E. V., Warner, D. E. And Nicholi [4] Year-2009	Survey data were collected from 1254, 7 th and 8 th grade students in two state .t tests and chi square tests were used.	M-rated game dose predicted greater risk for bullying (p<.01) and physical fights(p<.001)
2	EshratZamani , MalihehChashmiNasimHedayati [5] Year-2009	The sample size includes 564 students selected by multiple steps stratified sampling. Data were collected using Questionnaire (GHQ-28) scale. Pearson's correlation coefficient and structural model were used for data analysis.	The results of this study showed that there is a direct relationship between physical health, anxiety and depression with computer games addiction. However, the relationship of addiction to computer games and social dysfunction was significance and inverse.
3	Dongdong Li, Angeline Khoo, Hyekyung Choo, Albert K. Liao [6] Year-2012	Sample of total 2,998 adolescents from Primary schools. 2,179 were males and 819 were females. Average age of participants was 11.2 Years. ANOVA , T Test using SPSS.	Results indicate a positive relationship between longer gaming hours and poorer academic performance. Also positive relationship between longer gaming hours and more pathological symptoms were found.
4	Daniel L. King ,Michael Gradisar, Aaron Drummond	Seventeen males, aged 16 ± 1 years, were recruited via advertisements at an on-campus. Subjects	Prolonged video-gaming before normal bedtime caused a clinically

Journal Papers with **Negative** Effects Findings

Sr. No	Researcher & Publication	Research Methodology	Findings
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	,NicoleLovato, Jason Wessel, GoricaMicc, Paul Douglas AndPaulDeIffabro [7] Year -2012	were exposed to either 50 or 150 min of video-gaming Fifty minutes of video-gaming exposure was considered ‘normal’, given males aged 13–18 years play video-games between 34 and 76 min day1 (Marshall et al., 2006). Video-gaming for an uninterrupted 150 min period was considered ‘prolonged’ (i.e. >2 SDs above the mean)	significant reduction in adolescent sleep time. It may be extrapolated that long-term or repeated prolonged video gaming may produce cognitive deficits associated with chronic sleep reduction		ouhi-Moqhaddam, and Mahmoud Zivari [11] Year-2013		However, there was no statistically significant correlation between the amount of computer game usage and physical complaints, thinking problems, and attention problems.
				7	SelahattinÇavuş, Bünyamin Ayhan [13] Year - 2014.	384 students were surveyed. Questionnaires were asked and data was analyzed through SPSS 20 package program. The statistical significance level of the study was accepted 0.05.	It was found that the average of the boys were higher than those of girls when the whole addiction scale was considered. Moreover, the boys are observed to spend more money on games.
5	Halima SadiaQureshi and MussaratJabeen Khan UzmaMasroor [10] Year-2013	Sample consisted of 150 adolescents, divided into 76 male and 74 female, age ranged from 12 to 20 years. T-test, ANOVA, and Regression analyses	It was concluded that pathological video gaming can induce aggression and create feelings of loneliness among adolescents.	8	You, Sukkyung & Kim, Euikyung & No, Unkyung. [14] Year-2014	The study of 1242 participants studying in grades 7, 8, and 9 were selected. Structural equation modeling (SEM) was used to assess the hypothesized structural relations among the latent variables	The results indicated that violent video games have a significant direct effect on aggressive behaviors, and a significant indirect effect on pro social behaviors.
6	SolmazShokouhi-Moqhaddam, Noshiravan Khezri-Moghadam, ZeinabJavanmard, Hassan Sarmadi-Ansar, MehranAmirinaee, MajidShok	Required sample was determined according to the sample size and using Cochran’s formula (n = 384) through convenient random sampling method. Data analysis was done using the bivariate regression, and analysis of variance (ANOVA).	The Results of this study indicated that there was about 95% direct significant correlation between the amount of playing games among adolescents and anxiety/depression, withdrawn/depression, rule breaking behaviors, aggression, and social problems.	9	Luca Milani1, Elena Camisasca 2, Simona C. S. Caravita1, Chiara Ionio1, Sarah Miragoli1, and Paola Di Blasio [15] Year-2015	471 children attending primary and secondary schools in Northern Italy.	Participants who use violent video games show more externalizing problems, more aggression and more coping strategies compared with participants who do not use violent video games.

10	KarzanWakil,ShanoOmer,BayanOmer [16] Year-2017	Survey using Questionnaires for collecting Data and processing using Tool.	Students who are playing between 1-3 hours per day with electronic games their GPA(Grade Point Average) is not decreased or very few changes are seen which is -0.22% per hour.At the same time students that are playing more than 3 hours per day their GPA decreased more which is -2.41% per hour.
11	AdileAskim Kurt, EzgiDogan , YaseminKahyaogluErdogmus, BulentGurselEmiroglu [17] Year-2018.	open-ended questions with a personal information .The computer gaming addiction scale forchildren(CGAS-C)was utilized.	It was found that male students had higher levels of gaming addiction when Compared to females.
12	FundaErdoğdu,Burcu Berikan, ŞahinGökçe arslan. [18] Year-2018.	. The PISA 2015 study covers 87schools and 5895 15-year-old students from 61 provinces of Turkey. 49% of these students consist of girls while the rest are boys. open-ended questions.	increased class repetition rate may indicate a positive correlation between playing computer games and student failure in this age group
13	Ping Su1, Chengfu Yu2, Wei Zhang1*, Sha Liu1,	Using random cluster sampling questionnaires 386 seventh graders participated (52.94%	peer victimization positively related to Internet Gaming Addiction.

	Yang Xu1 and Shuangju Zhen [19] Year-2018	females, Mean age = 14.83, SD = 0.49, range = 13.50–16.50).	
14	Geert P. Verheijen ,William J. Burk , Sabine E. M. J. Stoltz ,Yvonne H. M. van den Berg, Antonius H. N. Cillessen, [20] Year-2018	sample to 705 adolescents (33.5% female, Mage = 14.07, SD = 1.29). Participants completed a computerized survey.	This study showed that the social context influences the effect of violent video games on aggressive behavior. Adolescents' exposure to violence in video games positively predicted the aggressive behavior of their best friend one year later..
15	T. Gnamb, L. Stasielowicz, I. Wolter, and M. Appel [21] Year-2018.	responses from N = 3,554students (56% female) across several years beginning in the ninth grade. The mean age at the time of the first wave was M =14.47 (SD = 0.57) years applied a non-linear transformation	playing computer and video games can result in a noticeably, albeit small, loss of educational returns, but it does not affect basic competences.

D. Review of Data Mining Techniques for finding effects of Mobile Games on Male Adolescents.

Data mining process is of inferring knowledge from huge data. It is searching large stores of data to discover patterns and trends Data collected from various surveys when properly mined, valuable knowledge can be discovered from data mining techniques and then can be used for finding various effects of mobile games on adolescents. The medical data mining produces business intelligence which is useful for predicting, classification is the major data mining technique which is primarily used in healthcare sectors for medical diagnosis and predicting diseases. Various data mining

techniques can be applied for finding effects of mobile games on adolescents.

E. Conclusion

Mobile gaming forms an essential paradigm in life of adolescents. As depicted in above reviews mobile games definitely play a dignifying role in everyday life of adolescents. Many of reviews show negative effects and some show positive effects on physical, social, academic, behavioral approach on adolescents. There were more studies related to effects of video games on adolescents but very few are specific with mobile only. As there is a difference between mobile and video games in portability, availability, cost it's very essential to study effects of mobile games on adolescents. Also it was revived that no data mining techniques were used for above studies. Data mining techniques viz. classification, association, neural networks can be used to find association between adolescents and mobile game playing.

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SSE Composite Index Forecasting Model via BP Neural Network with ADAM Optimizer

Yahui Chen
School of Communication
Engineering, Chengdu
University of Information
Technology,
Chengdu, China

Zhan Wen
School of Communication
Engineering, Chengdu
University of Information
Technology,
Chengdu, China

Kangjian Tang*, Wenzao Li
School of Communication
Engineering, Chengdu
University of Information
Technology,
Chengdu, China

Abstract: In China, stock investment is one of the important ways for people to manage their finances. Mastering the stock market dynamics can not only bring economic benefits to individuals and enterprises, but also help government to understand Chinese macroeconomic situation. The overall situation of Chinese stock market is mainly displayed through the SSE Composite Index. Therefore, effective prediction of the SSE Composite Index will help investors, enterprises and government agencies to grasp the overall information of the stock market and reduce investment risks in trading. With the development of computer technology, the application of machine learning algorithms to predict stock market volatility has become a hot spot. Among them, BP neural network is the most widely used model, but the gradient descent algorithm used in the model's back propagation has the problem of easily falling into a local minimum. Therefore, the ADAM algorithm to solve this problem was born. This article uses the ADAM optimizer to optimize the BP neural network for SSE Composite Index short-term prediction. The constructed ADAM-BP neural network's Goodness-of-fit index R^2 reached 0.986, which means that the model has good prediction performance. In addition, Compared with the BP neural network without the ADAM optimizer, the error evaluation index of the ADAM-BP neural network is significantly reduced.

Keywords: Machine learning; BP neural network; ADAM optimizer; SSE Composite Index; Stock market forecast

1. INTRODUCTION

In China, stock investment is one of the important ways of Chinese citizen's financial management. Since the securities market in mainland China started later than the mature foreign stock market, with greater randomness and worse predictability, Chinese investors urgently need an effective stock market forecasting method to assist investors in trading, reduce risks and blindness in stock investments. Government also need to understand the stock market fluctuations in time to grasp the macro economy. Chinese investors generally observe the overall trend of the Chinese stock market by observing the SSE Composite Index issued by the Shanghai Stock Exchange, because the SSE Composite Index has the earliest compilation date and covers the largest number of listed companies in the Chinese stock market. It can represent the trend of the Chinese stock market. Therefore, the analysis and forecast of the SSE Composite Index is important for investors to fully grasp the overall changes in the Chinese stock market.

In the past, forecasting methods were often: relying on the personal experience of investors, statistical analysis of stock market data by professional teams of investment companies, and researchers using time series models. These prediction methods have indeed achieved certain results, but there will be problems such as information lag and lack of human analysis errors. And the stock market has strong randomness, non-linearity, noise, etc. The prediction itself is difficult, so the accuracy of these prediction methods is not high.

Because machine learning algorithms have the ability to efficiently fit massive data and real-time analysis, they can be used as powerful tools for analyzing and predicting stock market trends. Machine learning algorithms have been applied in the field of quantitative trading and high-frequency trading,

and has achieved good returns. For example, Kinjal J and Nisarg A, used BP neural network to predict the Indian stock index and achieved good results (2011)[1]; Patel, J, et al. Used a hybrid model of support vector regression, random forest, and support vector machine to make short-term predictions of stock prices, and achieved good results (2015) [2]; Pan, Y. et al. Used a multi-layer support vector machine to predict the weekly price of individual stocks for the next 4 weeks. The accuracy of the prediction results in the first week reached 88%, and the accuracy of the predictions in the following weeks reached 51.3% (2017) [3]; A technology company called Perception in Silicon Valley, U.S.A. uses machine learning algorithms to predict stock market fluctuations, and machines perform stock market trading operations; In China, Flush Software has built an AI stock market forecasting intelligent platform to assist investors in investing.

There are many types of machine learning algorithms. At present, the use of BP neural network as a machine learning algorithm to fit historical market data is a major trend. For example, Ticknor uses financial technical indicators and market prices as input features of neural networks to predict individual stock prices in a certain period of time in the future, thereby obtaining more accurate results than the linear method (2013) [4]. Rather, A. et al. Compared the prediction results of the linear model with the neural network model in the short-term forecast of the stock market and showed that the neural network model has a better fit for the non-linear high-noise system of the stock market (2015) [5]. The principle of this model is simple, and only a single hidden layer can be used to infinitely approximate any non-linear function(2016)[6]. However, its backpropagation strategy is a gradient descent algorithm, which has the problem of easily falling into the local minimum and unable to reach the best point. Therefore, the ADAM algorithm came into being. It can adapt the

learning rate and solve the problem of falling into the local optimal solution(2015)[7].

Therefore, this article will use the ADAM optimizer to optimize a single hidden layer BP neural network to build a short-term prediction model of the SSE Composite Index. In order to use artificial intelligence to predict stock market fluctuations, assist Chinese investors to fully grasp the stock market trends and make scientific investment decisions.

2. Stock market forecasting methods

2.1 Introduction of the SSE Composite Index

The Shanghai Stock Exchange Index is an index issued by the Shanghai Stock Exchange. It includes the Shanghai Stock Exchange Composite Index(SSE Composite Index), Shanghai Stock Exchange 50 Index, and Shanghai Stock Exchange Dividend Index. Among them, the SSE Composite Index, as the earliest indicator compiled and issued in China, integrates information on all the stocks listed on the Shanghai Stock Exchange. It is currently the best index to reflect the overall situation of the Chinese stock market.

Since the SSE Composite Index covers the largest stock market information in China's stock market, and has the longest history and the most extensive application, this article will choose to predict the key index of the SSE Composite Index. Among them, the Shanghai Stock Exchange closing price is the most commonly used indicator, and it can most directly reflect the changing trend of the broader market. Therefore, this article chooses the Shanghai Stock Closing Price as the forecast target.

The input features selected the Shanghai Stock Exchange's opening price, closing price , volume, the highest price, the lowest price and Stock price change. The calculation process of the above indicators is more complicated. The calculation is based on the weight of the issued share capital of all sample stocks listed on the Shanghai Stock Exchange. Every day, the SSE calculates and publishes real-time indices through a program.

2.2 BP neural network and ADAM optimizer

The full name of BP neural network is error back propagation neural network. The implementation process of this model is divided into two parts, one is the forward propagation process, and the other is the back propagation process. The forward propagation process is a process of calculating the input features of each layer of the neuron to obtain the result; the back propagation process is a model optimization process that performs parameter correction based on the gap between the obtained result and the true value.

A general back propagation strategy uses a gradient descent algorithm, but the gradient descent algorithm does not have the function of adjusting the learning rate according to the gradient descent rate, it is easy to fall into a local optimal solution. Therefore, this article will use the ADAM optimizer to replace the gradient descent optimizer in the BP neural

network to adaptive learning rate, avoid falling into the local optimal solution. And the single hidden BP neural network has been proved to be able to approach arbitrary functions indefinitely, so this paper will build a single hidden layer BP neural network based on the ADAM optimizer to predict the SSE Composite Index. The detailed principle will be introduced below. The figure below shows the structure of a single hidden layer BP neural network:

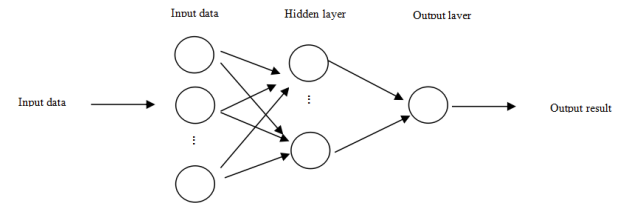


Figure1 : Single hidden layer BP neural network structure

The function that reflects the mapping between the output result and the input data is as follows:

$$F(X) = \omega_2 g(\omega_1 X + b_1) + b_2 \quad (1)$$

Given a set of training data X,

$$X = \begin{bmatrix} x_{11} & \dots & x_{1n} \\ \vdots & \ddots & \vdots \\ x_{m1} & \dots & x_{mn} \end{bmatrix} \quad (2)$$

Each column of the X matrix represents an input vector, and the number of rows represents the number of features.

$$\omega = \begin{bmatrix} \omega_{11} & \dots & \omega_{1m} \\ \vdots & \ddots & \vdots \\ \omega_{h1} & \dots & \omega_{hm} \end{bmatrix} \quad (3)$$

ω_1 and ω_2 also corresponds to a matrix form, which represents the weight of each neuron in the hidden layer and the output layer, respectively. The number of rows h is related to the number of neurons in the hidden layer, and the number of columns is the same as the number of input vector features.

