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Applied Research and Innovation in Disruptive Technology to Mitigate Risks towards Disruptive Digital Society

Tangerang, 5th August 2017

Volume 4

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Preface

It is with a thankful heart to God that the proceedings of the ACMIT (Annual Conference on Management and Information Technology) 2017 is published. This is the publication of the papers which were presented during the conference ACMIT 2017 which was held at Swiss German University (SGU) on Saturday, 5th August 2017.

The theme of the conference was "Applied Research and Innovation in Disruptive Technology to Mitigate Risks towards Disruptive Digital Society". This is an up-to-date theme since nowadays there are a lot of disruptive technology, such as online taxis, online shops, new kind of energy source, etc. which change the landscape of conventional businesses. The theme was mainly reflected in the plenary sessions with the following speakers:

1. Dr. Tjahyo Tamtomo MA. M-Phil, Head of Security and Disaster Mitigation Section, Smart City Council, Bekasi, Indonesia who gave a talk on "Smart City Planning Approach in Security and Disaster Mitigation Aspects at Bekasi City"
2. Dr. Widi Setiawan, Lecturer at Master of Mechanical Engineering Swiss German University and former Director of The Center for Accelerator and Material Process Technology of National Nuclear Energy Agency (BATAN) who gave a talk on "Towards Hydrogen Energy Economy"

In this conference a special session was also given for the presentation of the papers from the students of Master of Mechanical Engineering Swiss German University. This study program was also a co-organizer of the ACMIT 2017.

It is hoped that the published papers in this proceeding can be beneficial for the readers.

Tangerang, 15th November 2017

Dr. Eka Budiarto, S.T., M.Sc.
Head of Steering Committee

ACMIT Committee

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Rundown ACMIT 2017

Time	ACMIT Conference August 5, 2017, SGU Campus
09:00 – 09:30	Registration
09:30 – 09:45	Prayers and singing the National Anthem of Republic of Indonesia
09:45 – 10:00	Welcoming speech by Head of MIT, Dr. M. Amin Soetomo, M.Sc
10:00 – 10:45	First Plenary session by Dr. Widi Setiawan
10:45 – 11:00	Question and Answer Session
11:00 – 11:15	Coffee Break
11:15 – 11:45	Second Plenary Session by Dr. Tjahyo Tamtomo
11:45 – 12:00	Question and Answer Session
12:00 – 12:15	Photo Session
12:15 – 13:30	ISOMA
13:30 – 15:30	Parallel Sessions

Schedule of Parallel Sessions
ACMIT 2017

Room 2009

No.	Time	Presenter	Moderator
1.	13:30 – 13:45	Agus Syafa'at	Dr. Eka Budiarto, S.T., M.Sc.
2.	13:45 – 14:00	Andi Yuniantoro	
3.	14:00 – 14:15	Benny Yunianto	
4.	14:15 – 14:30	Cindy Mareyta	
5.	14:30 – 14:45	Anis Choirunnisa	
6.	14:45 – 15:00	Puguh Sugeng Putranto	
7.	15:00 – 15:15	Ahmad Firdaus	

Room 2005

No.	Time	Presenter	Moderator
1.	13:30 – 13:45	Byan Haqi Mupitra	Dr. Ir. Mohammad A. Amin Soetomo, M.Sc
2.	13:45 – 14:00	Tine Sopaheluwakan	
3.	14:00 – 14:15	Luyen Ha Nam	
4.	14:15 – 14:30	Charles Sosang Bandaso	
5.	14:30 – 14:45	Irwin Lawrencius Siagian	
6.	14:45 – 15:00	Rio Parnando	
7.	15:00 – 15:15	Sukristiyanti A. Nugroho	

Room 2004

No.	Time	Presenter	Moderator
1.	13:30 – 13:45	Teddy Aryono	Ir. Heru Purnomo Ipung, M.Eng
2.	13:45 – 14:00	Amien Harisen	
3.	14:00 – 14:15	Michelle Steffi Gunawan	Dena Hendriana, BSc., S.M., Sc.D,
4.	14:15 – 14:30	Victor Fernandez	
5.	14:30 – 14:45	Daniel Christian Susanto	
6.	14:45 – 15:00	Paulus Agung Krismantara	
7.	15:00 – 15:15	Maung Kyaw Soe Moe	

Prototype of Strategic Information System Used for Marketing Funnel: Study Case at Fusion Payments – a Fin Tech Startup

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Abstract

Nowadays E-Commerce business is appealing for majority investor. Almost every month, we hear new startup is creating a new innovative product ready to be released into the market. There are many types of of startup with vary types of business, such as marketplace, ecommerce, etc. With limited resources and budget, it is very essential for a startup to begin the journey with the the right information and IT Strategic Planning. The aim is to have clear goals and framework before developing the business into real product.

Keywords : Strategic Information System (SIS), IS Strategy, Strategic Planning, IT-based competitive advantage, startup, ecommerce

1. Introduction

Fusion Payments is a startup company who based in Sydney Australia. At first its focus to delivery secure messaging infrastructure to support credit card based transactions in Indonesia, but later shifted its focus to provide financial service that targeted the end user. The goal of the company is becoming major player in personal financial service to the mass market in Indonesia.

Fusion Payments targets Indonesia as the market that they can penetrate with the following considerations:

- Readiness of banking infrastructure in Indonesia is considered as the most advance technology compare to other countries in South East Asia
- Penetration of credit card and debit card in Indonesia is high
- Increasing number of middle class income in Indonesia will be quadruple in the next 5 years
- Strong foundation in Indonesia through banking partners and telecommunication providers

In Indonesia there are a lot of major player had tried to gain access to Indonesia market, not to mentioned 3 (three) largest telecommunication providers have been taking part to provide financial services to end user in Indonesia. Telkomsel, Indosat and XL had launched their financial services back in 2012 - 2014 through their wallet system [1]. However, after major investment made for several years, none of the product really strikes the market and widely acceptable as alternative payment option to the majority of customers.

Fusion Payments as one of player in financial technology sector, tries to provide different models than what had been trying to be introduced by the major players. Instead of providing wallet service to the end user with restriction to its issuers and providing cash in solution, Fusion Payments aggregates any payment sources for the end customer through a single account that can be interoperable with any source of funds or wallet system providers.

But before going big, the case study provided by Fusion Payments is penetrating the market through simple transaction such as recharge or purchase data package directly to the telecommunication which believed will drive the traction and conversion to the online payment system. The key success of this solution is to provide easiness on user experience and stability of the system to eliminate trust issue and raise convenience and satisfactory. The founder believes that user habits will shift once the satisfaction rate in online payment service is higher than the offline payment models.