The parameter b represents the bias that comes with each neuron. The $g(\cdot)$ in the formula is the activation function of the hidden layer. It is a non-linear function in each neuron in the neural network. The result obtained by the activation function is the output of the neuron. The purpose of its existence is to make the values in the network no longer be a linear combination of inputs, so that the entire network is non-linear and can approximate any non-linear function. The Relu function with a steep gradient is the main choice of the current neural network activation function as well as in this paper. Its analytical formula is as follows:

$$RELU = \text{MAX}(0, Z) \quad (4)$$

The process of obtaining the output data after activation by the activation function is the forward propagation process of the BP neural network.

To build a neural network model, you need to get the neural network weights when the error function reaches a minimum. The process of updating the weights, that is, updating the weights to minimize the loss function, is the back propagation

process. In this paper, $J(\cdot)$ is the loss function. Generally, the mean square error is used as the loss function in the prediction problem:

$$J = \frac{1}{n} \sum_{i=1}^n (y - \hat{y})^2 \quad (5)$$

Where y is the true value and \hat{y} is the predicted value. n is the number of samples. The loss function represents the average distance between the predicted value and the true value, and is a criterion for measuring the accuracy of the model. The smaller the value, the higher the model accuracy. The ADAM optimizer minimizes the loss function by the following formula for updating weights:

$$dw = \frac{\partial J(\omega_i)}{\partial \omega_i} \quad (6)$$

$$v_{dw}^1 = dw \quad (7)$$

$$v_{dw}^2 = \beta_1 v_{dw}^1 + (1 - \beta_1) dw$$

$$v_{dw}^3 = \beta_1 v_{dw}^2 + (1 - \beta_1) dw$$

... ..

$$v_{dw}^{n+1} = \beta_1 v_{dw}^n + (1 - \beta_1) dw \quad (8)$$

dw is the calculation of the partial derivatives of the parameters ω_i in the loss function $J(\cdot)$. v_{dw}^1 refers to the initial gradient value, and the secondary gradient is modified by the formula. The above formula indicates that the gradient of the n -th generation is not only related to the current gradient, but also to the gradient of the previous n -generation. (The smaller the value of n , the smaller the correlation, because $\beta_1 = 0.9$) In this case, when our gradient suddenly becomes larger or smaller, the improved gradient will not abruptly change, which is conducive to the stability of the model.

The ADAM algorithm also introduces the introduction of differential weighted averages to adjust the size of the learning rate. The calculation method is as follows:

$$s_{dw} = \beta_2 s_{dw} + (1 - \beta_2) dw^2 \quad (9)$$

$$s_{db} = \beta_2 s_{db} + (1 - \beta_2) db^2 \quad (10)$$

The general setting of β_2 in the above formula is 0.999, the second moment of the gradient is calculated as dw^2 , db^2 . s_{dw} , s_{db} used to adjust the learning rate, after calculating according to the above steps, you can update the parameters, as shown in the following formula:

$$w = w - \alpha \frac{v_{dw}^c}{\sqrt{s_{dw}^c + \epsilon}} \quad (11)$$

$$b = b - \alpha \frac{v_{db}^c}{\sqrt{s_{db}^c + \epsilon}} \quad (12)$$

α is the learning rate, which represents the magnitude of the gradient descent. If it is too large, it will be difficult for the model to reach the minimum value. If it is too small, the

gradient descent rate will be too slow. According to experience, the initial value is generally set to 0.001. v_{dw}^c , s_{dw}^c , v_{db}^c , s_{db}^c called a modified gradient. Because the initialization value is generally 0, the parameters will be biased, so the correction index of the above index needs to be calculated. $\frac{v_{db}^c}{\sqrt{s_{db}^c + \epsilon}}$ can make the learning rate adaptive. When

the gradient declines too fast, the learning rate will become smaller, and when the gradient declines too slowly, the learning rate will increase accordingly.

The above is the implementation principle of BP neural network based on ADAM optimizer.

3. Model implementation

3.1 Data collection

This article collected a total of 1691 pieces of data on SSE Composite Index from 2012 to 2018, provided by the domestic stock market data collection professional website "Forecaster Network". Some historical market data are as follows:

Table1: The Historical SSE Composite Index (Partial)

date	open	Close	lowest	highest	volume	change
2017/12/1	3315.1	3317.62	3302.44	3324.52	13919830000	0.000129628
2017/12/4	3310.38	3309.62	3304.1	3324	14805328800	-0.002411367
2017/12/5	3301.69	3303.68	3300.51	3315.74	20827886200	-0.001794768
2017/12/6	3291.31	3293.96	3254.61	3296.2	15160445200	-0.002942174
2017/12/7	3283.28	3272.05	3259.16	3291.28	13210590000	-0.006651568
2017/12/8	3264.48	3289.99	3258.76	3297.13	13320931400	0.005482801
2017/12/9	3290.	3322.	3288.	3322.67	131965	0.009790

12/11	49	2	29		984 00	303
2017/ 12/12	3320. 31	3280. 81	3280. 33	3320.31	124 604 827 00	- 0.01 2458 612
2017/ 12/13	3278. 4	3303. 04	3273. 32	3304.01	111 998 647 00	0.00 6775 766

3.2 Feature engineering

The forecast target selected in this article is the closing price of the SSE Composite Index. Based on previous research and actual needs, this article chooses to use five input features, including the closing price, opening price, change rate, highest price and lowest price.

And the method called single-step forecast is used to construct input features. The single-step prediction is also called one-step prediction. The specific method is to use the observed value at the previous moment as input data to predict the index fluctuation at the next moment, and the actual observed value at the next moment will become part of the next input data to participate in the prediction. That is, using the SSE Composite Index of the previous four days to predict closing price of the SSE Composite Index next day. The length of the input feature is 20. The Partial input data are as follows:

Table 2: Input feature vector display (partial)

The date of prediction	Opening price 1	Opening price 2	Opening price 3	Opening price 4	Closing price 1
2012/1/10	2212	2160.9	2148.15	2164.74	2169.39
2012/1/11	2160.9	2148.15	2164.74	2221.83	2148.45
2012/1/12	2148.15	2164.74	2221.83	2282.91	2163.4
2012/1/13	2164.74	2221.83	2282.91	2268.74	2225.89
2012/1/16	2221.83	2282.91	2268.74	2277.08	2285.74
2012/1/17	2282.91	2268.74	2277.08	2230.43	2276.05
2012/1/18	2268.74	2277.08	2230.43	2206.5	2275.0

8	4	8	3	3	1
2012/1/19	2277.08	2230.43	2206.5	2298.83	2244.58
2012/1/20	2230.43	2206.5	2298.83	2266.08	2206.19
2012/1/30	2206.5	2298.83	2266.08	2300.5	2298.38
2012/1/31	2298.83	2266.08	2300.5	2324.49	2266.38
2012/2/1	2266.08	2300.5	2324.49	2285.95	2296.08
2012/2/2	2300.5	2324.49	2285.95	2288.07	2319.12
2012/2/3	2324.49	2285.95	2288.07	2273.85	2285.04
2012/2/6	2285.95	2288.07	2273.85	2306.66	2292.61
2012/2/7	2288.07	2273.85	2306.66	2334.25	2268.08
2012/2/8	2273.85	2306.66	2334.25	2319.42	2312.56
2012/2/9	2306.66	2334.25	2319.42	2291.81	2330.41

Closing price 2	Closing price 3	Closing price 4	Change rate 1	Change rate 2
2148.45	2163.4	2225.89	-	-
2163.4	2225.89	2285.74	0.009651561	0.00695524
2225.89	2285.74	2276.05	0.00695524	0.028887466
2285.74	2276.05	2275.01	0.028887466	0.026889918
2276.05	2275.01	2244.58	0.026889918	-0.00424282
2275.01	2244.58	2206.19	-0.00424282	-
2244.58	2206.19	2298.38	0.000455175	0.013375765
2206.19	2298.38	2266.38	-	-
			0.013375765	0.017102086

2298.38	2266.38	2296.08	-	0.017102086	0.041783742
2266.38	2296.08	2319.12	0.041783742	0.013919394	-
2296.08	2319.12	2285.04	0.013919394	0.013100604	-
2319.12	2285.04	2292.61	0.013100604	0.010035822	-
2285.04	2292.61	2268.08	0.010035822	0.014695242	-
2292.61	2268.08	2312.56	0.014695242	0.00331373	-
2268.08	2312.56	2330.41	0.00331373	0.010699596	-
2312.56	2330.41	2331.14	0.010699596	0.019609538	-
2330.41	2331.14	2291.9	0.019609538	0.0077183	-
2331.14	2291.9	2347.53	0.0077183	0.000313679	-

0.010035822	-	2257.9	2259.34	2293.89	
-	0.014695242	0.00331373	2259.34	2293.89	2284.29
0.00331373	-	0.010699596	2293.89	2284.29	2277.06
-	0.010699596	0.019609538	2284.29	2277.06	2263.34
0.019609538	0.0077183	2277.06	2263.34	2268.69	-
0.0077183	0.000313679	2263.34	2268.69	2300.98	-
0.000313679	-	0.016830421	2268.69	2300.98	2317.42
-	0.016830421	0.024271544	2300.98	2317.42	2278.83

Change rate 3	Change rate 4	The lowest price1	The lowest price 2	The lowest price 3
0.00695524	0.028887466	2168.64	2145.56	2132.63
0.028887466	0.026889918	2145.56	2132.63	2148.45
0.026889918	-0.00424282	2132.63	2148.45	2218.28
-0.00424282	0.000455175	2148.45	2218.28	2265.19
-	-	2218.28	2265.19	2265.26
0.000455175	0.013375765	2265.19	2265.26	2225.74
-	0.017102086	2265.26	2225.74	2206.05
0.017102086	0.041783742	2225.74	2206.05	2196.12
0.041783742	0.013919394	2206.05	2196.12	2257.9
-	0.013100604	2196.12	2257.9	2259.34
0.013100604	0.010035822	2196.12	2257.9	2259.34

The lowest price 4	The highest price 1	The highest price 2	The highest price 3	The highest price 4
2148.45	2217.52	2183.4	2164.32	2226.22
2218.28	2183.4	2164.32	2226.22	2288.63
2265.19	2164.32	2226.22	2288.63	2290.64
2265.26	2226.22	2288.63	2290.64	2295.22
2225.74	2288.63	2290.64	2295.22	2281.53
2206.05	2290.64	2295.22	2281.53	2241.26
2196.12	2295.22	2281.53	2241.26	2298.38
2257.9	2281.53	2241.26	2298.38	2311.58
2259.34	2241.26	2298.38	2311.58	2305.71
2293.89	2298.38	2311.58	2305.71	2322.89
2284.29	2311.58	2305.71	2322.89	2324.49
2277.06	2305.71	2322.89	2324.49	2296.38
2263.34	2322.89	2324.49	2296.38	2305.86
2268.69	2324.49	2296.38	2305.86	2312.56
2300.98	2296.38	2305.86	2312.56	2336.27
2317.42	2305.86	2312.56	2336.27	2341.58

2278.83	2312.56	2336.27	2341.58	2319.71
2286.82	2336.27	2341.58	2319.71	2350.97

3.3 model evaluation criteria

In the experiments in this paper, three model evaluation standards will be selected, namely Mean Absolute Error (MAE), Root Mean Squared Error (RMSE), and R2 determination coefficient. Mean absolute error MAE (Mean Absolute Error) is also called L1 norm loss, the formula is as follows:

$$MAE = \frac{1}{M} \sum_{i=1}^n |y_i - \hat{y}_i| \quad (13)$$

MAE refers to the average of the absolute values of the residuals of the actual and predicted values. Although this indicator can better measure the quality of the regression model, the existence of the absolute value causes the function to be non-smooth and cannot be derived at some points. Change the absolute value to the square of the residual, which is the mean square error. However, the mean square error is inconsistent with the dimension of the target variable. In order to ensure the consistency of the dimension, the root mean square error (RMSE) of the root mean square error (RMSE) is obtained by performing the root mean square error. RMSE is also called L2 norm loss, the formula is as follows:

$$RMSE = \sqrt{\frac{1}{M} \sum_{i=1}^n (y_i - \hat{y}_i)^2} \quad (14)$$

In order to measure how well the model fits the data, this article will also use R2 to determine the coefficient, which reflects the proportion of the total variation of the dependent variable that can be explained by the independent variable through a regression relationship. The calculation formula is as follows:

$$R^2(y_i, \hat{y}_i) = 1 - \frac{\frac{1}{M} \sum_{i=1}^n (y_i - \hat{y}_i)^2}{VAR(y)} \quad (15)$$

R2 is the difference between one and the ratio between the mean square error and the true value variance. If the result is 0, it means that there is no predictive relationship between the model prediction and the predictive dependent variable. The general result is a number between 0-1. The larger the number in this interval, the higher the degree of fit between the model and the data.

3.4 Empirical results of ADAM-BP neural network Forecasting the SSE Composite Index

During each experiment, the data will be randomly scrambled, and the training set and test set will be divided at a 7: 3 ratio according to the division ratio of the training set and the test set commonly used in the literature to avoid data distribution problems Overfitting and low accuracy. And considering the

generalization of the model, the performance of the model is mainly reflected by the results on the test set.

The main tuning parameter is the number of hidden neurons. According to the Kolmogrov's theory, the number of theoretical optimal hidden layer neurons is twice the size of the input vector plus one. This article will focus on the theoretically optimal number of neurons, set the range, and choose the best number of hidden layer neurons based on the evaluation results to improve the persuasiveness of the experiment. The following are the evaluation results with the different number of hidden layers' neurons on the test set:

Table 3: ADAM-BP Neural Network's Evaluation Results

Number of neurons	R2	MAE	RMSE
39	0.985	47.915	77.454
40	0.985	46.917	76.748
41	0.986	46.354	74.787
42	0.985	47.63	74.807
43	0.986	46.375	75.601

As can be seen from the table above, the number of best hidden layer neurons when predicting the closing price of the SSE Composite Index is 41.

3.5 Empirical results of BP Neural Network Forecasting the SSE Composite Index

In order to prove the optimization effect of the ADAM optimizer, a BP neural network based on a gradient descent algorithm will be constructed for comparison. The BP neural network model evaluation of the number of different hidden layer neurons is as follows:

Table 4: BP Neural Network's Evaluation Results

Number of neurons	R2	MAE	RMSE
39	0.971	61.833	106.897
40	0.972	67.666	105.081
41	0.979	63.814	91.325
42	0.982	58.187	83.99
43	0.975	59.697	98.736

It can be seen that in the process of predicting the closing price of the SSE Composite Index, the model works best when the number of neurons in the hidden layer is 42.

3.6 Model comparison

The following compares the performance of the two types of the above BP neural network models:

Table 5: Evaluation of the SSE Composite Index Forecasted by Different Neural Network Models

Evaluation indicators	Model	R2	MAE	RMSE
SSE Composite Index closing price	BP Neural Networks	0.982	58.187	83.99
	ADAM-BP Neural Networks	0.986	46.354	74.787

It can be seen that the R2 of the ADAM-BP neural network has increased, which proves that the model's ability to fit the data increases. MAE and RMSE have significantly decreased compared with the BP neural network. This proves that the use of ADAM optimizer is effective for the improvement of BP neural network.

4. Conclusion

This article shows that BP neural networks are actually suitable for the non-linear subject like stock market prediction, and can achieve high accuracy. R2 of the BP Neural network using gradient descent algorithm for back propagation is 0.982. The evaluation indicators representing the errors are 58.187(MAE), 83.99(RMSE). It can be seen that the R2 of the ADAM-BP neural network has increased, which means the model's ability to fit the data has increased. Compared with the BP neural network without the ADAM optimizer, the error of the ADAM-BP neural network is significantly reduced. Therefore, using ADAM optimizer is a efficacious method to optimize BP neural network's ability.

And the final model called ADAM-BP neural network for SSE Composite Index short-term prediction is a useful tool to assist investors, enterprises and government agencies to grasp the overall information of the stock market and reduce investment risks in trading.