2. Recharge Service through Telco Networks

Recharge Service is one of huge volume based transaction penetrate market partner with telecommunication provider. Came as a wallet with telecommunication operator, Fusion payment

acquired their customer by providing recharge service from traditional into modern channel. The traditional service channel is a physical voucher that will distribute to retailer and then end customer. We change it to cut the cost of distribution, providing direct recharge from operator into end user using debit or credit card as a payment.

3. Customer Funnels

There are series of introduction made to the end user before converting users from a new visitor into an active customer. Multiple channels are being used by marketing team to ensure customer visits the website and start making a purchase in the system. The following is the marketing funnels made as reference to decide the segmentation of users within the system. The funnel is designed to address any marketing strategies that required to be taken in order to convert a visitor to become an active customer in the system.

3.1 New Visitors

New visitors are the one that reluctant to make a payment or signing up to the service and given up their credential information, i.e. credit card details or saving account details. Most of the customer feels unsecured to giving up their account details to a websites, given there are numbers of ecommerce security system has been breached and exposed threats to user credential information. Education and thorough communication are one of the drives that make the customer feels attracted to visit the websites and try to perform any activity in the system. Designing the right user experience would drive the customer to actually performing transaction instead of surfing the websites without making an actual conversion.

3.2 Registering Customer

It is a fact that can't be avoided that most of users are driven by gimmick to register themselves to a service. And in other case of ecommerce business models, such as Lazada, the cost of converting a user from an anonymous to a registering customer can climb up to 7million IDR per user and without guarantee that converted user will became an active customer.

The similar case and pattern are shown in this service as well, most of visitors are converted to be a registered customer when there is gimmick provided post registration service. However, if we compare the cost acquisition for the websites compare to other competitors the cost is lower than the average.

It is actually very crucial for the service to get a customer registered into the system. Once the customer is registered, system could start labeling the account with the right credential data and build the pattern based on the profiling.

When a customer registering himself to the service, system requests a unique identifier that will be associated to the customer account details. And activity that made by the customer will be recorded under the specified account. In this platform, system defines user mobile number as the identification of the system and it requires MPIN to authenticate any payment activities made from the source account.

3.3 Second Transaction (Registered Customer)

Once user registered in the system they can freely choose any medium or interface to make the transaction that integrated to the payment system. The current established interfaces are:

- USSD Channel that can be accessible from customer registered mobile number
- Web Desktop and Mobile
- Native Apps

Each of channels provides a difference advantages for the customer, and it is up to the customer to select the most convenience channel they prefer to use, although nowadays 60% traffic would be driven from native apps channel.

The interaction of second transaction would be the moment of truth for the solution. It shows shorter processing time compare to first transaction and provides far better user experience. Second payment result determines the conversion of user from visitor to become an active customer.

3.4 Active Customer

Active customers are the ones that attached to the service and they are reluctant to use other financial platform to perform the same activities. They would prefer to use the service as they find it providing convenience at most.

This typical customer is really hard to shift to other provider unless they have experienced a very bad interaction that would make them not loyal to the service. Once the user becoming an active

customer, the company can leverage the service based on habit and patterns of the customer and monetize the feature as a service. Below chart depicts the customer funnel as described above:

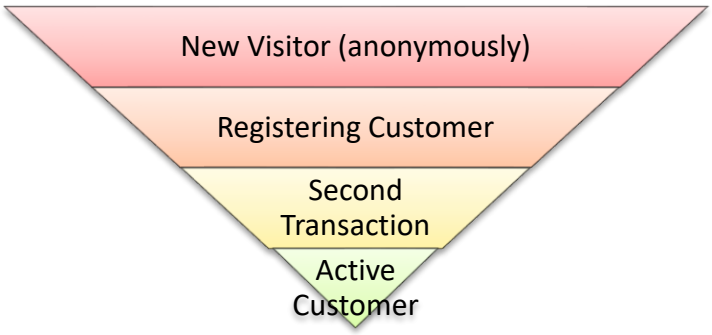

Figure 1: Customer Funnel

4. Aggregating Customer Data and Profiles

Actual implementation of customer funnels in Fusion Payments. As mentioned in above chapter, the system is designed to identify customer through a unique identifier setup in the system. The account will attach the unique identifier and it holds the details activity made by the users.

The following diagram depicts how the information will be incorporated in the system and later to be used as data analytic to understand the trends that shows the overall customer behavior.

Under the analytic system, the application is not only incorporate data and setup trends, but the system is also expected to develop an AI which later to be used as form of communication to the end customer or to develop further customer advocacy bot.

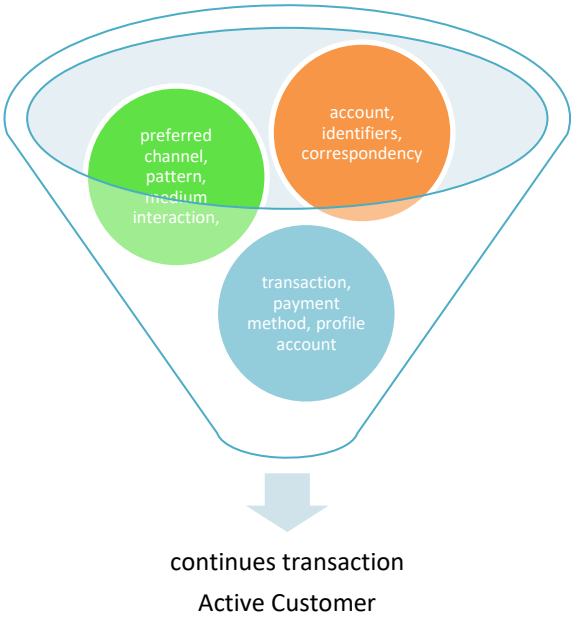

Figure 2: Funnel data diagram

The following is the sample how system creates profiling for a registering customer:

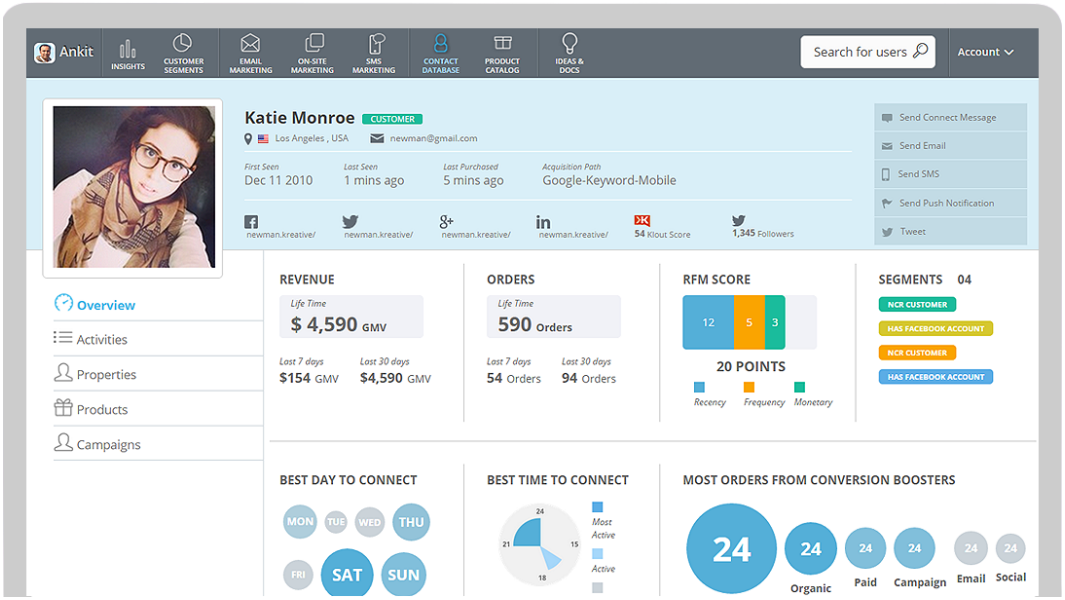

Figure 3: Unified Customer Profiling in Beta Out [2]

5. Analytic Framework and Decision Making

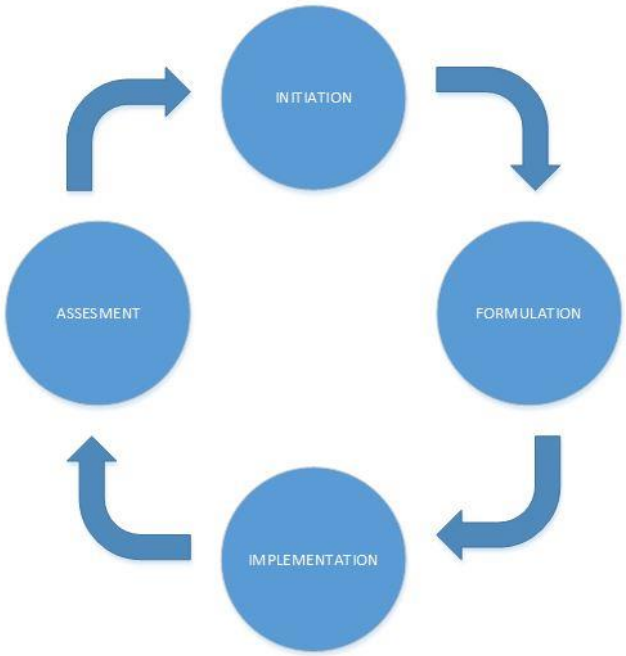

Figure 4: Strategic Information System Implementation

5.1 Formulation

The design of customer funnels became the guidelines for the product design in short term and long run. Although slight adjustment to the funnel is possible in order to meets the market requirement which is fluid and unpredictable, yet dramatic alterations must be avoided at any circumstances as it will impact

to the overall company strategy, product design, development effort and incurred cost (both in development and marketing cost).
Understanding the formulation of the customer funnel that described in previous chapters, define:

- Business opportunities that can be leveraged based on the information that system holds and infrastructure that has been built to support the operations
- Clear business opportunities will drive the product roadmap
- A firmed product roadmap can be used as basic guidelines for the company strategy as it provides cost and benefit analysis to take the decision on the opportunity or distraction that may incurred higher cost for company to operates

5.2 Implementation

The development of detailed process in building up a system in the long run or creating a feature in the short term plans for carrying out any marketing requirement that agreed on in strategy formulation. The implementation phase are :

- Business planning: Setting specific project objects, creating project schedule, and setting measureable performance target.
- Resource allocation : Determined what are organizational resources including humans, financial, technology, etc.
- Project management : putting life to the project through hiring stuff purchasing, equipment, license, and so on.

5.3 Assessment

The continuous evaluation of progress toward the organizations strategic goal, resulting in corrective action and, if necessary, strategy reformulations.

6. Conclusion

This paper describes how Fusion Payments implement strategic information and planning used for marketing funnel. The framework can be used as a baseline for creating customer funnel in other area, using customer profiling and analytics framework to take decision.

Reference

[1] ITPA Team, “Summary report : Building a Digital in Indonesia : A Snapshot of the Indonesian Telecommunication Industry” , Indonesian Telecommunication Providers Association,2015.
[2] Ruchi Pandita, “Betaout- Humanizing the e-commerce experience” , url: http://knowstartup.com/2016/07/betaout/,2016.

Reputation Scoring Fake News Using Text Mining

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Abstract

The classification of hoax news or news with incorrect information is one of the text categorization applications. Like text-based categorization of machine applications in general, this system consists of pre-processing and execution of classification models. In this study, experiments were conducted to select the best technique in each sub-process by using 1200 articles hoax and 600 articles no hoax collected manually. This research Tried experimenting to determine the best preprocessing stages between stop removals and stemming and showing the results of the deception Tree algorithm achieving an accuracy of 100% concluded above naive byes more stable level of accuracy in the number of datasets used in all candidates. Information gain, TFIDF and GGA based on using Naive Byes algorithm, supporting Vector Machine and Decision Tree no significant percentage change occurred on all candidates. But after using GGA (Optimize Generation) feature selection there is an increase of accuracy level The results of a comparison of classification algorithms between Naive Byes, decision trees and Support Vector machines combined with the GGA feature selection method for classifying the best result is generated by the selection of GGA + Decision Tree feature on candidate 2 (Paslon2) 100% and in the selection of the Information Gain + Decision Tree Feature selection with the lowest accuracy Candidate 3 at 36.67%, but overall improvement of accuracy Occurred on all algorithm after using feature selection and Naive byes more stable level of accuracy in the number of datasets used in all candidates.

*Keywords***:** Classification, Pre-processing, Feature Selection, Accuracy;

1. Introduction

Nowadays, anyone is easily utilized social media and the Internet to create a variety of controversial issues, whether the issue is true or just on script. The presence of social media and the digital world is now absolutely massive and has become part of people's daily lives. Therefore, in seconds, what is thrown into the digital world will spread to various parts of the world instantly.

This research give scoring fake news in website, the system used to classify news automatically using text mining with Classification method and combination Machine Learning. Hoax detection is defined as the task of categorizing news along a continuum of veracity, with an associated measure of certainty, such that traditional fact checking and vetting from potential deception is impossible against the flood arising from content generators, as well as various formats and genres.[1]

1.1. Research Problem

Fake news in the last period of his special very disturbing society in Indonesia, the Fake News making people confused where the news is true because the media or others make bias. fake News was published when the election many heads of state or head of region, with the fake news that cannot be accounted making people misunderstand and could make propaganda resulted in the disintegration because of his lack of knowledge of fake news.