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Quality of Service Analysis on Udayana University Wireless Network

Chandra Gupta Murtono
Departement of Information
Technology
Faculty of Engineering
Udayana University
Bukit Jimbaran, Bali,
Indonesia

I Nyoman Piarsa
Department of Information
Technologi
Faculty of Engineering
Udayana University
Bukit Jimbaran, Bali,
Indonesia

Gusti Made Arya Sasmita
Departement of Information
Technology
Faculty of Engineering
Udayana University
Bukit Jimbaran, Bali,
Indonesia

Abstract: The use of Internet in this globalization era is really needed to support easier data and information exchange. The quality of the connection or has to be considered too, a good Internet connection is must for a smooth data and information exchange. This paper explains about the quality of Internet network or known as QoS (Quality of Service) on Udayana University the parameters used are throughput, delay, jitter and packet loss. Measurements at the access point in every 13 Faculty and Pasca Sarjana at Sudirman Campus, Nias Campus and Bukit Campus in the morning, afternoon and evening. From the results of the measurements, the performance of wireless network service on Udayana University is belongs to the very good, which has a average value of delay < 150 ms, an average jitter of 0 ms and an average packet loss of 0% categorized according to TIPHON version standardization is very good.

Keywords: QoS (Quality of Service); Throughput; Delay; Jitter; Packet Loss.

1. INTRODUCTION

Internet is making data and information exchange easier today. Internet is a network with wide and enormous range that connect to each other with computer network that in turn connect human and electronic devices all around the world by telephone line, optic cable, coaxial cable, satellite, or electromagnetic waves to replace cable, Internet gives way for data (text, image, sound, video, and other form) sharing for it users. Data sharing is enabled by using a standard protocol called Transmission Control Protocol and Internet Protocol or TCP/IP. Onno W. Purbo defines that internet is a media that is used to make communication process more efficiently by using various application like Web, VoIP, E-mail [1].

The more people that use wireless network technology then more public places that provide internet services called hotspot, especially on campus. By the use of hotspot enable using internet without cable, this makes data exchanges easier for students, lectures, and employees.

The majority of internet users at Udayana University did not know whether the quality provided is quite good or not especially to studens, lectures, and employees during lecture or the otherwise. Users convenience is affected by the quality of service provided. QoS (Quality of Service) is a method to measure how good the network is and to define the characteristic and nature of a service [2]. QoS can be used to measure a set of performance attribute that have been specified and associated with a service, so that to bring a better internet service. According to Zeithaml quality of service is the degree of differences between consumers expectation or desire and perceptions [3].

Analysis of QoS (Quality of Service) on wireless network can be measured by a parameter of throughput, delay, jitter, and packet loss [4]. After the measurement, it can be seen what factor that affect the quality of internet service provided. The

goal of this research is to determine the degree of quality of network service that is provided to become information material for management of USDI (Unit Sumber Daya Informasi) Udayana University to bolster ICT (Information Communication Technology) based education services.

2. LITERATURE REVIEW

The research that had been done previously by Timur Dali Purwanto and Widya Cholil on 2013 titled “Analisa Kinerja Wireless Radius Server pada Perangkat Access Point 802.11g (Studi Kasus di Universitas Bina Darma)”. From the results of the research and QoS analysis of the hotspot network on Bina Darma University it can be concluded that QoS is affected by wall thickness factor and adjacent signal interference from other components that cause the decrease of signal quality being received [5].

Another research had been done by Roman Lara-Cueva, Diego Benitez, Claudia Fernandez dan Carlos Morales titled “Performance Analysis of Wireless Network Modes in Conformance with IEEE 802.11b and WDS”. The main goal of this research is to compare Ad-Hoc, IEEE 802.11b and WDS network in open space. The result obtained is WDS networks have higher efficiency therefore, better performance in long distance communication than Ad-Hoc and IEEE 802.11b networks [6].

The research done by Rika Wulandari titled “Analisis QoS (Quality of service) pada Jaringan Internet (Studi Kasus: UPT Loka Uji Teknik Penambangan Jampang Kulon - Lipi)”. The average measurement results of throughput, delay, jitter and packet loss for each buildings on morning between 07.30 AM - 12.00 AM, afternoon 01.00 PM - 04.00 PM, evening on 06.00 PM - 10.00 PM is classified as very good according to TIPHON standardization [7].

The research done by Vikram Mehta and Dr. Neena Gupta titled “Performance Analysis of QoS Parameters of WiMAX

Networks”. QoS research using delay, jitter, packet delivery ratio, packet loss ratio dan throughput parameter. Packet delivery ratio calculation result is when mobile node increases then packet delivery ratio also increases, Packet loss ratio measurement result is when mobile node increases then packet delivery ratio will decreases, and throughput calculation result is when mobile node increases then throughput also increases [8].

3. RESEARCH METHODOLOGY

The research was done based on data gotten from measurement result of throughput, delay, jitter and packet loss in the morning, afternoon, and evening on Jimbaran Hill Campus, Sudirman Campus, and Nias Campus. The measurement process stages of quality of service are illustrated in the flowchart which can be seen in Figure 3.1.

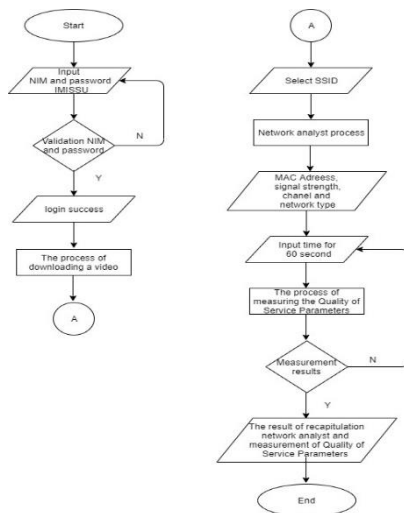


Figure. 1 Flowchart of Quality of Service measurement

Figure 1 is flowchart design of quality of service measurement, when device is connected to the network then it will be directed to the login page which uses NIM and GIS (the password is IMISSU) which in case fail then will be forced to reinput NIM and password IMISSU again. After a successful login, start downloading the file first and then continue with network observation process using the tool called insider by selecting the SSID which the device connected to. The network observation process will display a network information interface which include MAC address, signal strength, channel, and network type. After that in the process of measuring the quality of service parameters will be using wireshark tool by inputting the duration of 60 second to measure throughput, delay, and jitter also packet loss. In case of failure, then restart by inputting 60 seconds duration until successful result and then continue with recapitulation of network observation result and quality of service parameter measurement.

3.1 Quality of Service Parameter Calculation Process

Quality of service parameter calculation is being done after all the need data has been collected, the data is collected from the measurement using wireshark tool. As for quality of service parameter include.

Throughput value calculation is obtained from the measurement results that have been done using wireshark. Throughput can be calculated using equation (1).

$$\text{Throughput} = \frac{\sum \text{Data Delivered}}{\text{Length of Measurement}} \quad (1)$$

Delay value is obtained from the measurement results that have been done using wireshark. Delay can be calculated using equation (2).

$$\text{Delay Average} = \frac{\sum \text{Delay}}{\sum \text{Data Packet}} \quad (2)$$

Jitter value is obtained from the measurement results that have been done using wireshark. Jitter can be calculated using equation (3).

$$\text{Jitter} = \frac{\sum \text{Delay Variation}}{(\sum \text{Data Packet} - 1)} \quad (3)$$

Packet loss value is obtained from the measurement results that have been done using wireshark. Packet loss can be calculated using equation (4).

$$\text{Packet Loss} = \frac{\sum \text{Data Delivered} - \sum \text{Data Arrival}}{\sum \text{Data Delivered}} * 100\% \quad (4)$$

4. CONCEPTS AND THEORIES

Literature review contains supporting theories in the research that will be conducted. The theories including Quality of Service and its Parameters will be discussed as follows.

4.1 Quality of Service

QoS (Quality of service) is a metode to discern and measure how well a network is and aim to define the characteristic and nature of a service. QoS is closely related to multimedia data, multimedia services and real time multimedia, and so as to provide better Internet services [2]. According to Zeithaml quality of service is the degree of differences between consumers expectation or desire and perceptions [3].

4.2 Quality of Service Parameters

The quality of service measurement of Udayana Universty wireless network, using QoS method (Quality of Service) and as for the technical quantities parameters of QoS to measure the quality of a service, are [4].

4.2.1 Throughput

Throughput is the average speed of data packets (bit) effective over a certain observation interval (second). The value of throughput is measured in bps (bits per second) [2].

4.2.2 Delay

Delay is the delay time of a packet caused by transmission process from one point to its destination point. Delay is defined as the length of time it takes for the data packet to arrive at the destination represented in second units [2]. The value of the delay calculation results that have been obtained, then determine the results of the delay calculation is classified in which category according to the TIPHON standardization version.

Table 1. TIPHON Delay Standardization Version

Degradation Category	Delay Magnitude	Index
Very Good	< 150 ms	4
Good	151 - 300 ms	3
Average	301 - 450 ms	2
Bad	> 451 ms	1

4.2.3 Jitter

Jitter is a variation of delay, in which there is a difference in delay in the delay in packets sent by the data packet stream represented in units of seconds [2]. The value of the jitter calculation results that have been obtained, then determine the results of the jitter calculation is classified in which category according to the TIPHON standardization version.

Table 2. TIPHON Jitter Standardization Version

Degradation Category	Jitter Magnitude	Index
Very Good	0 ms	4
Good	1- 75 ms	3
Average	76 – 125 ms	2
Bad	126 – 225 ms	1

4.2.4 Packet Loss

Packet loss is the number of packets lost on a computer network during data packets transmission caused by collisions, overload traffic, and errors caused by endless TTL (Time to Live) packets [2]. The value of the packet loss calculation results that have been obtained, then determine the results of the packet loss calculation is classified in which category according to the TIPHON standardization version.

Table 3. TIPHON Packet Loss Standardization Version

Degradation Category	Packet Loss	Index
Very Good	0%	4
Good	3%	3
Average	15%	2
Bad	25%	1

5. RESULT AND DISCUSSION

Result and discussion were obtained from sample result of quality of service measurement at one access point for three days time in the morning, afternoon, and evening in 13 faculties and Sudirman Post Graduate Campus, Nias Campus, and Jimbaran Hill Campus. From the result sample obtained, one faculty was selected for further research by adding observation period to 5 day in the morning, afternoon, and evening at Faculty of Social and Political Sciences and the Faculty of Economics and Business at Sudirman Campus.

5.1 Quality of Service Parameter Recapitulation

Throughput, delay, jitter dan packet loss measurement results at the Faculty of Social and Political Sciences at Sudirman Campus can be seen in Table 4.

Table 4. QoS Parameter Recapitulation of Faculty of Social and Political Sciences at Sudirman Campus

SSID	Period	Throughput	Delay	Jitter	Packet loss
Monday, 2 September 2019					
imissu@berbudaya	Morning	2453 Kbps	3 ms	0 ms	0%
	Afternoon	1350 Kbps	4 ms	0 ms	0%
	Evening	6686 Kbps	1 ms	0 ms	0%
imissu@mandiri	Morning	4148 Kbps	2 ms	0 ms	0%
	Afternoon	2942 Kbps	3 ms	0ms	0%
	Evening	15523 Kbps	1 ms	0 ms	0%
imissu@unggul	Morning	3858 Kbps	2 ms	0 ms	0%
	Afternoon	2622 Kbps	3 ms	0 ms	0%
	Evening	11296 Kbps	1 ms	0 ms	0%
Tuesday, 3 September 2019					
imissu@berbudaya	Morning	4815 Kbps	2 ms	0 ms	0%
	Afternoon	2495 Kbps	3 ms	0 ms	0%
	Evening	9634 Kbps	1 ms	0 ms	0%
imissu@mandiri	Morning	10618 Kbps	1 ms	0 ms	0%
	Afternoon	4149 Kbps	2 ms	0ms	0%
	Evening	8286 Kbps	1 ms	0 ms	0%
imissu@unggul	Morning	15079 Kbps	1 ms	0 ms	0%
	Afternoon	5121 Kbps	2 ms	0 ms	0%
	Evening	10797 Kbps	1 ms	0 ms	0%
Wednesday, 4 September 2019					
imissu@berbudaya	Morning	4983 Kbps	2 ms	0 ms	0%
	Afternoon	2972 Kbps	3 ms	0 ms	0%
	Evening	5503 Kbps	1 ms	0 ms	0%
imissu@mandiri	Morning	6641 Kbps	1 ms	0 ms	0%
	Afternoon	5005 Kbps	1 ms	0ms	0%
	Evening	12543 Kbps	1 ms	0 ms	0%
imissu@unggul	Morning	6755 Kbps	1 ms	0 ms	0%
	Afternoon	5103 Kbps	2 ms	0 ms	0%
	Evening	11890 Kbps	1 ms	0 ms	0%

Thursday, 5 September 2019					
imissu@berbudaya	Morning	3968 Kbps	2 ms	0 ms	0%
	Afternoon	2941 Kbps	2 ms	0 ms	0%
	Evening	6082 Kbps	1 ms	0 ms	0%
imissu@mandiri	Morning	6691 Kbps	1 ms	0 ms	0%
	Afternoon	5939 Kbps	1 ms	0ms	0%
	Evening	12399 Kbps	1 ms	0 ms	0%
imissu@unggul	Morning	6745 Kbps	1 ms	0 ms	0%
	Afternoon	5580 Kbps	2 ms	0 ms	0%
	Evening	12423 Kbps	1 ms	0 ms	0%
Friday, 6 September 2019					
imissu@berbudaya	Morning	4285 Kbps	2 ms	0 ms	0%
	Afternoon	3547 Kbps	2 ms	0 ms	0%
	Evening	8811 Kbps	1 ms	0 ms	0%
imissu@mandiri	Morning	5855 Kbps	1 ms	0 ms	0%
	Afternoon	4584 Kbps	2 ms	0 ms	0%
	Evening	14975 Kbps	1 ms	0 ms	0%
imissu@unggul	Morning	7095 Kbps	1 ms	0 ms	0%
	Afternoon	4744 Kbps	2 ms	0 ms	0%
	Evening	14309 Kbps	1 ms	0 ms	0%

Based on the table of QoS parameter measurement result above the highest throughput is on SSID imissu@mandiri with value of 15.523 Kbps while lowest throughput is on SSID imissu@berbudaya with value of 1.350 Kbps. Delay measurement result is < 150 ms. Packet loss and jitter measurement result on each SSID is 0% and 0 ms.

Throughput, delay, jitter dan packet loss measurement results at the Faculty of Economics and Business at Sudirman Campus can be seen in Table 5.

Table 5. QoS Parameter Recapitulation of Faculty of Economics and Business at Sudirman Campus

SSID	Period	Throughput	Delay	Jitter	Packet loss
Monday, 9 September 2019					
imissu@berbudaya	Morning	3117 Kbps	3 ms	0 ms	0%
	Afternoon	4315 Kbps	2 ms	0 ms	0%
	Evening	8608 Kbps	1 ms	0 ms	0%

imissu@mandiri	Morning	4567 Kbps	2 ms	0 ms	0%
	Afternoon	3983 Kbps	2 ms	0 ms	0%
	Evening	3597 Kbps	2 ms	0 ms	0%
imissu@unggul	Morning	3769 Kbps	2 ms	0 ms	0%
	Afternoon	2774 Kbps	3 ms	0 ms	0%
	Evening	4198 Kbps	2 ms	0 ms	0%
Tuesday, 10 September 2019					
imissu@berbudaya	Morning	4372 Kbps	2 ms	0 ms	0%
	Afternoon	3830 Kbps	2 ms	0 ms	0%
	Evening	6279 Kbps	1 ms	0 ms	0%
imissu@mandiri	Morning	5774 Kbps	2 ms	0 ms	0%
	Afternoon	3867 Kbps	2 ms	0 ms	0%
	Evening	9220 Kbps	1 ms	0 ms	0%
imissu@unggul	Morning	6769 Kbps	1 ms	0 ms	0%
	Afternoon	6320 Kbps	1 ms	0 ms	0%
	Evening	6171 Kbps	1 ms	0 ms	0%
Wednesday, 11 September 2019					
imissu@berbudaya	Morning	4659 Kbps	2 ms	0 ms	0%
	Afternoon	3397 Kbps	2 ms	0 ms	0%
	Evening	12372 Kbps	1 ms	0 ms	0%
imissu@mandiri	Morning	5569 Kbps	2 ms	0 ms	0%
	Afternoon	3682 Kbps	2 ms	0 ms	0%
	Evening	11370 Kbps	0 ms	0 ms	0%
imissu@unggul	Morning	5119 Kbps	2 ms	0 ms	0%
	Afternoon	4229 Kbps	2 ms	0 ms	0%
	Evening	11482 Kbps	1 ms	0 ms	0%
Thursday, 12 September 2019					
imissu@berbudaya	Morning	5922 Kbps	1ms	0 ms	0%
	Afternoon	4137 Kbps	2 ms	0 ms	0%
	Evening	10555 Kbps	1 ms	0 ms	0%
imissu@mandiri	Morning	8083 Kbps	1ms	0 ms	0%
	Afternoon	4655 Kbps	2 ms	0 ms	0%
	Evening	10585 Kbps	1 ms	0 ms	0%

imissu@unggul	Morning	8080 Kbps	1ms	0 ms	0%
	Afternoon	4668 Kbps	2 ms	0 ms	0%
	Evening	11614 Kbps	1 ms	0 ms	0%
Friday, 13 September 2019					
imissu@berbudaya	Pagi	4625 Kbps	2 ms	0 ms	0%
	Siang	3903 Kbps	2 ms	0 ms	0%
	Sore	12406 Kbps	1 ms	0 ms	0%
imissu@mandiri	Pagi	7.106 Kbps	1 ms	0 ms	0%
	Siang	5882 Kbps	1 ms	0 ms	0%
	Sore	7424 Kbps	1 ms	0 ms	0%
imissu@unggul	Pagi	7260 Kbps	1 ms	0 ms	0%
	Siang	5101 Kbps	2 ms	0 ms	0%
	Sore	10129 Kbps	1 ms	0 ms	0%

Based on the table of QoS parameter measurement result above the highest throughput is on SSID imissu@berbudaya with value of 12.406 Kbps while lowest throughput is on SSID imissu@unggul with value of 2.774 Kbps. Delay measurement result is < 150 ms. Packet loss and jitter measurement result on each SSID is 0% and 0 ms. Based on the table of QoS parameter measurement result above the highest throughput is on SSID imissu@berbudaya with value of 12.406 Kbps while lowest throughput is on SSID imissu@unggul with value of 2.774 Kbps. Delay measurement result is < 150 ms. Packet loss and jitter measurement result on each SSID is 0% and 0 ms.

5.2 QoS Data Processing

The index result of quality of service with parameters of throughput, delay, jitter and packet loss based on TIPHON version as standard in the Faculty of Social and Political Sciences at Sudirman Campus can be seen in Table 6.

Table 6. QoS Index of Faculty of Social and Political Sciences at Sudirman Campus Based on TIPHON standard

Period	Parameter	Average	Index	Category
imissu@berbudaya				
Morning	Throughput	4037 Kbps	-	-
	Delay	2.2 ms	4	Very Good
	Jitter	0 ms	4	Very Good
	Packet Loss	0%	4	Very Good
Afternoon	Throughput	2661 Kbps	-	-
	Delay	2.8 ms	4	Very Good
	Jitter	0 ms	4	Very Good
	Packet Loss	0%	4	Very Good
Evening	Throughput	7343 Kbps	-	-
	Delay	1 ms	4	Very Good
	Jitter	0 ms	4	Very Good
	Packet Loss	0%	4	Very Good

imissu@mandiri				
Morning	Throughput	6791 Kbps	-	-
	Delay	1.2 ms	4	Very Good
	Jitter	0 ms	4	Very Good
	Packet Loss	0%	4	Very Good
Afternoon	Throughput	4524 Kbps	-	-
	Delay	1.8 ms	4	Very Good
	Jitter	0 ms	4	Very Good
	Packet Loss	0%	4	Very Good
Evening	Throughput	12745 Kbps	-	-
	Delay	1 ms	4	Very Good
	Jitter	0 ms	4	Very Good
	Packet Loss	0%	4	Very Good
imissu@unggul				
Morning	Throughput	7906 Kbps	-	-
	Delay	1.2 ms	4	Very Good
	Jitter	0 ms	4	Very Good
	Packet Loss	0%	4	Very Good
Afternoon	Throughput	4634 Kbps	-	-
	Delay	2.2 ms	4	Very Good
	Jitter	0,001400 ms	4	Very Good
	Packet Loss	0%	4	Very Good
Evening	Throughput	12143 Kbps	-	-
	Delay	1 ms	4	Very Good
	Jitter	0 ms	4	Very Good
	Packet loss	0%	4	Very Good

Based on the table above, analysis of quality of service data processing with SSID imissu@berbudaya in the morning, afternoon, and evening belong to very good category based on TIPHON standardization version, SSID imissu@mandiri in the morning, afternoon, and evening belong to very good category based on TIPHON standardization version, and SSID imissu@unggul in the morning, afternoon, and evening belong to very good category based on TIPHON standardization version.

The index result of quality of service with parameters of throughput, delay, jitter and packet loss based on TIPHON version as standard in the Faculty of Economics and Business at Sudirman Campus can be seen in Table 7.

Table 7. QoS Index of Faculty of Economics and Business at Sudirman Campus Based on TIPHON standard

Period	Parameter	Average	Index	Category
imissu@berbudaya				
Morning	Throughput	4798 Kbps	-	-
	Delay	2 ms	4	Very Good
	Jitter	0 ms	4	Very Good
	Packet Loss	0%	4	Very Good
Afternoon	Throughput	3917 Kbps	-	-
	Delay	2 ms	4	Very Good
	Jitter	0 ms	4	Very Good
	Packet Loss	0%	4	Very Good
Evening	Throughput	10044 Kbps	-	-
	Delay	1 ms	4	Very Good
	Jitter	0 ms	4	Very Good
	Packet Loss	0%	4	Very Good

imissu@mandiri				
Morning	Throughput	6220 Kbps	-	-
	Delay	1.6 ms	4	Very Good
	Jitter	0 ms	4	Very Good
	Packet Loss	0%	4	Very Good
Afternoon	Throughput	4414 Kbps	-	-
	Delay	1.8 ms	4	Very Good
	Jitter	0 ms	4	Very Good
	Packet Loss	0%	4	Very Good
Evening	Throughput	8439 Kbps	-	-
	Delay	1 ms	4	Very Good
	Jitter	0 ms	4	Very Good
	Packet Loss	0%	4	Very Good
imissu@unggul				
Morning	Throughput	6199 Kbps	-	-
	Delay	1.4 ms	4	Very Good
	Jitter	0 ms	4	Very Good
	Packet Loss	0%	4	Very Good
Afternoon	Throughput	4618 Kbps	-	-
	Delay	2 ms	4	Very Good
	Jitter	0 ms	4	Very Good
	Packet Loss	0%	4	Very Good
Evening	Throughput	8719 Kbps	-	-
	Delay	1 ms	4	Very Good
	Jitter	0 ms	4	Very Good
	Packet Loss	0%	4	Very Good

Based on the table above, analysis of quality of service data processing with SSID imissu@berbudaya in the morning, afternoon, and evening belong to very good category based on TIPHON standardization version, SSID imissu@mandiri in the morning, afternoon, and evening belong to very good category based on TIPHON standardization version, and SSID imissu@unggul in the morning, afternoon, and evening belong to very good category based on TIPHON standardization version.

6. CONCLUSION

Quality of service data with parameters of throughput, delay, jitter, and packet loss in imissu@berbudaya, imissu@mandiri, and imissu@unggul at Udayana University have very good quality based on TIPHON standard with average of < 150 ms delay value, 0 ms jitter, and 0% packet loss.

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Management and Information Technology Audit Using the COBIT 5 Framework at Archives and Library Department Bali Region

I Dewa Gede Adi
Department of Information
Technology
Faculty of Engineering
Udayana University
Badung, Bali, Indonesia

Gusti Made Arya Sasmita
Department of Information
Technology
Faculty of Engineering
Udayana University
Badung, Bali, Indonesia

Ni Made Ika Marini Mandenni
Department of Information
Technology
Faculty of Engineering
Udayana University
Badung, Bali, Indonesia

Abstract: Audit and Information Technology Governance Framework is an assessment that required to align an organization's business processes with technology of information. Archives and Library Department Bali Region is the government department that tasked to realizing potential archives and library in their valuable management as a vehicle for learning and preservation towards BALI MANDARA. Anticipating the occurrence of obstacle such as lack of human resources and infrastructure optimization to do an archival services and libraries which potentially make procedural errors happened. It is necessary to conduct a governance audit to determine the capability level of IT processes and the level of gaps. The IT's Processes obtained according to COBIT 5 are EDM 04, APO 06, APO 12, DSS 04, MEA 01. Previously, the domain selection process has been carried out starting from the observation and interview stages to determine the critical point of the department, followed by identification of business objectives with department's critical point, identification of IT objectives, identification of IT processes, and level of importance analysis. The results of the IT process capability level obtained for the average current capability at the agency is a performed process while the target capability desired by the agency is a predictable process. The recommendations are given using the ISO 27002 standard which got through mapping IT process on COBIT 5.

Keywords: Audit; IT Governance; IT Audit; COBIT 5; RACI Chart.

1. INTRODUCTION

The use of information technology in government can increase the effectiveness, transparency, efficiency, and accountability of government administration. The implementation of IT governance runs efficiently and effectively if the agency has previously observed the extent to which IT governance has been implemented to the maximum. One of the government agencies that implement IT governance is the Office of Archives and the Bali Regional Library. The Office of Archives and the Bali Regional Library is an agency tasked with realizing potential libraries and archives in the management of valuable libraries and archives as a vehicle for learning and preservation towards Bali Mandara.

The purpose of this study is to obtain the results of the gap level that previously had obtained the capability level analysis results to be able to provide recommendations for improvements that are in accordance with existing problems in the agency in order to improve the existing IT governance in the Archives and Bali Regional Library. The audit was conducted using the COBIT 5 framework. COBIT 5 is a framework that provides standards in a domain framework consisting of a set of IT processes that represent activities that can be controlled and structured. COBIT 5 integrates good practices in managing information technology and provides a framework for IT governance that can help understanding and managing risks and obtaining benefits related to information technology [1].

2. LITERATURE REVIEW

Research conducted by Maskur, Nixon Adolung and Rusliy Mokodongan discusses the implementation of IT governance

using the COBIT 5 framework. This research was carried out through the identification of IT objectives and IT processes, then mapped with the COBIT 5 framework. The research is used as a reference to determine the level of capability [2].

Research conducted by Ryan Randy Suryono, Dedi Darwis and Surya Indra Gunawan discussed the IT governance audit at the Lampung Sea Aquaculture Center. The method used is COBIT 5 as a reference for conducting audits. Constraints that occur in the Lampung Center for Aquaculture Fisheries, such as human resources who do not understand the e-SKP application. A thorough audit needs to be carried out to provide appropriate recommendations [3].

Research conducted by the State and Yudha Dwi Putra discusses how to identify the level of IT maturity so that related parties can find solutions to all the problems that exist in the academic information system at the Islamic University of Madura. The framework used is COBIT 5 because the method is more focused on the desired IT processes [4].

Research conducted by Aris Irwanto, Lukito Edi Nugroho and Eko Nugroho discusses the financial information system audit at the Audit Board of the Republic of Indonesia. The problem of auditors being the main focus is the lack of knowledge of human resources in using the information system. The COBIT 5 framework is needed as a reference to anticipate these obstacles [5].

3. RESEARCH METHODS

There are several steps in conducting this research. The stages of the research can be seen in Figure 1.

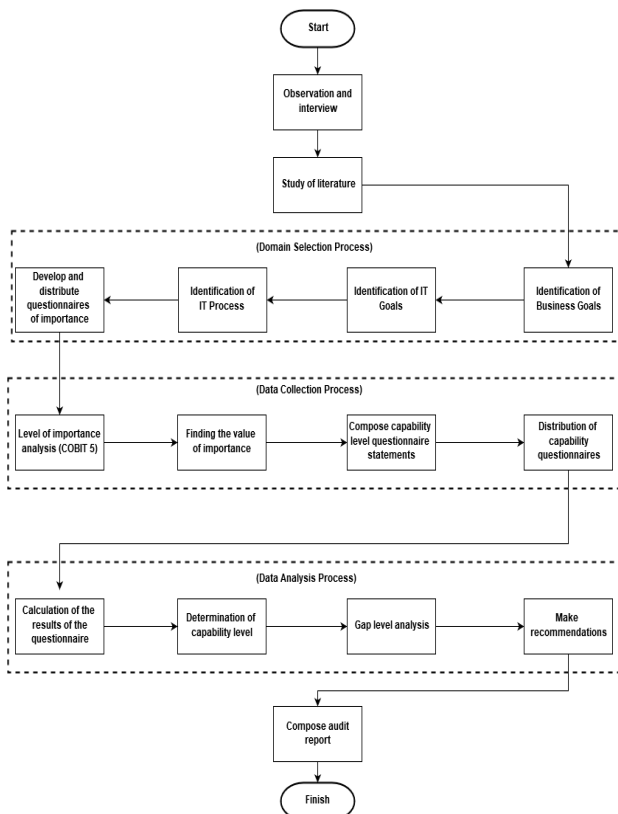


Figure 1. Research Stages

The first stage starts from the process of requesting permission to conduct audits at Archives and Library Department Bali Region. Next is conducting observations and interviews with the highest part that governs the course of information technology management to find out the problems faced. The interview also aims to know more clearly the object to be audited so that research is more directed at the time of the audit process. The next stage is to conduct a literature study related to information technology governance, implementation guidelines using the COBIT 5 framework. The next stage is the domain selection stage. This stage consists of several interrelated processes namely identifying business goals, identifying IT goals, identifying IT processes and compiling a questionnaire of importance. Identification of business goals aims to match business goals and critical points in agencies with business goals that exist in COBIT 5. Identification of IT goals aims to see the relationship between the organization's business goals from the matching business goals with IT goals on COBIT 5. IT process identification is the process of finding domain processes that are in COBIT 5 that are associated with previously mapped IT goals. The IT process that has been selected will then be carried out the preparation of a questionnaire of importance. The function of this level of importance questionnaire is to find out the opinion of the higher-ups of the institution regarding the importance of each IT process. The results of the importance level questionnaire, will then be summarized according to the results of the domain of importance level obtained through the highest assessment.

The next step is determining capability level through the capability questionnaire that has been made, which after getting the results of the questionnaire then analyzes the data. At the stage of data analysis the calculation of the results of the questionnaire was filled out by the respondents. The results of the answers to the questionnaire statements will be analyzed and then the level of maturity is calculated using the

capability level assessment method. Furthermore, the gap level analysis is done by comparing the expected level of maturity with the current level of maturity. The level of gaps obtained is then given recommendations for improvement using development procedures based on COBIT 5 high level control objectives. The last stage is the preparation of audit report.

4. CONCEPTS AND THEORIES

Concepts and theories contain explanations of supporting theories that will be used in this study. These theories include Audit, Information Technology Audit, IT Governance, RACI Chart, and COBIT 5. The theory will be discussed as follows.

4.1 Audit

Audit or examination in the broadest sense means an evaluation of an organization, system, process or product. An audit is carried out by a competent, objective and impartial party called an auditor. The aim is to verify that the subject of the audit has been completed or is running according to accepted, accepted standards, regulations and practices [6].

4.2 Information Technology Audit

Information Technology Audit is an activity of collecting data and evaluating evidence to determine whether IT processes in the company have been managed in accordance with standards that are equipped with objective controls to monitor their use and whether they have met business objectives effectively [7]. Information Technology Audits can emphasize the use of integration between propriety and substantively tests whose composition is used in a balanced manner in accordance with the conditions of the process being audited. Information Technology Audit as a process of gathering and evaluating evidence to determine whether information systems can protect assets, existing information technology has maintained data integrity so that both can be directed towards achieving business objectives effectively by using resources effectively [8].