1.2. Research Objective

This research attempt to use the classification model to do that and at the same time checking for detection hoax. Formulated to the point, the purpose of this study is:

- To develop scoring fake news using algorithm machine learning.

2. Literature Review

2.1. Text Categorizations

The computational detection of deceptive text is a text categorization problem. For example, categorization models may be used to classify news on the internet [2] although text categorization models may have used human experts to define logical rules that were then translated into text categorization computer algorithms [3], over the last 20 years machine learning techniques have proved to be a far more accurate and less labor intensive method [4]. In a textual domain, machine learning

algorithms replace human experts by creating classification models that learn from a corpus of pre-classified pieces of text. Although humans are obviously capable of categorizing news articles.

2.2. Machine Learning Techniques

Supervised machine learning algorithms are trained to learn from pre-classified existing deceptive and truthful statements to create models capable of classifying new pieces of text with a minimum error. Experimental research has used a wide variety of different machine learning algorithms for different applications. This is due to the difficulty in determining whether the algorithm has influenced the results or whether results have been influenced by the input feature vector or background conditions, such as dimensionality reduction and parameter tuning. Furthermore, [5] suggests that a direct comparison may only be made when the algorithms have been tested on the same corpus by the same researchers, using the same background conditions. To this aim, [6] compared 10 supervised learning algorithms using eight performance criteria across 11 binary classification problems. They found that boosted decision trees gave the best overall performance, with bagged decision trees, SVM also performing well. Naïve byes more stable for more data set.

3. Methodology

The research steps on the hoax news classification system are depicted in Figure 1. The research is divided into two stages: the training and testing stage.

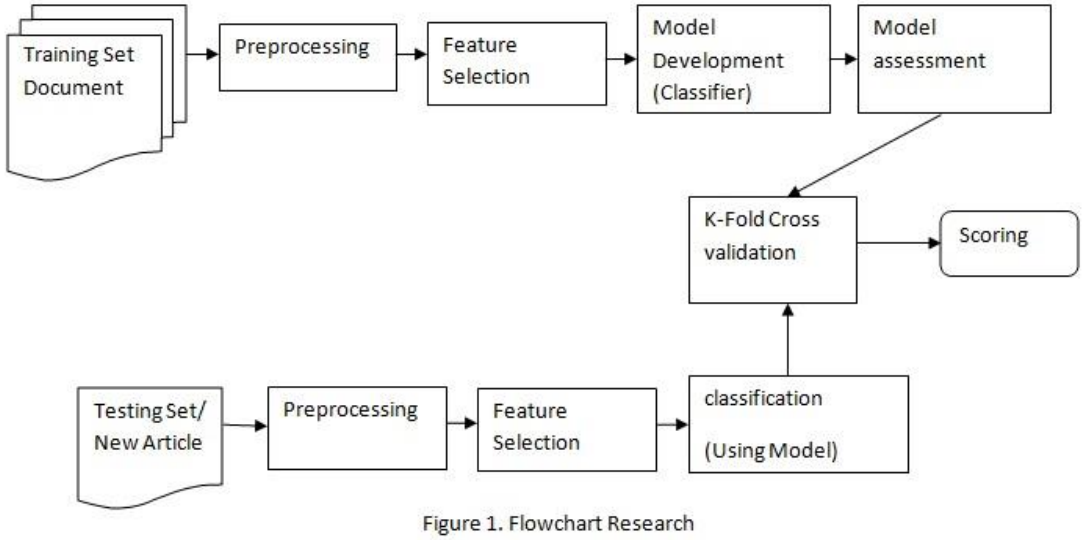

Figure 1. Flowchart Research

3.1. Preprocessing

All documents of training data and testing data or new article are pre-processed. The preprocessing stage consists of lexical processing and word conversion to word features. Lexical processing aims to process word tokenization and comprises tokenization module, case folding and stop word removal. The Training set used in this study refers to Indonesian language news which amounts to 1200 news articles from 3 candidates Governor DKI 2017, 600 news articles hoax and 600 unidentified hoax news collected manually. 600 hoax news articles come from anti hoax community and 600 news unidentified hoax from media mainstream. Training set uses Indonesian language, so stop word used for preprocessing data is also Indonesian language.

3.1.1. Case Folding

Case folding step to change all the letters in the document into lowercase. Only the letters 'a' to 'z' are accepted. Characters other than letters are removed and deemed delimiters, example:

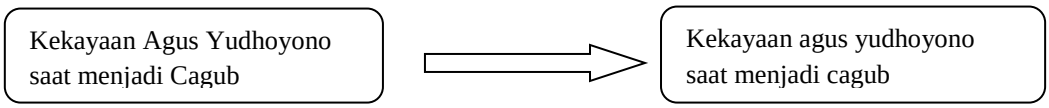

Figure 2. Case Folding

3.1.2. Tokenize

The process of this stage cuts the input string based on each word that compiles it In addition, whitespace is used to separate the words. This process divides the text of the document into a sequence of tokens, example: "kekayaan agus yudhoyono saat menjadi cagub" produce 6 token as "kekayaan" , "agus" , "yudhoyono" , "saat" , "menjadi" , "cagub"

3.1.3. Stopword Removal (Dictionary)

This process aims to reduce word volume. Stop words can be front words, conjunctive words, and alternate words. Examples of stop words in Indonesian are "yang", "ini", "dari", "ke", "di", "dari", "ber", "me". The effect of omitting stop words depends on the type of classification and collected data, example:

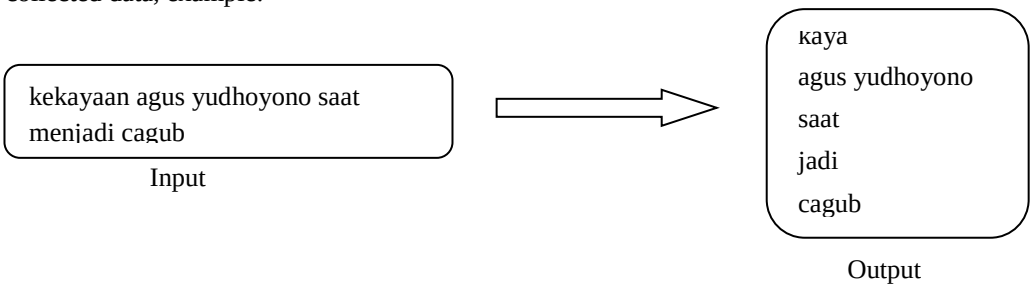

Figure 3. Stop word Removal

3.1.4. Generate N-Gram

The way N-Gram works is done by moving one word forward (although in the process there is a process by which the word forwarded a number of X words) example bigrams:

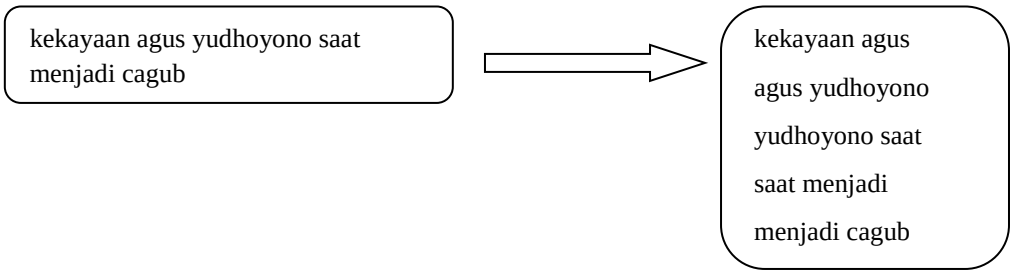

Figure 4. Generate N-Gram

3.2. Feature Selection

The purpose of selection of this feature is to reduce the level of complexity of a classification algorithm, improve Accuracy of the classification algorithm, and able to know which features are most influential on the level of accuracy. The resulting feature results are then selected to retrieve only a number of features that are assumed to hold important information from the document class. Techniques used for feature selection are information gain (IG) TF x IDF and GGA.

3.3. Model Development

Model development phase where to choose the best machine learning. The machine learning algorithm selected on this hoax news classification system is Naïve Bays, SVM (Support Vector Machine) and Decision Tree. The naïve bays algorithm was chosen in this research because it has proven effective for text categorization; the process is simple, fast and high classification accuracy. The Support Vector Machine (SVM) algorithm was chosen because it is the best machine learning algorithm for text classification [7]. Assessment the accuracy of the classification model (or classifier) generated by a supervised learning algorithm.

3.4. Model Assessment

Assessment the accuracy of the classification model (or classifier) generated by a supervised learning algorithm is important for the following two reasons: first, as it can be used to assess the predictive accuracy of the future, which may imply a confidence level that we must have in the classifier output on

the prediction system. Second, it can be used to select a 'classifier' of a given set (identifies the best 'classification model' among many trained models).

3.5. Cross Validation

The input Example Set is partitioned into k subsets of equal size. Of the k subsets, a single subset is retained as the testing data set (i.e. input of the testing sub process), and the remaining k − 1 subsets are used as training data set (i.e. input of the training sub process). The cross-validation process is then repeated k times, with each of the k subsets used exactly once as the testing data. The k results from the k iterations then can be averaged (or otherwise combined) to produce a single estimation. The value k can be adjusted using the number of validations parameter.

3.6. Classification (Using Model)

After building a model with supervised learning ability this means that this model has obtained the best results from some experiments algorithm so researchers at this stage using the classification method to provide news Scores and predict the news is fake news or not.

3.7. Scoring

The measurement of algorithm performance in this research using Confusion Matrix, as in the Table below

Table 1. Confusion Matrix

	Actual Positive	Actual Negative
Predicted Positive	TP	FP
Predicted Negative	FN	TN

4. Result and Discussion

4.1. Research Design

The objectives of the Research Design that have been carried out in this research include:

- Evaluate the use of Stop word Removal and Stemming modules on the preprocessing.
- Selection of feature selection techniques, type selection feature Gain Information, TFIDF and GGA.
- Election of the best machine learning algorithm (Naives Bays, Support Vector Machine and Decision Tree)

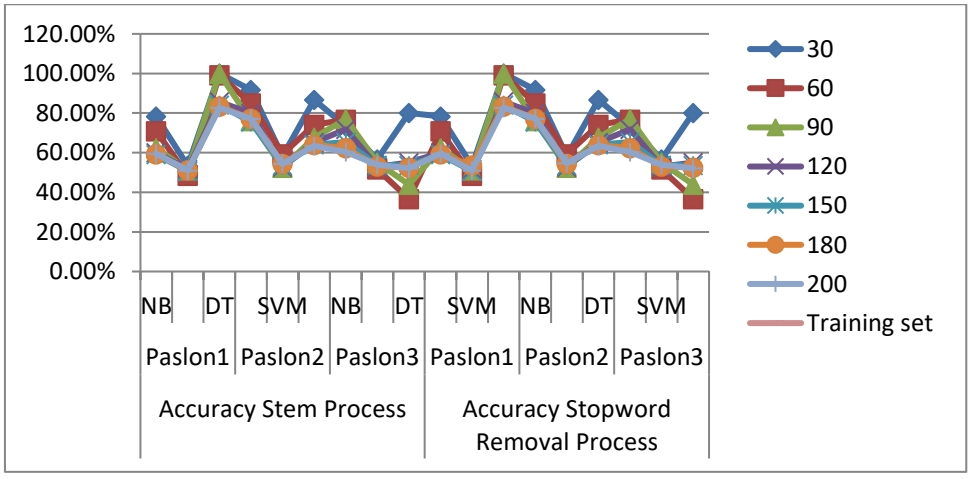

Figure 5. Stemming and Stop word Removal on preprocessing

On all Training set preprocessing using Stemming to reduce computation time. Objective Selection Preprocessing is best for improving the performance of Naïve Byes, SVM and Decision Tree algorithms.

In Figure 5 and shows a high accuracy level graph obtained on Paslon1 using Decision Tree method 100%, for the lowest in Decision Tree method on Paslon3 with an 43.89%. From the Figure above naive byes more stable in all candidate. By looking at the results of the comparison, the most optimal results achieved by Stop word Removal with Using Decision tree method with 100% accuracy for small amount of dataset and can be concluded above naive byes more stable level of accuracy in the number of datasets used in all candidates.