4.3 IT Governance

IT governance is the process of governance for decision making by ensuring the allocation of IT usage in the strategies of the organization concerned. IT governance reflects the application of organizational principles with a focus on management activities and the use of IT for organizational achievement [9].

4.4 RACI Chart

The RACI Chart is a matrix of all activities and authority in the organization that helps in making decisions. An explanation of the RACI chart includes having a responsibility that explains who is responsible for the given task. This refers to the main role or the person in charge of operational activities, meeting the needs and creating desired results for the organization. Accountable explains who is responsible for the success of the task. This refers to overall responsibility for the task that has been done. Consulted explained who provided input. This refers to the role that is responsible for obtaining information from other units or external partners. Informed explains who received the information. This refers to the role that is responsible for receiving the right information to oversee each task performed [10].

4.5 COBIT 5

COBIT 5 is a framework that can help companies or organizations achieve their goals for corporate IT management and management. Simply put COBIT 5 helps companies create optimal value from IT by maintaining a balance between getting benefits and optimizing the level of risk and using resources. COBIT 5 allows IT to be managed and managed in a more comprehensive way for the entire scope of the company, covering the entire scope of business and the functional area of IT, taking into account the interests of internal and external stakeholders associated with IT [10] .

5. RESULT AND DISCUSSION

The results and discussion of the audit process begins with the domain selection process which includes identification of business objectives, identification of IT objectives, and identification of IT processes. The data collection process includes analyzing the level of importance and finding the value of the level of importance. The data analysis process includes determining capability levels, analyzing gap levels and making recommendations for improvement.

5.1 Identification of Business Goals

The identification of business goals is the stage of mapping business objectives contained in COBIT 5 with the agency's critical point. This stage is carried out by analyzing the critical point in the Archives Service and the Bali Regional Library as the center of IT operations which is matched with the business goals contained in the COBIT 5 framework. Mapping critical points with COBIT 5 business goals is shown in Table 1.

Table 1. Mapping Critical Points with COBIT 5 Business Goals

Critical Point	No.	Business Goals	Performance Perspective
Limitations of human resources in operating computer systems at the Office of Archives and the Bali Provincial Library	16	Skilled and motivated employees	Learning and Growth Perspective
Infrastructure facilities are less than optimal due to lack of budget	12	Optimization of business process costs	Internal Perspective
There is no clear book coding standard and book grouping	11	Optimization of business process functions	Internal Perspective
The IT application system at the Bali Archives and Regional Library is not functioning optimally	11	Optimization of business process functions	Internal Perspective
There is no IT-based archiving service at the Bali Archives and Regional Library Office	11	Optimization of business process functions	Internal Perspective

Table 1 is a mapping of critical points with business objectives carried out based on the COBIT 5 framework. The mapping results were based on the results of analysis and interviews at the Bali Archives and Regional Library Office.

5.2 Identification of IT Goals

The identification of IT goals is done by looking at the results of the matching of the critical points of agencies with COBIT 5 business goals. COBIT 5 business goals that have an equivalent with the agency's critical point. Then mapped with the aim of IT COBIT 5 which can be seen in Table 2.

Table 2. Mapping Business Goals with IT Goals

No.	Business Goals	IT Goals
11	Optimization of business process functions	1,7,8,11
12	Optimization of business process costs	6,11
16	Skilled and motivated employees	11,16,17

The results of mapping IT objectives obtained are numbers 1,6,7,8,11,16, and 17 based on the COBIT 5 framework. Explanation of each IT objective is presented in Table 3.

Table 3. Explanation of IT Goals

No.	IT Goals
1	Aligning IT with business strategies
6	Transparency in IT costs, benefits, and IT risks
7	Delivery of IT services that suits business needs
8	Appropriate use of applications, information and technology solutions
11	Optimization of assets, resources and IT capabilities
16	IT personnel who are competent and have motivation towards the existing business
17	Knowledge, expertise and initiatives for business innovation

Table 3 is the result of mapping IT goals with business objectives. The purpose of IT is then used to map the IT process so that the results of the IT process focus on the company's critical points.

5.3 Identification of IT processes

After the IT goals and business objectives are mapped, the next process is to identify the IT processes on COBIT 5. Referring to the IT objectives obtained, the processes in the COBIT 5 domain are chosen. Mapping of the IT process from COBIT 5 is shown in Table 4.

Table 4. Mapping IT Goals with IT Processes

IT Goals		IT Processes				
		EDM	APO	BAI	DSS	MEA
1	Aligning IT with business strategies	01	01	01		
		02	02	02		
			03			
			05			
			07			
		08				
6	Transparency in IT costs, benefits, and risks	05	06	09		
			12			
			13			

7	Delivery of IT services that suits business needs	05	02 08 09 10 11	02 03 04 06	01 02 03 04 06	01
8	Appropriate use of applications, information and technology solutions		04	05 07		
11	Optimization of assets, resources and IT capabilities	04	01 03 04 07	04 09 10	03	01
16	IT personnel who are competent and have motivation towards the existing business	04	01 07			
17	Knowledge, expertise and initiatives for business innovation		01 02 04 07 08	05 08		

Table 4 is the result of mapping between IT processes and IT objectives. The mapping results obtained 33 interrelated IT processes. The selected IT process can be seen in Table 5.

Table 5. IT Support Process on COBIT 5

Domain	Sub Domain												
	1	2	3	4	5	6	7	8	9	10	11	12	13
EDM	1	2	3	4	5								
APO	1	2	3	4	5	6	7	8	9	10	11	12	13
BAI	1	2	3	4	5	6	7	8	9	10			
DSS	1	2	3	4	5	6							
MEA	1	2	3										

Table 5 explains that there are 33 processes obtained after mapping according to COBIT 5 reference where the process will be filtered again using a questionnaire of the importance level carried out in the relevant agencies.

5.4 Importance Level Questionnaire Result

The determination of the importance level questionnaire refers to the research objectives, agency objectives as well as the critical point of the business process obtained from the importance level questionnaire. Based on observations, 5 IT processes were chosen that fit the audit needs, which can be seen in Table 6.

Table 6. Final Results Questionnaire Importance

Domain	IT Processes
EDM 04	Ensuring resource optimization
APO 06	Manage budgets and costs
APO 12	Managing Risks
DSS 04	Manage continuity
MEA 01	Monitor, evaluate and assess performance

5.5 Capability Level Questionnaire Results

The capability level questionnaire results are obtained after analyzing the capability questionnaire that has been distributed to respondents who have an interest. The following is a table of the results of the analysis of the capability level questionnaire EDM 04 process that can be seen in Table 7.

Table 7. EDM 04 Questionnaire Results

Respondents	Capability Level Process									
	Lv. 1	Lv. 2.1	Lv. 2.2	Lv. 3.1	Lv. 3.2	Lv. 4.1	Lv. 4.2	Lv. 5.1	Lv. 5.2	
1	70	70	80	60	75	70	85	50	75	
2	84	80	85	83	85	85	83	85	84	
3	75	70	55	50	85	20	85	75	75	
4	70	65	75	75	80	60	85	55	80	
5	60	60	75	60	75	60	80	50	75	
Average	72	69	74	66	80	59	84	63	78	

Table 7 shows that the EDM04 process was at level 1, because the average value obtained from the five respondents was 72. The average value of capability is sought from the lowest process capability level with an average value below 85.

Table 8. APO 06 Questionnaire Results

Respondents	Capability Level Process									
	Lv. 1	Lv. 2.1	Lv. 2.2	Lv. 3.1	Lv. 3.2	Lv. 4.1	Lv. 4.2	Lv. 5.1	Lv. 5.2	
1	60	80	50	75	80	85	80	80	85	
2	85	87	83	90	85	90	90	85	85	
3	90	75	75	85	80	65	85	90	90	
4	55	75	50	60	75	80	86	80	80	
5	50	75	50	75	75	80	85	70	85	
Average	68	78	62	77	79	80	85	81	85	

Table 8 shows that the APO 06 process was at level 1, because the average value obtained from the five respondents was 68. The average value of capability is sought from the lowest process capability level with an average value below 85.

Table 9. APO 12 Questionnaire Results

Respondents	Capability Level Process									
	Lv. 1	Lv. 2.1	Lv. 2.2	Lv. 3.1	Lv. 3.2	Lv. 4.1	Lv. 4.2	Lv. 5.1	Lv. 5.2	
1	75	75	80	80	75	85	80	50	85	
2	83	83	90	85	85	90	90	85	90	
3	80	80	85	75	70	90	85	90	90	
4	80	85	85	85	75	85	80	60	95	
5	75	80	85	80	75	85	85	50	90	
Average	79	81	85	81	76	87	84	67	90	

Table 9 shows that the APO 12 process was at level 1, because the average value obtained from the five respondents

was 79. The average value of capability is sought from the lowest process capability level with an average value below 85.

Table 10. DSS 04 Questionnaire Results

Respondents	Capability Level Process								
	Lv. 1	Lv. 2.1	Lv. 2.2	Lv. 3.1	Lv. 3.2	Lv. 4.1	Lv. 4.2	Lv. 5.1	Lv. 5.2
1	70	80	85	70	85	85	80	85	85
2	83	85	83	83	85	85	84	83	86
3	95	85	95	90	85	75	70	70	80
4	65	80	90	70	85	90	80	85	90
5	60	80	90	70	90	90	85	85	90
Average	75	82	89	77	86	85	80	82	86

Table 10 shows that the DSS 04 process was at level 1, because the average value obtained from the five respondents was 75. The average value of capability is sought from the lowest process capability level with an average value below 85.

Table 11. MEA01 Questionnaire Results

Respondents	Capability Level Process								
	Lv. 1	Lv. 2.1	Lv. 2.2	Lv. 3.1	Lv. 3.2	Lv. 4.1	Lv. 4.2	Lv. 5.1	Lv. 5.2
1	90	85	90	90	85	85	80	80	85
2	90	90	90	90	84	85	87	90	90
3	90	75	90	80	70	70	75	80	85
4	90	90	85	90	80	85	85	90	90
5	95	90	95	90	80	90	85	95	85
Average	91	86	90	88	80	83	82	87	87

Table 11 shows that the MEA 01 process was at level 3, because the average value obtained from the five respondents was 80. The average value of capability is sought from the lowest process capability level with an average value below 85.

5.6 Gap Analysis

Gap level analysis is the process of comparing the current level of agency maturity with the expected level of maturity. The gap level of capability level process can be seen in Table 12.

Table 12. Gap Analysis

IT Process	Current Capability (CC)	Expected Capability (EC)	GAP (EC-CC)
EDM 04	1	2	2 - 1 = 1
APO 06	1	3	3 - 1 = 2
APO 12	1	2	2 - 1 = 1
DSS 04	1	2	2 - 1 = 1
MEA 01	3	4	4 - 3 = 1

Gap Average	1,2
-------------	-----

Table 12 is a gap level analysis in which the current capability is at level 1 (Performed Process). This is because the average value obtained from the company's current capability is 1.4 and in general the stages of the process that have been implemented have successfully carried out the IT process and achieved the objectives of the IT process. Expected capability is the capability desired by the company where for the EDM 04 IT process the desired capability is level 2 (Managed Process). The GAP value is obtained from the difference between expected capability and current capability, where the average gap obtained is 1.2. Gaps can occur because companies have not implemented COBIT 5 standards within the company so that IT governance has some differences with what is implemented by COBIT 5.

5.7 Recommendations for Improvement

Current conditions, conditions of hope and suggestions for improvement are given based on the COBIT 5 framework. Analysis of recommendations for improvement can be seen in Table 13.

Table 13. Analysis of Recommendations for Improvement

Domain	Current Conditions	Condition of Hope	Recommendations for Improvement
EDM 04	Lack of competent human resources	So that the existing human resources in the department can be competent and can operate existing computer systems to input book catalogs on the Inlislite information system	Provide a special training for HR who are not yet experts and competent in their fields, especially in operating computer systems (library information systems) such as computer basics training, especially Microsoft Excel
	in total there are 25 computers only 10 computers that can be used, 2 printers and 2 Wi-Fi routers cannot be used	The rejuvenation of infrastructure and the replacement of damaged computers with new computers and the addition of printers so that SOP can run well	Communicating the problem of lack of IT equipment to the relevant institutions in this case is the Ministry of Communication and Information, which is assistance for the necessary facilities such as the addition of computers, printers, and the addition of bandwidth and with regular repairs

APO 06	Lack of budget to buy and maintain IT devices such as computers, printers and Wi-Fi routers	Budget / cost transparency for maintaining and purchasing IT equipment that has been damaged to maximize business processes and SOP	The flow of funds to be used should be notified to all members in the form of a ledger to make it easier for all members to know the budget for the funds to be used
APO 12	Not all book catalogs have been entered into the inlislite system	The existence of a regular and clear book coding system and book grouping in the inlislite information system	It is recommended to enter a book catalog in accordance with the book code in the Inlislite information system
	There is no media for data backup outside the system that is safe in the library information system	The existence of a secure data backup media other than inlislite to prevent the loss of data catalog books that exist in the inlislite information system	Make secure data backup media such as NAS (Network Attached Storage), which is data storage media in an internet network that is separate from the PC. And do a full data backup every time a book catalog has been changed
DSS 04	IT officers are not responsive in handling when an incident occurs	IT officers are expected to quickly deal with disruptions to existing IT services at the service so that the IT process can run optimally	Coordinate all stakeholders involved in the IT service process to conduct a thorough and gradual review and evaluation
MEA 01	Most of the book catalog search process is still using manual methods and laying books are still irregular	A library service information system needs to be effective in the book search process	recruiting officers who are experts to assist in the process of inputting a book catalog

6. CONCLUSION

The level of information technology governance maturity that exists in the agencies of the 5 IT processes selected, namely for the IT process EDM04, obtaining an average value of capability 72. This can be identified that the EDM04 process has been implemented and successfully achieved its objectives. The IT process APO06 obtained an average rating of 68 capabilities. This can be identified that the APO06 process has been implemented and successfully achieved its objectives. The APO12 IT process scores an average of 79 capabilities. This can be identified that the APO12 process has

been implemented and successfully achieved its objectives. The DSS 04 IT process has an average capability rating of 77. This can be identified that the DSS04 process has been implemented and successfully achieved its objectives. The MEA01 IT process has an average capability rating of 80. It states that the MEA 01 process has been implemented using certain predetermined processes, which are able to achieve the expected results. The result of the gap level value obtained from the gap analysis between the current capability level and the capability expected by the agency is 1.2.

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Business Process Reengineering at Bakery X with the Odoo Application Implementation

Made Diah Pradnya Pramitadewi
Department of Information
Technology
Faculty of Engineering
Udayana University
Badung, Bali, Indonesia

Dwi Putra Githa
Department of Information
Technology
Faculty of Engineering
Udayana University
Badung, Bali, Indonesia

Ni Kadek Dwi Rusjyanthi
Department of Information
Technology
Faculty of Engineering
Udayana University
Badung, Bali, Indonesia

Abstract: Bakeries are one of the business ventures that have intense business competition. However, the sales, procurement, and production processes that are still manual make it difficult to maintain market share, so it is necessary to be efficient in all fields including ongoing business processes in order to increase competitiveness. The way to improve business process efficiency is to improve business processes by applying the concept of Business Process Reengineering. Techniques to determine the success of performance targets in previous business processes need to be used as a measuring instrument. Measuring test instruments used are Key Performance Indicators. The results of KPI measurement are four factors that has yet to be achieved, namely, reducing errors in making sales invoices, reducing errors in receiving raw materials, reducing errors in the purchase of raw materials, and reducing misuse of raw materials. To improve business processes that are still conventional and overcome the problems of the results of the KPI at the bakery, it is necessary to create a new business process that is systemized using the Odoo Application. After using the Odoo Application the problems contained in the KPI results can be overcome by using a number of Odoo modules related to sales, procurement, and production.