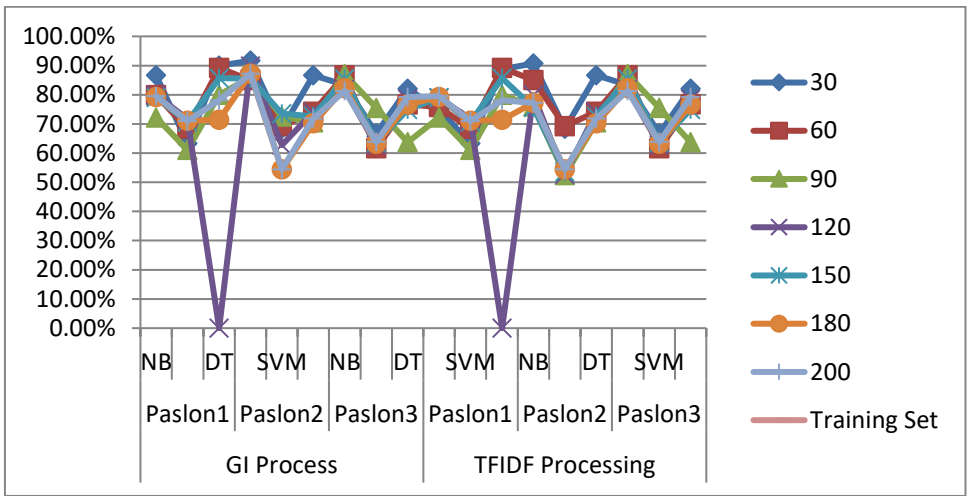

Figure 6. GI and TFIDF on Feature selection

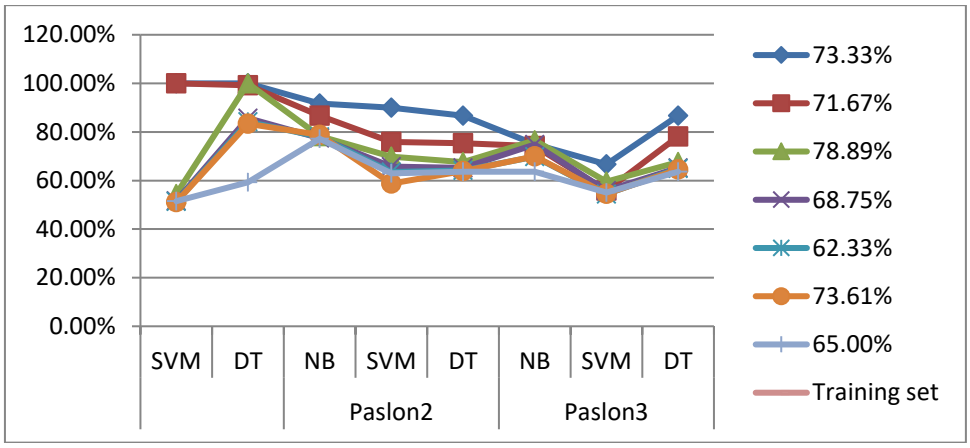

Figure 7. GGA on Feature selection

Of all the Figure and table show that by applying information feature of probabilistic information-based feature. TFIDF and Information Gain based on using Naive Byes algorithm; supporting Vector Machine and Decision Tree no significant percentage change occurred on all candidates. But after using GGA (Optimize Generation) feature selection there is an increase of accuracy level. The test result states that the best result is generated by the selection of GGA + Decision Tree feature on candidate 2 (Paslon2) 100% and in the selection of the GI + DT Feature selection with the lowest accuracy Candidate 3 at 36.67%, but overall improvement of accuracy Occurred on all algorithm after using feature selection.
Here are some points generated from the whole test:

- The stemming feature provides better accuracy. This shows that the founder of the deceitful news is determined lexically.
- The classification algorithm that produces the best accuracy value is the Decision tree and the lowest is the Decision Tree with 10 times cross-validation. For the number of data sets that slightly decision tree produces the best value but when the data set its more the level of accuracy generated Decision tree decreases. Naive bays for small or large number of datasets provide good and stable accuracy. SVM for the number of datasets that give little or a lot of accuracy is less good and stable.
- The overall test shows that the selection of GGA Optimize Generation is better based by the features of the Information Gain feature better than TFIDF frequency-based feature selection.

5. Conclusion

In this research, we have built news hoax classification system using machine learning. The data set for the system contains 1200 articles consisting of 600 hoax articles and 600 manually labeled non-hoaxed articles. News articles captured using the Indonesian language. The system consists of a pre-process module, feature selection and classification itself. For each module, experiments were conducted that compared several techniques. The best experimental results are achieved with Decision Tree algorithm with preprocess stop word removal and best feature selection using Optimize Generation (GGA) and Naive byes more stable level of accuracy in the number of datasets used in all candidates.

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Ransomware 101: Understanding the Business Model

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Abstract

WannaCrypt Ransom ware outbreak in 2017 shocked everyone in the term of the spreading and damage it caused. WannaCry Ransomware keep us reminded that the impact of ransomware attack is devastating and costly. Crypto Wall alone racked up around $324 million in 2016 (Trend Micro, 2016), while WannaCry tally not yet to be confirmed, since its spreading in 150 countries including Indonesia within its infection spreading in 2017. Since its modern outbreak in 2014, ransomware produce one word to the cybercriminal operator, profit. In this paper, we will breakdown how the ransomware works, the history of ransomware, and why it is one of the profitable main fronts for the cybercriminal.

Keywords: Ransome; WannaCry, WannaCrypt; Cyber Extortion; Cyber Criminal;

1. Introduction

Ransomware is a category of malicious software which, when run, disables the functionality of a computer insome way (Symantec, 2012). When it's running its lock the affected computer and depends on the type of ransomware, they encrypt all the files with strong encryption until the owner of the computer pay some ransom (mostly by bit coin) to the attacker. Paying the ransom unfortunately does not guarantee the files would be come back and safe to the owner (Checkpoint, 2017).

Ransomware it's not a new threat in cyber security, since its first occurrence appears in 2005, different kind of ransomware appeared and impacted the users in different way. Still these kinds of threat usually treated lightly by the end user, because 71% of the ransomware spread are from spam email (Trend Micro, 2016). The devastating impact of ransomware was estimated USD 1 billion in 2016, and it cost USD 209 millions alone in the first 3 month of 2016 in the USA (CarbonBlack, 2016).

This paper will be divided into multiple chapter, chapter 1 would be the introduction, chapter 2 consist of the history of the ransomware, chapter 3 would be the methodology of how ransomware infected the victim, chapter 4 would be the business model of ransomware, how the monetization system works, and chapter 5 would be the conclusion and how to mitigate the ransomware attack.

2. Ransomware History & Type

According to Carbon Black, Ransomware is not new, its 30 years old malicious software that suddenly became a trend because of cybercriminal using it as a business model to easily extort money from victim (CarbonBlack, 2016).

2.1 Ransomware History

The first model of ransomware ever recorded was dubbed AIDS (AIDS Info Desk) Trojan that were encrypting files in diskette back in 1989 also known as "PC Cyborg Trojan" because if the user needs to regain access, they would have to send USD 189 to PC Cyborg Corp. at a post office box in Panama (U. Shalvi, 2016). The initial creation of ransomware in that day was unsuccessful since the owners of a computer are small and exclusive, and AIDS had flaw in their function since they are using symmetrical encryption.

The reign of modern ransomware creation was emerged in the year of 2005, with the appearance of Archives, the first ransomware that implement the asymmetric encryption, and its growing from there. The brief rundowns of well-known ransomware are shown below (CarbonBlack, 2016) (U. Shalvi, 2016):

- AIDS Trojan (1989), Infected 20k diskettes distributed at AIDS conference; symmetric cryptography; set in motion three decades of ransomware attacks.
- Archives (2005) is the first ransomware to use asymmetric encryption; encrypting every file in My Documents, and required users to make purchases from websites to obtain passwords to decrypt files.

- GP Code, It is an encryption Trojan, which initially spread via an email attachment appearing to be a job application which used a 660-bit RSA public key to encrypt the victim files.
- Reveton (2012), Spawned 'police based' ransomware including Urausy and Tohfy.
- CryptoLocker (2013), First cryptographic malware spread by downloads from a compromised website and/or business professionals in the form of email attachments.
- CryptorBit (2013), another ransomware that was discovered in December 2013. CryptorBit corrupts the first 1024 bytes of any data file, and tt can bypass Group Policy Windows settings put in place to tackle against this kind of ransomware infection. It uses social engineering technique to get users to install the ransomware using a fake update. It uses Tor and Bit coin for a ransom payment.
- CryptoDefense (2014), Used Windows 'built-in encryption CryptoAPI, 2048-bit RSA encryption & Tor/Bit coin for anonymity.
- Crypto Wall (2014), An improved version ransomware from creators of Crypto Defense; first to establish persistence behavior to the victim computer; According to an August 27 report from Dell Secure Works Counter Threat Unit (CTU): "CTU researchers consider Crypto Wall to be the largest and most destructive ransomware threat on the Internet as of this publication, and they expect this threat to continue growing." More than 600,000 systems were infected between mid-March and August 24, with 5.25 billion files being encrypted. 1,683 victims (0.27%) paid a total $1,101,900 in ransom. The latest version of Crypto Wall is 4.0 and it was released in 2015.
- CTB Curve-Tor-Bit Coin Locker (2014), Suspected from Eastern European developer and targeted the Russian Mainland, it's the first ransomware to communicate directly with a command center server in Tor Network as well as implement method deleting Volume Shadow Copies on Windows machines.
- Sypeng (2014), First Android-based ransomware.
- Koler (2014), Considered the first "Locker worm"
- SynoLocker (2014), this ransomware targeting Synology NAS devices. Using BitCoint for payment and TOR for anonymity.
- SimplLocker (2014), First 'crypto-based' ransomware for Android devices that encrypted files on simply locked phones
- Crypto Blocker (2014), A new ransomware variant emerged in July 2014. It only encrypts the files whose size is less than 100MB and will skip anything in Windows or Program Files. It uses AES rather than RSA encryption.
- OphionLocker (2014), It used ECC (Elliptic Curve Cryptography) public-key encryption. If the ransom was not paid within three days, the private key would be deleted.
- Pc Lock (2015),
- Locker Pin (2015),
- TeslaCrypt (2015),
- Chimaera (2015),
- LowLevel4 (2015),
- Vault Crypt (2015),
- 7ev3n (2015)
- Ransomware32 (2016),
- Sam Sam (2016),
- Locky (2016),
- Petya (2016),
- KeRanger (2016),
- Maktub (2016),
- Jigsaw (2016),
- CryptXXX (2016),
- Power Ware (2016),
- ZCryptor (2016),
- WannaCrypt (2017)

2.2 Ransomware Type

There are three different ransomware which described below (Heimdal Security, 2017):

- Master Boot Record (MBR) Ransomware, its type of ransomware that overwrites the MBR of the entire hard drive, causing the victim OS (Windows) to crash. This is also the technique of getting around of any security products. If user try to reboot his PC, the modified MBR will prevent him from loading the OS (Windows) normally and instead greeted the victim with an ultimatum to pay up with a certain amount of money (usually in bit coins) or lose access to your files and computer forever (Trend Micro, 2016). Examples include Satana and Petya Ransomware.
- Locker Ransomware, is the type of ransomware that locked the victim out of their operating system, making it impossible to access their files and the OS itself. However, this kind of ransomware doesn't encrypt the files of the victim, but still demand payment. Examples include WinLocker.
- Encrypting Ransomware, is the most popular and dangerous kind of ransomware which encrypt all the victim's files with strong algorithms which in many case cannot be decrypted except they pay ransom or gain the master key. Examples include Locky, Crypt Locker, Wannacry, etc.

3. Ransomeware Infection Methodology

The method of ransomware infection methods usually follows the same modus operandi used by cybercriminals to infect victims with any malware (Symantec, 2016). There several different methods that's was popular among the cybercriminal such as:

3.1 Traffic Distribution Method (TDS)

This method implemented a site that hosted an exploit kit (Zeltser, 2015) to be ready for a victim that being redirected from the Traffic Distribution Service which cybercriminal bought from the TDS vendor. This method usually accompanied by a drive-by download method.

3.2 Malvertisement

Malvertisement or malicious advertisement put a mislead or click bait advertisement to a site that hosted an exploit kit to infect the user that brave enough to click it.

3.3 SPAM Email

This method by far is the most successful method of delivering the malicious ransomware to the potential victim (Trend Micro, 2016; Trend Micro, 2016; Trend Micro, 2016). Thisold-fashioned method uses an email that looks like a legitimate email from victim's boss, colleague or other legitimate services that point to a malicious site that host an exploit kit or using social engineering technique to leverage user to download or install malicious software.

3.4 Dowloaders & Botnet

This method usuallytricks the users to download a look alike legitimate software that in background download a secondary Trojan that infect the users.

3.5 Social Engineering & Self-Propagation

Some of ransomware has the ability to spread worm like method. WannaCry is the latest examples that utilize such techniques, as explained in the Microsoft Analysis report. Microsoft hasn't found evidence of the exact initial entry vector used by this threat, but there are two scenarios that they believe are highly possible explanations for the spread of this ransomware (Microsoft, 2017):

- Arrival through social engineering emails designed to trick users to run the malware and activate the worm-spreading functionality with the SMB exploit
- Infection through SMB exploit when an unpatched computer is addressable from other infected machines

4. Ransomware Business Model & Monetization

4.1 Ransomware Traditional Business Model

FBI estimation in 2016 stated that ransomware would be cybercriminal $1 billion source of income in 2016 (CNN, 2016). This number achieved because 70% of the ransomware victim are choosing to pay the perpetrator in order to get their data back (IBM X-Force, 2016). The traditional business model is to send phishing mail to the company and public services agency such as hospital, mass transport operator, hotel, etc. This step is taken by cybercriminal to raise the chance of being paid, because of the nature of their business. However, cybercriminal targeted more on the medium and large company rather than small company by 50% (IBM X-Force, 2016).