Keywords: Business Process Reengineering, Key Performance Indicators, Sales Process, Procurement Process, Production Process, Odoo Application.

1. INTRODUCTION

A company needs new innovations to survive in the competitive world of business in this modern age. This innovation is carried out to maintain existing market share and capture new market share. The company must also make efficiency in all fields including existing or ongoing business processes in order to increase competitiveness [1].

The solution to improve business process efficiency is to improve business processes by applying the concept of Business Process Reengineering (BPR). The concept of BPR is a change management technique for ongoing business processes to improve the efficiency, effectiveness, and service of business processes [2] [3]. Techniques to determine the success of performance targets in previous business processes need to be used as a measuring instrument. Measuring test equipment used is KPI (Key Performance Indicators) [4]. KPIs are used to monitor the performance of each business process, which is the main indication of measurement that determines how well the business process performance is to be achieved [5].

Implementation of business process improvement is done using the Odoo Application. Odoo is a management system application in which there are several integrated modules that can be used in various sectors, one of which is the trade sector, making it suitable for implementing business processes in bakery [6]. The business process at a bakery is related to the business process of selling, purchasing raw materials and producing. The modules contained in the Odoo Application that are suitable for use in implementing business processes in a bakery are the Manufacturing, Invoicing, Sales Management, Warehouse Management, and Purchasing modules [7]. The design of new business processes by utilizing information technology such as the Odoo

Application can add value to new business processes that are created [8].

This research utilizes the Odoo Application to analyze and help improve business processes in different case studies, namely at the bakery so as to increase the efficiency of time and costs incurred. The concept used in this research is Business Process Reengineering (BPR) with the implementation of the Odoo Application.

2. LITERATURE REVIEWS

Much research has been done on improving business processes and the use of Odoo, one of which is a journal that discusses the implementation of warehouse management information systems based on Enterprise Resource Planning using Odoo Applications [9]. Subsequent research on Business Process Reengineering with the Implementation of Open ERP in the sales and procurement process uses the Odoo Application [10].

3. RESEARCH METHODS

3.1 Research Flow

The first stage of the research is determining where to conduct the research and then conducting research licensing. The second stage is collecting data that can be done by studying literature from books, journals or e-books, but it can also be done by conducting interviews and direct observation. The third stage, after the data is collected and then conduct an analysis of old or ongoing business processes. After that, measuring performance on the old business processes, then making recommendations or modeling new business processes and implementing them to the Odoo Application.

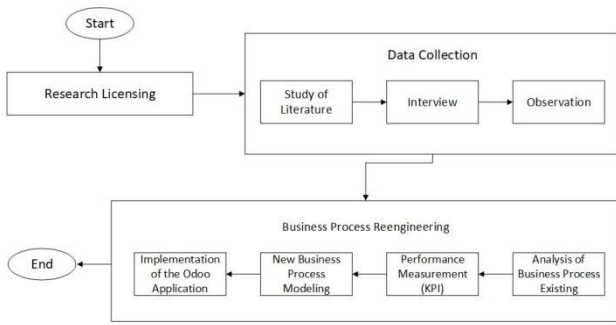


Figure 1. Research Flow

Figure 1 is the flow of research that contains a series or stages carried out in business process improvement studies in bakery X with the concept of business process reengineering.

3.2 Overview

This overview explains the implementation of new business processes that use the Odoo Application. The modules in Odoo that are needed in the process of selling, procurement, and production in the bakery X are the Purchase module, the Sales module, the Inventory module, the Manufacturing module, and the Invoicing module.

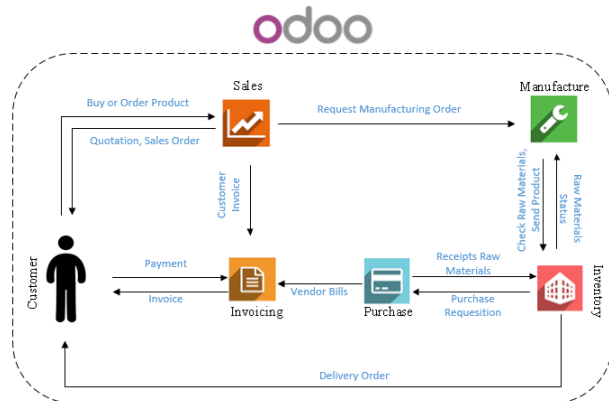


Figure 2. Overview

Figure 2 is an overview of the system usage of the Odoo Application which uses five modules. The Sales module is used for the sales process, the Manufacture module for the production process, the Purchase module for the procurement process, the Inventory and Invoicing modules are additional modules related to other modules.

3.3 KPI Measurement

KPI (Key Performance Indicators) measurements are carried out in three categories, namely measurements for the sales, procurement and production processes.

3.3.1 Sales

There are three KPI measurements in the sales process, namely calculating the percentage increase in the number of products sold (A1), the percentage of errors in making sales invoices (A2), and the percentage of the level of customer satisfaction with the products sold (A3).

$$A1 = \frac{(\text{Total of new sales} - \text{Total of old sales})}{\text{Total of old sales}} \times 100\% \quad (1)$$

$$A2 = \frac{\text{Total invoice error creation}}{\text{Total transaction}} \times 100\% \quad (2)$$

$$A3 = \frac{(\text{Total customer score} - \text{Total customer complain})}{\text{Total customer score}} \times 100\% \quad (3)$$

3.3.2 Procurement

There are three KPI measurements in the procurement process, namely counting the percentage of raw material receipt (B1), the percentage of purchase errors of raw material (B2), and the percentage of the number of delays in the delivery of raw materials (B3).

$$B1 = \frac{\text{Total error of receipt}}{\text{Total receipt}} \times 100\% \quad (4)$$

$$B2 = \frac{\text{Total error of purchase}}{\text{Total purchase}} \times 100\% \quad (5)$$

$$B3 = \frac{\text{Total shipping delays}}{\text{Total shipping}} \times 100\% \quad (6)$$

3.3.3 Production

There are three KPI measurements in the production process, namely calculating the percentage of the number of production orders that can be fulfilled (C1), the percentage of misuse of raw materials (C2), and the percentage of the number of defective products (C3).

$$C1 = \frac{\text{Total orders that can be fulfilled}}{\text{Total orders}} \times 100\% \quad (7)$$

$$C2 = \frac{\text{Total abuse of raw materials (per product)}}{\text{Total products produced}} \times 100\% \quad (8)$$

$$C3 = \frac{\text{Total defective products}}{\text{Total products produced}} \times 100\% \quad (9)$$

4. CONCEPTS AND THEORIES

4.1 Business Process Reengineering

Business Process Reengineering is a fundamental rethinking and radical redesign of a business process to achieve dramatic improvements [11] [12] [13]. By measuring current performance through the elements of cost, quality, service, and speed [14]. The steps in carrying out the BPR process can be explained as follows [15].

1. Position yourself for change, in this case must position the company and determine why it must change. Change to what or what you want to focus on. Develop a focus for change and mobilize resources for implementation.
2. Conduct a diagnosis of the current process, in this case must know how the current process is and what it looks like, and why the current system is designed like that. This understanding when associated with the customer's will, then forms the basis for fundamentally new thinking about the business processes that are made.
3. Redesign business processes, to create new business processes, imagine and think of new ways to organize and carry out processes or activities to meet customer needs and

goals. Seek input from several people to form a vision that encourages improvement in the process.

4. Transition to new design, develop business plans or strategies to change towards a predetermined vision. New process tests are conducted to demonstrate their performance and to show that there are new concepts and at the same time generate enthusiasm, in addition to managing changes that occur at all levels.

4.2 Key Performance Indicators

Key performance indicators (KPI) is a performance measurement tool for a company that reflects the goals to be achieved by a company [16]. Key performance indicators refer to the measurements used to show the performance of each process [17]. Key performance indicators are indicators used to monitor the level of achievement of a company's performance targets. In this case it is often referred to as a company KPI. The determination of company KPI basically must be based on the company's vision and mission, strategy, and strategic objectives of the company. Obtaining KPIs can generally be done through discussions between employees and leaders through interviews, or from internal organizational documents [18].

4.3 Odoo

Odoo is an open source web application which is one of the implementations of ERP (Enterprise Resource Planning). The Odoo application was previously named TinyERP, and in 2009 it was renamed OpenERP. The database on Odoo uses postgresql, while the programming language uses javascript and python [19]. Odoo is a management system application that can be used by large, medium or small companies and can be applied in various sectors, such as trade, textiles and so on. Odoo application has various integrated modules in it which help in running a business, such as Manufacturing, Invoicing, Sales Management, Warehouse Management, Purchasing, Point of Sale and others [7].

Odoo has three components in its architecture, namely the database, server and client components. The database handles the storage of information that is run by Odoo servers, the server handles business logic and interactions with database applications, while the client provides information to the user and allows it to be operated with the server using other applications [20].

According to Jindal and Singh Dhindsa the benefits of using Odoo for the company are as follows [21].

1. The ability to adapt is better because it is open source and easier to adjust.
2. Vendor dependency becomes lower because it is open source, so the company does not depend on the software owner.
3. Lower implementation costs, because there are no licensing fees and only basic infrastructure is needed to get good application performance.
4. Easier to integrate, because Odoo uses a common database, hardware and operating system.
5. Odoo has good quality on the technical side because it is supported by the community.

5. RESULT AND IMPLEMENTATION

5.1 KPI Analysis

The results of the analysis of business process performance measurement at bakery X using the KPI (Key Performance Indicators) measurement model can be seen in the following table.

Table 1. KPI Measurement Result

Category	No	KPI	Result	Target
Sales	A1	Percentage increase in the number of products sold	22,9%	Min 20%
	A2	Percentage of errors in making sales invoices	1,18%	0%
	A3	Percentage of customer satisfaction	100%	Min 95%
Procurement	B1	Percentage of error in receipt of raw materials	4,28%	0%
	B2	Percentage of purchase error of raw material types	2,85%	0%
	B3	Percentage of many late delivery of raw materials	0%	0%
Production	C1	Percentage of the number of production orders that can be fulfilled	100%	100%
	C2	Percentage of misuse of raw materials (per product)	1,59%	0%
	C3	Percentage of total defective products	0%	0%

There were four results of KPI performance measurements in the table above, namely A2 in the sales category, B1 and B2 in the raw material procurement category, and C2 in the production category. The four factors that do not reach the target can be overcome by using the Odoo Application.

5.2 Current vs Business Processes

Current or ongoing business processes are still conventional so everything is done manually. While the new business processes use the Odoo Application which is already systemized and integrated.

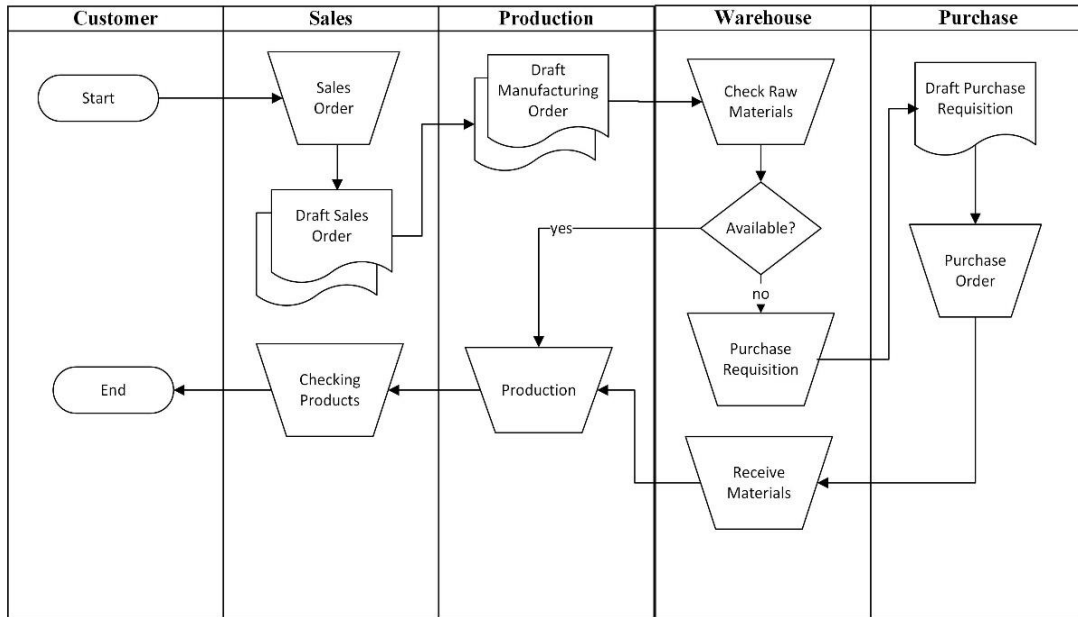


Figure 3. Ongoing or Current Business Process

Figure 3 shows the flow of the ongoing business processes. The ongoing business process is still conventional and inefficient because the process is still manual. The sales process is still recorded directly by the employee. The process of procuring raw materials is also manual, in which the warehouse section checks the availability of raw materials first, if there is a lack of availability, then it is coordinated to the purchasing department to purchase raw materials. The production process is also manual, where the production

department must ask the warehouse to find out the availability of raw material stock.

In the new business process, it uses several modules in the Odoo Application. The selling process involves the sales and invoicing module, the production process involves the manufacturing and inventory modules, while the purchasing process involves the purchase and invoicing module.

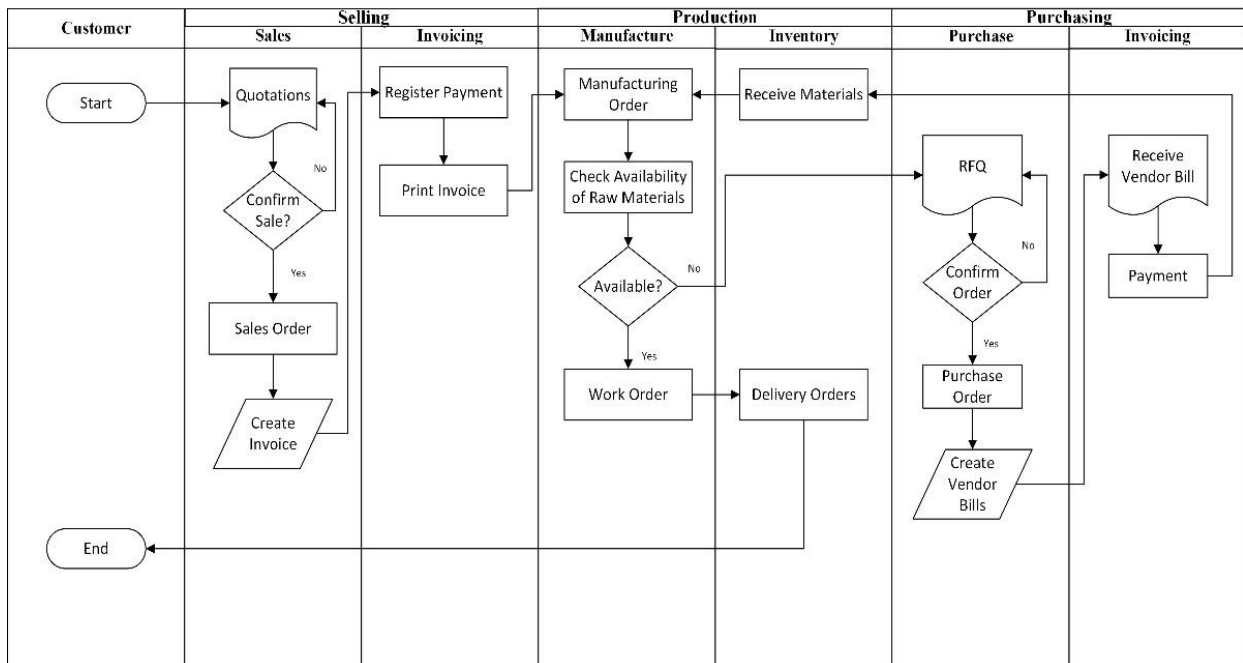


Figure 4. New Business Processes

Figure 4 shows the business process flow according to the Odoo Application. Modeling new business processes using the Odoo Application makes it more efficient because it is systemized. The sales process is efficient because orders are directly inputted and stored in the system. The process of

procuring raw materials is carried out automatically by the system when the stock in the warehouse is running low. The production process is also more efficient because the availability of raw materials is displayed automatically by the system when it wants to do production.

5.3 Implementation by Odoo Application

Implementation with the Odoo Application is carried out in accordance with the new business processes that have been created. The implementation is divided into three processes namely, the sales process, the production process, and the procurement process.

5.3.1 Sales Process

The sales process in the Odoo Application starts when the customer wants to place an order, the sales department makes quotations.

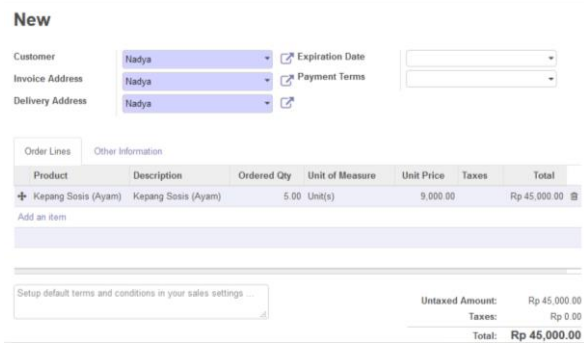


Figure 5. Quotations

Figure 5 is an example of making quotations on the Odoo Application. Quotations is the recording of customer orders. Making quotations is in the Sales module. After completing the quotations, the sales department creates an invoice according to the quotations made.

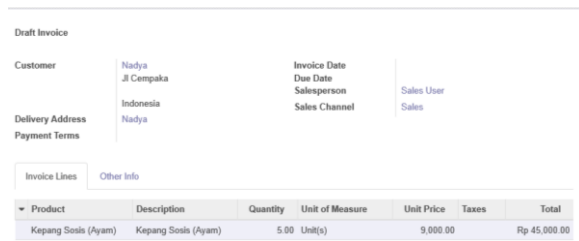


Figure 6. Invoice

Figure 6 is an example of creating invoices on the Odoo Application. Invoices are automatically generated according to customer orders. This automatic invoice creation can help overcome the KPI problem in A2 code, which is to avoid mistakes in making sales invoices.

5.3.2 Production Process

The production process is the process of making goods in accordance with the request of the buyer, after the buyer makes an order. The production process in the Odoo Application is in the Manufacturing module.

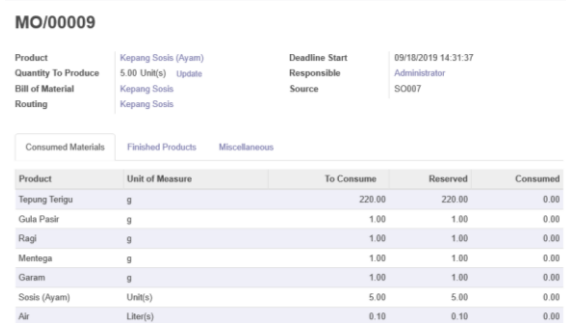


Figure 7. Manufacturing Orders

Figure 7 is an example of display manufacturing orders. Manufacturing orders are lists of production orders ordered by customers. In each order list, below it appears the bills of materials and the required quantities according to the type of product you want to make. These Bills of materials can help overcome the KPI problem in C2 code, namely avoiding misuse of raw materials.

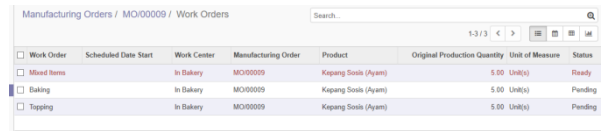


Figure 8. Work Orders

Figure 8 is an example of the appearance of work orders. Work orders are the stages of the production process that are in manufacturing orders. These stages must be carried out sequentially, when it is finished in the last stage, the product is ready and sent.

5.3.3 Procurement Process

The process of procuring raw materials is the process of purchasing raw materials, this process takes place if the availability of raw materials has run low or has reached a minimum stock.



Figure 9. Run Scheduler

Figure 9 is the run scheduler display. Ordering of raw materials can be done automatically by clicking on the run scheduler button in the Inventory module. Run scheduler is done to check which raw materials are out of stock or reach minimum stock. This run scheduler can help to overcome the problem of KPI in B2 code, which is avoiding mistakes in purchasing raw materials.

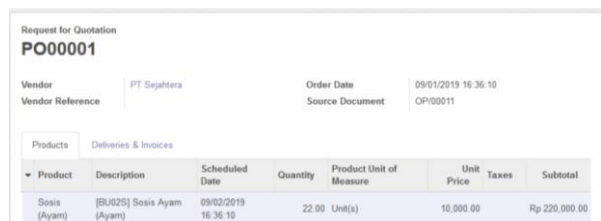


Figure 10. Requests for Quotation

Figure 10 is an example of the display request for quotation or purchase order. A list of raw materials purchased after running the scheduler is automatically displayed on the Requests for Quotation menu in the Purchase module.

Product	Initial Demand	Done	Unit of Measure
Sosis (Ayam)	22.00	22.00	Unit(s)

Figure 11. Receipts

Figure 11 is an example of display receipts. Raw materials that come from suppliers appear in the Receipts feature in the Inventory module, where there is a check on the amount of raw material stock that comes whether it matches the quantity of raw material stock purchased. This checking process can help resolve the KPI problem in code B1, which is to avoid receiving raw materials.

6. CONCLUSION

To improve business processes, old business processes must be analyzed in advance in order to know the existing problems and can make a new business process modeling. KPIs are one way to analyze ongoing business processes. The results of KPI measurement there are four factors that cannot be achieved, namely, reducing errors in making sales invoices, reducing errors in receiving raw materials, reducing errors in the purchase of raw materials, and reducing misuse of raw materials. The results of the KPI are then made a new business process modeling using the Odoo Application to improve the old business processes, so that these four factors can be overcome.

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Operational Audit Result Using Framework COBIT 5 (Case of PT. Jasa Raharja Persero)

Ni Made Ariwira Astuti
Department of Information
Technology
Faculty of Engineering
Udayana University
Badung, Bali, Indonesia

I Ketut Adi Purnawan
Department of Information
Technology
Faculty of Engineering
Udayana University
Badung, Bali, Indonesia

I Putu Agus Eka Pratama
Department of Information
Technology
Faculty of Engineering
Udayana University
Badung, Bali, Indonesia

Abstract: Operational Audit (Operational Audit), is an audit that evaluates the efficiency and effectiveness of each part in the operational procedures and methods applied by the organization / company. This research begins with the identification of business goals, IT objectives, and IT processes. The IT processes that are obtained are then scaled down to obtain important IT processes for company leaders (Top Level Management). The IT processes obtained are DSS 02, EDM 01, APO 05, and then are used as material to determine the level of capability of the company level. The results of the audit using these 3 domains namely DSS 02 are at level 2, EDM 01 is at level 2, and APO 05 is at level 2. This study also compares the results of the audit (current capability) with the expectations of company officials (expected capability) Gap obtained when there is a difference between (current capability) and (expected capability). Suggestions and improvements are then given to the process that has a GAP so that in the future in accordance with expected.

Keywords: IT Audit, Ability Level, Framework COBIT 5, Operations, IT Process.

1. INTRODUCTION

IT Governance is a concept that develops from the private sector, but with the growing use of Information Technology (IT) by government organizations, IT Governance must also be applied in this sector. The role of IT Governance is no doubt in achieving the goals of an organization that adopts IT. IT Governance is basically the activity of managing the use of IT in order to produce maximum output in the organization, helping the decision making process and helping the problem solving process.

IT audit is the process of gathering and evaluating evidence to determine whether the computer system used has been able to protect the assets of the organization, able to maintain data integrity, can help achieve the goals of the organization effectively, and use resources owned efficiently. COBIT is a framework that provides standards within a domain framework consisting of a set of IT processes that represent activities that can be controlled and structured [1].

Operational Audit is a term used for the purpose of testing carried out is to determine the effectiveness and efficiency of organizational units. The purpose of conducting operational audits is to increase the effectiveness of the performance of employees or management who carry out activities in the company. Besides operational audits are also useful as a control tool so that the company's operations run well and correctly.

PT. Jasa Raharja is a state-owned company engaged in the field of social insurance, namely accident insurance, and the operationalization of its business is the implementation of Law No. 33 (passenger accident coverage) and Law No. 34 of 1964 (coverage of road traffic accidents). For accident victims who are passengers of public transportation, whether or not it is based on the law. No 33 of 1964, while for victims of road traffic accidents who are not passengers of public transportation, guaranteed or not based on the Act. No. 34 of 1964. Claim Services Section PT. Jasa Raharja (Persero) Bali Branch is a field that provides compensation claim services

for accident victims in accordance with Law No. 33 and Law No. 34 of 1964. Some people experienced dissatisfaction with the services provided by PT. Jasa Raharja (Persero) Bali Branch. These obstacles need to be addressed to improve the quality of compensation claims services at PT. Jasa Raharja (Persero) Bali Branch.

2. OBJECTIVE OF THE STUDY

The study aims to provide advice and improvements on the performance of the compensation claims service process at PT. Jasa Raharja (Persero) Bali Branch.

3. LITERATURE REVIEW

IT Governance is a concept developed from the private sector, but with the development of the use of Information Technology (IT) by government organizations, IT Governance must also be applied in this sector. The use of information technology (IT) in most companies is no longer a rare commodity found. It is also undeniable about the information technology that is needed when needed for the organization in running its business. IT is needed by organizations to help achieve it, but IT procurement requires a large investment. IT investment that has been spent by the company must be able to run optimally. The role of IT Governance is undoubtedly in achieving the goals of an organization adopting IT Previous research related to this research is "Evaluation of BPJSTK Mobile Services Using Domain Deliver, Service and Support Based on COBIT 5 Framework (Case Study: BPJS Employment of Mataram Branch)" explains about BPJSTK Mobile services that are not optimal in carrying out their duties and achieving goals, so that BPJSTK Mobile is evaluated using the COBIT 5 framework so that the information technology implemented is as expected [2]. Based on this research it is necessary to have a study entitled "Operational Audit of PT. X claims service area "which focuses on the use of IT systems, business processes and to find out the level of maturity or capabilities

then provide advice and improvements. This is done so that the utilization of information technology goes as expected to find out the capability level in accordance with the objectives of the strategic plan (IT strategic) that has been made.

4. CONCEPTS AND THEORIES

4.1 COBIT 5

COBIT (Control Objectives for Information and Related Technology) is an IT governance work arrangement and set of supporting tools that enable managers to bridge the preparation / difficulty of controlling needs, technical issues and business risks. COBIT allows the development of clear policies and good practices for controlling IT throughout the organization. COBIT approved according to regulations, helps organizations to increase the value obtained from IT, adjusts alignment and simplifies the implementation of COBIT agreements [3].

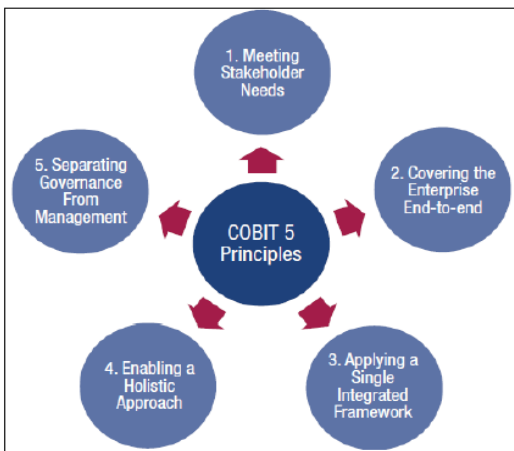


Figure. 1 Principles in COBIT 5

4.2 IT Audit

Information technology audits are the process of gathering and evaluating evidence to determine whether a computer system can secure assets, maintain data integrity, can encourage the achievement of organizational goals effectively and use resources efficiently [4].

4.3 IT Governance

Information Technology governance taken from the IT Governance Institute is a policy framework, procedure and set of company regulations to produce a system of supervision and transparency in IT utilization, which consists of leadership, organizational structure, and processes that ensure that IT companies support and expand strategies and organizational goals [5].

5. RESEARCH OF METHODOLOGY

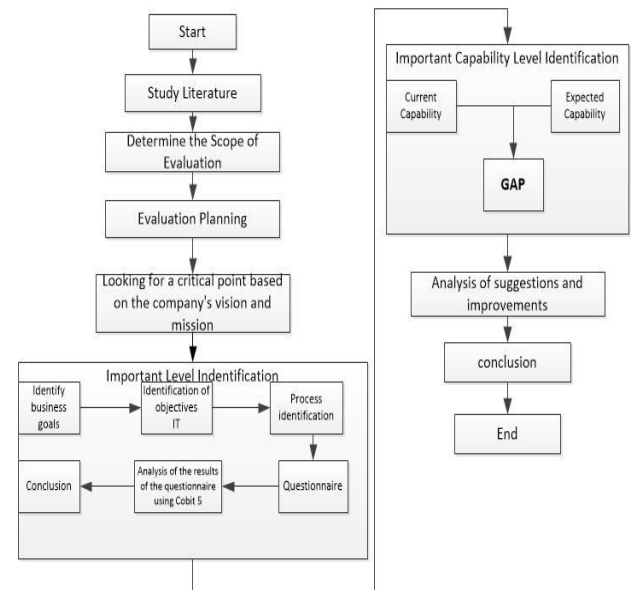


Figure 2. Research Flow

The steps taken in the process of determining the capability level at PT.X include literature study, determining the scope of the company, making evaluation plans, looking for critical points of the company, looking for the level of company interest by doing (mapping business objectives, mapping IT objectives, mapping IT processes), data collection, data processing, data analysis, data testing, and suggestions for improvement if needed.

6. ANALYSIS AND RESULT

6.1 Identification of Business Objectives

In this process a mapping of the mission of PT. X on the company's business goals according to COBIT 5. The following table is the result of mapping between the company's mission and business objectives according to COBIT.

TABLE 1. MAPPING OF COMPANY GOAL WITH COBIT 5 BUSINESS GOAL

PERFORMANCE PERSPECTIVE	NO	BUSINESS GOAL	COMPANY GOAL
Financial	1	Stakeholder value of business investments	1.Community service. 2. Serving the State.
Customer	6	Customer oriented service	3.Devotion to the Company.
Internal	13	Managed business change	4. Devotion to the

		programmes	Environmen.
Learning & Growth	17	Product and business innovation culture	

6.2 Importance of Determination

Determination of the level of importance is part of the detail of the IT process needed to support IT processes in the company. In determining this level of importance, not all IT processes are used by auditors because of time constraints in research, therefore only the top three processes are chosen.

TABLE 2. IMPORTANCE OF DETERMINATION

Process	Respondent					
	1	2	3	4	5	value
DSS02	0	0	0	0	5	25
EDM01	0	0	0	5	0	20
APO05	0	0	0	5	0	20

6.3 Process Domain With Highest Value

The value of the importance level questionnaire above is obtained from the 3 processes that have the highest value and later the audit will be carried out in more detail at the capability level.

**TABLE 3
PROCESS DOMAIN WITH HIGHEST VALUE**

Domain	IT Process
DSS 02	Ensuring the company's operational service levels are reached and the IT tools used can withstand and be repaired from failures and problems encountered.
EDM 01	Make plans and expand business strategies and meet the IT operational needs transparently to the activities carried out by PT. X.
APO 05	Monitor and optimize the overall performance and service of all programs.

6.4 Result Capability Level

The results of the capability level questionnaire have been analyzed and obtained 3 domains that have the highest value, namely DSS 02, EDM 01, and APO 05. Following are the results of the capability level questionnaire that was filled out

by respondents at PT.X.

TABLE 4. CAPABILITY DOMAIN DSS 02

Capability Level Process										
No	Respondent	Lv 1	Lv 2.1	Lv 2.2	Lv 3.1	Lv 3.2	Lv 4.1	Lv 4.2	Lv 5.1	Lv 5.2
1	A	96	91	89	98	97	90	89	93	95
2	B	93	88	81	87	91	92	83	87	89
3	C	77	90	84	87	87	80	79	86	83
4	D	83	84	78	87	81	84	83	83	80
5	E	85	89	76	83	85	86	80	80	84
6	F	100	96	90	96	95	89	93	93	91
7	G	83	86	83	86	87	93	86	86	88
8	H	83	83	83	85	83	85	85	82	85
9	I	90	88	77	94	86	85	81	84	84
10	J	93	79	76	88	87	82	80	84	84
Level Average										
		88	87	82	89	88	87	84	86	86

6.5 GAP Level

Determination of the target of IT process Capability in this study was conducted by interviewing the leadership of the company to find out the current IT processes. Target Capability of this IT process is determined by looking at the internal environment and business processes and expectations of company leaders. The following is a table of the current level of Capability (current Capability), the level of Capability expectation of company leaders (expected Capability), and the difference in Capability (gap).

TABLE 5. GAP LEVEL

IT Process	(CC)	(EC)	(EC – CC)
DSS 02	2	3	1
EDM 01	2	3	1
APO 05	2	3	1

6.6 Recommendation Process

Recommendations to overcome the Capability gap for compensation claims services, there are 3 (three) important domains. Furthermore, suggestions are given that the Capability level can reach largely achieved or fully achieved at level 3 if possible. Recommendations and suggestions refer to COBIT 5 standard.

TABLE 6. RECOMMENDATION PROCESS

No	Domain	
1	DSS 02	Ensuring the company's operational service levels are reached and the IT tools used can withstand and be repaired from failures and problems encountered. PT. Jasa Raharja (Persero) must be able to maintain the quality of IT, especially in the operational section, it is expected to conduct periodic checks on devices related to IT operations to ensure that the devices do not experience problems when used.
2	EDM 01	Make plans and expand business strategies and meet the IT operational needs transparently to the activities carried out by company. PT. Jasa Raharja (Persero) is expected to carry out careful planning in expanding business strategies by holding operational members' meetings to find out the objectives of meeting transparent operational needs and to ensure that the ongoing processes can meet the company's business plans.
3	APO 05	<p>Monitor and optimize the overall performance and service of all programs. The following is a recommendation from PT. Jasa Raharja (Persero), namely:</p> <ol style="list-style-type: none"> 1. The company validates that active IT investment and services are aligned with the company's vision and the goals of the company's architecture vision. 2. The company identifies categories of information systems, applications, data, IT services, infrastructure, IT assets, resources, skills, practices, controls and relationships needed to support the company's strategy. 3. The company carries out detailed assessments of all business program cases, evaluating strategic alignment, company benefits, risks and availability of resources. 4. Companies can create and maintain IT portfolios according to investment programs, IT services and IT assets, which form the basis of current IT budgets and support IT tactical and strategic plans. 5. The company agrees to use metrics on the methods achieved and how the development of the entire life cycle and project programs are exempt from IT services.

7. CONCLUSION

The conclusion from the research of PT. The claims service X field uses the COBIT 5 framework is to get a Capability level or maturity level that focuses on DSS 02, EDM 01, APO 05. Domains DSS 02, EDM 01, and APO 05 are at level 2 so that they can be implemented in a systematic manner and results from this process in accordance with company objectives.

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Research on Garbage Image Classification Method Based on Convolutional Neural Network

Kangjian Tang
School of Communication
Engineering Chengdu
University of Information
Technology Chengdu, Sichuan

Zhan Wen
School of Communication
Engineering Chengdu
University of Information
Technology Chengdu, Sichuan

Yahui Chen
School of Communication
Engineering Chengdu
University of Information
Technology Chengdu, Sichuan

Wenzao Li
School of Communication
Engineering Chengdu
University of Information
Technology Chengdu, Sichuan

Abstract: The issue of garbage classification has aroused great concern for residents recently. The traditional garbage classification method has a low classification accuracy rate, high cost, and large personnel demand. With the increasing amount of garbage, it is difficult for traditional methods to effectively separate waste. Therefore, consider applying deep learning to the garbage classification problem. This paper uses two types of Convolutional Neural Networks (CNNs)--Inception V3 and Inception V4 to train Huawei's public garbage data set (Garbage Date) and establish a garbage classification model. After experiments, the classification results are compared and the performance of the model is tested. In this paper, by observing the changes in the accuracy rate and cross-entropy loss function of the two models on the training and test sets in the experiment, it is found that both models can obtain higher accuracy of garbage classification. The network model using Inception V4 is more stable and accurate than the network model using Inception V3. The experimental results also show that this method can improve the accuracy of garbage classification in daily life and the efficiency of recyclable garbage collection.

Keywords: Deep learning; Convolutional neural network; Inception

1. INTRODUCTION

The problem of garbage classification and treatment has always been closely related to people's lives. An accurate and efficient method of garbage classification and treatment can promote the sustainable development of society and have a profound impact on saving resources and protecting the environment. Due to the lack of awareness of garbage classification and limited garbage classification equipment, traditional garbage classification methods have the characteristics of low classification efficiency, high cost, and large demand for personnel, and it is difficult to achieve accurate and efficient garbage classification, leading to garbage Classification efficiency and accuracy are very low, and environmental and resource issues are becoming increasingly serious. The method of combining artificial intelligence with garbage classification and processing problems can make up for the disadvantages of traditional garbage processing methods and has the advantages of high efficiency, high accuracy, and low cost.

This paper considers the use of deep learning to classify garbage images using convolutional neural networks. This paper mainly researches the garbage classification method based on convolutional neural networks. Two types of garbage classification models are established by using convolutional neural networks including Inception module--

Inception V3 and Inception V4, and the models are used in Huawei's open garbage dataset Garbage Date was trained and obtained higher accuracy and lower loss function values. The establishment of this model improves the efficiency and accuracy of waste classification and aids with subsequent waste classification processing.

2. RELATED WORKS

In recent years, CNN has been widely used in the field of image processing. Researchers have proposed many convolutional neural network models with superior performance. The proposal of the Inception series network is a milestone in the development history of CNN classifiers. Before the Inception network was proposed, in order to make the neural network's ability to extract event features better, in order to achieve better classification results, most popular universal CNN use stacking of convolutional layers in the network multiple times. Model [8-9]. For example, the AlexNet network proposed by Krizhevsky has extended the depth of its network structure and used network optimization methods such as ReLU and Dropout when constructing the network model [1]. Similarly, the VGG-Net network proposed by Simonyan et al. Also has a deeper network structure and uses a smaller convolution kernel than the AlexNet network [2]. However, the VGG-Net network has a good generalization performance, but also because of the deepening of the network structure, the parameters of its network are very large. Subsequently, a deep convolutional neural network called Inception was proposed. The main feature of the

network structure is that the utilization of computing resources inside the network is improved, and the width and depth of the network are increased while keeping the computing budget constant. The architecture decision is based on the Hebbian principle and multi-scale processing intuition to optimize network quality [3]. The Inception of deep convolution architecture was first introduced by Szegedy et al. And is called GoogLeNet or Inception V1 [3]. With the continuous improvement of the Inception architecture, Batch Normalization [4] was introduced by Ioffe et al., Which is called Inception V2. The Inception system was improved by adding the factorization idea, and the arrangement and size of the convolutional layers were changed to obtain Inception V3 [5]. To reduce the complexity of the modules in the network and make the network modules more consistent, a fast reduction was added to the Inception system. At the same time, a new series of network structures Inception V4 [6- 7].

3. EXPERIMENTAL METHODS AND VERIFICATION

3.1 Network model

The reason why Inception series networks have such excellent performance is that different types of Inception modules are used in the network. The Inception module has multiple size filters in parallel on the same level. Its main advantages include: it can well collect feature information in input images of different sizes, and it can well solve the easy overfitting caused by the network being too deep And gradient updates are difficult to transmit to the entire network, which can greatly reduce the computing resources consumed during the calculation.

The Inception V3 network introduces the idea of Factorization into small convolution, which decomposes a larger two-dimensional convolution into two smaller asymmetric one-dimensional convolutions, which saves many parameters. On the one hand, it speeds up the operation and reduces overfitting. At the same time, it also adds a layer of non-linear extended model expression ability. On the other hand, Inception V3 optimizes the structure of the Inception module and uses branches in the branches of the module [5]. This structure not only improves the training speed of the Inception V3 network but also improves the classification accuracy.

Looking back at the Inception series of networks, we limited the optimization and transformation of the network structure to the changing isolated network components and ignored the rest of the network. The unsimplified network part will make the network look more complicated. So, the Inception V4 network specifies the size of each grid, making a unified choice for the Inception module. Inception V4 network solves the unnecessary complexity of some modules, makes the modules more consistent, and uses more consistent modules to improve performance. Besides, the Inception V4 network also introduces a dedicated reduction block for changing the width and height of the grid, making the network model more concise [6].

Considering the high recognition efficiency and high accuracy of the Inception series network on image classification, this

experiment uses Inception V3 and Inception V4 convolutional neural networks to construct a garbage classification model.

3.2 Experimental verification

The data set selected for the experiment is Huawei Garbage Date. The data includes 40 types of garbage, with a total of 11,087 pictures. In this experiment, Inception V3 and Inception V4 convolutional neural networks were used to train the Garbage Date dataset, and a garbage classification model was established. The performance of the classification model is determined by analyzing the accuracy of the garbage classification model and the value of the cross-entropy loss function. The closer the accuracy rate is to 1, the higher the accuracy of the model. The cross-entropy value describes the distance between two probability distributions. The smaller the cross-entropy value is, the closer the two are, and the closer the value is to 0, the more accurate the classification result. The training results were then tested using a single-class image dataset.

To compare the performance of Inception V3 and Inception V4, this experiment uses the same parameter settings for the basic parameters of the classification models trained by these two neural networks. Select the Garbage Date dataset as the model input, divide the training set and test set in a ratio of 3: 1, set the number of training times to 1,000, the learning rate to 0.001, and the batch-size of training to 64. The specific parameter settings are shown in Table 1 below. During training, the neural network first retrieves the category of the pictures in the data set to form a label. As a classified category, there are a total of 40 categories in this data set, so 40 labels will be formed. Then the pictures in the folder corresponding to each tag are retrieved in turn, and a txt text file corresponding to each picture is generated. When training, input a batch size image to the neural network each time, which can reduce the network training time. After 1000 iterations of training, the training results of the model are finally obtained.

Table 1 Basic parameter settings of the network model

Name of parameters	Value of parameters
Training percentage	75%
Testing percentage	25%
Training steps	1000
Learning rate	0.001
Batch size	64

In this section, two garbage classification models trained using Inception V3 and Inception V4 neural networks are compared. Every 32 iterations in the experiment, the accuracy of the training and testing sets of the model and the cross-entropy function value are output. Figures 3.1, 3.2, and 3.3 are the comparison results of training set accuracy, test set accuracy, and cross-entropy function values in two different

model.

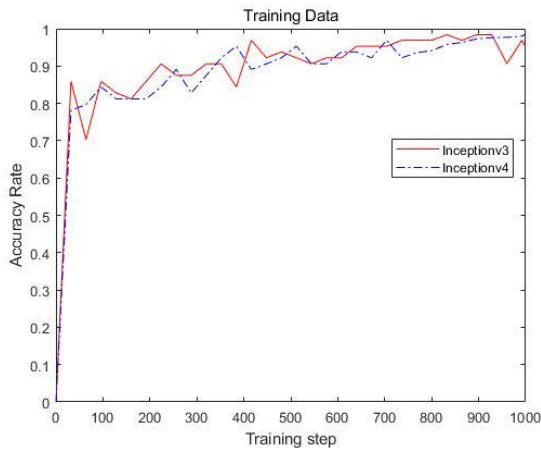


Figure 3.1 Training set accuracy

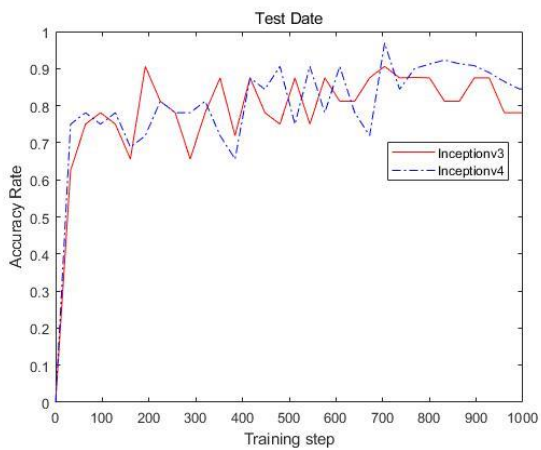


Figure 3.2 Test set accuracy

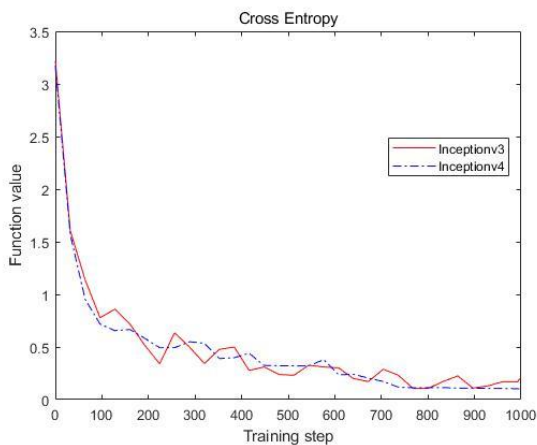


Figure 3.3 Loss function value

The red horizontal line in the figure above represents the model using the Inception V3 neural network and the blue dotted horizontal line represents the model using the Inception V4 neural network. From the three figures, we can know that with the continuous increase in the number of iterations, the accuracy of the two models on the training set and the test set

is increasing. When the number of iterations reaches about 50, the accuracy of the two networks is accurate. The rates increase rapidly and then fluctuate with the number of iterations. When the number of iterations reached about 750 times, the increase in accuracy on the training set and test set of Inception V4 leveled off, while the accuracy on the training set of Inception V3 still fluctuated slightly. The accuracy rate on the test set The fluctuations are still very obvious. After training, the accuracy of Inception v3 on the training set reached 95.3%, and the accuracy on the test set reached 80.2%; while the accuracy of Inception V4 on the training set reached 98.5%, and the accuracy on the test set The accuracy rate reached 84.5%. The cross-entropy function values of the other two networks also decrease with the number of iterations. The cross-entropy function value of Inception V3 fluctuates more than the cross-entropy function value of Inception V4. After training, the cross-entropy function value of Inception V3 is 0.206, and the cross-entropy function value of Inception V4 is 0.102. It can be seen that the garbage classification models using Inception V3 and Inception V4 networks can both obtain higher accuracy and lower loss function values, but the performance of the latter network is more stable than the former.

When the canned picture set is input to the two models to detect the accuracy of the two models, the top-5 results output by the two network models is shown in Table 2. It can be seen from Table 2 that from the top-5 results of classification, both networks have a high accuracy rate for the classification of canned picture sets. The accuracy rate of Inception V4 is 97.37%, and the accuracy rate of Inception V3 is 89.2%. The accuracy of Inception V4 is higher than that of Inception V3.

Table 2 Top-5 classification results of the two models

Top-5	Inception V3	Top-5	Inception V4
Cans	89.20%	Cans	97.37%
Drink bottle	8.66%	Drink bottle	0.97%
Dry cell	0.83%	Dry cell	0.63%
Metal can	0.42%	Metal can	0.36%
Wire plug	0.23%	Condiment bottle	0.17%

4. SUMMARY

Combining artificial intelligence with garbage classification is achievable. Compared with the traditional garbage classification method, the garbage classification method using deep learning convolutional neural network has higher accuracy, can achieve the purpose of garbage classification, and can save a lot of time and labor costs. This paper discusses two garbage classification models of convolutional neural networks. The results show that both Inception V3 and Inception V4 can achieve the purpose of garbage classification. Both network models can be used in deeper research in the field of garbage classification. After structural analysis and experimental comparison of the two networks, it is found that the stability and accuracy of Inception V4 are slightly higher than those of Inception V3.

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