After successfully infected the victim and encrypt the files, the cybercriminal is asking certain amount of money to the victim to a certain bit coin wallet.Bitcoin is a decentralized digital currency peer-to-peer payment network, meaning neither does it have central authority, nor does it have a central bank, and there are also a finite number of bit coins in the world (Bitcoin Organizations, 2017). Although it is not completely anonymous, there is an element of privacy involved in bit coin as well as it being almost impossible to counterfeit, immune to fraudulent chargeback's and transactions being irreversible. This reason, as well as the global use of the currency, has led to concerns that it is a perfect currency for cybercriminals (Metro, 2017).

Ransomware outbreak is also one of the factors that raised the demand of crypto currency such as Bit coin (Vox Media, 2017). In 2017 Bit coin value raise in the breaking record of $ 2400 per 1 Bit coin, this number raised around 500% from the 2016 (BitStamp, 2017). With some ransomware have success rate around 40% (IBM X-Force, 2016), cybercriminal could be milking more from this kind of method in the future.

4.2 Ransomware As A Service

The cybercriminal doesn't stop innovating only on creating a new and better ransomware, but also creating another business model regarding the ransomware. The Ransomware as a Service (RaaS) is a cybercriminal service to offer a profit sharing for a individual to take advantage of ransomware without having minimum or zero knowledge of technical ability such as programming to be able to launch a ransomware attack(Manky, 2013) (Trend Micro, 2016). This type of business model opens a new opportunity for insider threat or any individual that has money to purchase the ransomware and start the attack (Trend Micro, 2016).

There are currently two types of this kind of RaaS in the market, called Stampado and Jigsaw. This two is already sold in the underground market for any individual to purchase to as low as $39 (Trend Micro, 2016). Even Stampado has an online YouTube video to promote their ransomware.

5. Conclusion

In this paper, we learn about the history, evolution, infection method and the business model of the ransomware. The biggest ransomware outbreak in history is WannaCry that spread in 150 countries with hundreds of thousand computer infections. In order to handle this kind of cyber-attack, we need to work together as a team. Awareness is the most important things to be acquired since the most effective method to deliver the infection is through phishing. The second one would be patching management that needed to be enforcing, since the ransomware attack based on the vulnerability of the unpatched system. The third one would behave backup plan both online and offline, and taking steps to protect it.

The future of ransomware may infect your smart devices since most of technology innovations leads to such things, such as smart TV, smart refrigerator, etc. The challenge is how fast our security behavior adapts with such threat.

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IT Competency Model for IT People

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Abstract

Speed of innovation in Information Technology will not aligned with speed of capability human resource in the organization, if there is no strategy in human resource development especially in information technology. Information Technology and Human Resource need a framework that can link both as key success factor of organization in implementation information technology. Framework will defined competency based on job description IT people in organization, competency standard as reference in mapping with job description we can get from The European e-Competence Framework (e-CF) or SFIA (Skills Framework for the Information Age). After we get list of competency aligned with job description from IT people, we can mapping competency to job roles in organization structure. From this we already have a competency framework based on job description and related to job roles. We can use this framework for Human Resource Development in Information Technology, through assessment IT people based on competency framework, we can found gap competency of IT people and fulfill gap competency with training. Or we can use this competency framework for reward management of IT People, Career management of IT People, Training development of IT People and recruitment/selection of IT People.

Keyword: The European e-Competence Framework (e-CF), SFIA (Skills Framework for the Information Age)

1. Introduction

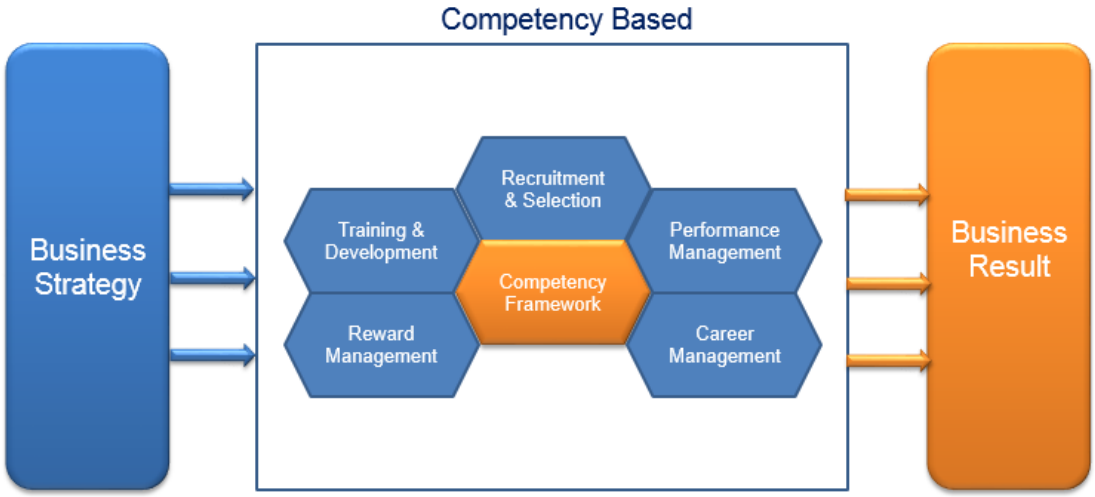
Implementation information technology in an organization can be success if we concern to 3 dimensions are People, Process and Technology. There are like 3 in 1. Information Technology cannot run good without 3 dimensions implemented. Technology consists application and infrastructures Application are website, CRM or ERP, etc. Infrastructures are data center, internet connection, LAN, etc. Technology can build from self-development, managed service by third party or buy-in vendor. Processes are policy, standard operational procedure and regulation. There are being guidance and reference in how to operate and running information technology in good governance. The organization can create policy and procedure based on need, risk and objective from the organization. It ensures to align between information technology and organization objectives. How about the people?

People in information technology divide into 2 parts, are IT people and IT user. IT People have responsibility to manage and ensure Information Technology running align with organization objectives. IT users are people that using information technology to help their activities in the organization. IT People in organization have 5 jobs categories are Plan, Build, Run, Enable, and Manage.

- Plan, how to make a plan of Information Technology that aligns with organization strategy.
- Build how to create or implemented the plan of Information Technology.
- Run, how to handling incident or problem of Information Technology when running
- Enable, how to ensure quality and performance of Information Technology
- Manage, how to monitor and evaluate of Information Technology

How to build skill of IT People? There are many things jobs have to do. Organization structure will be the first point to build IT People. IT Department in an organization can divide into subdivision, like Application Development Division, Infrastructure Division, Operational Division and IT Management Division. Each division has job description and people inside have a job role. Information Technology have high speed in innovation in world. How to mapping between job descriptions, job roles and high speed innovation of Information Technology? The answer is Competency Framework.

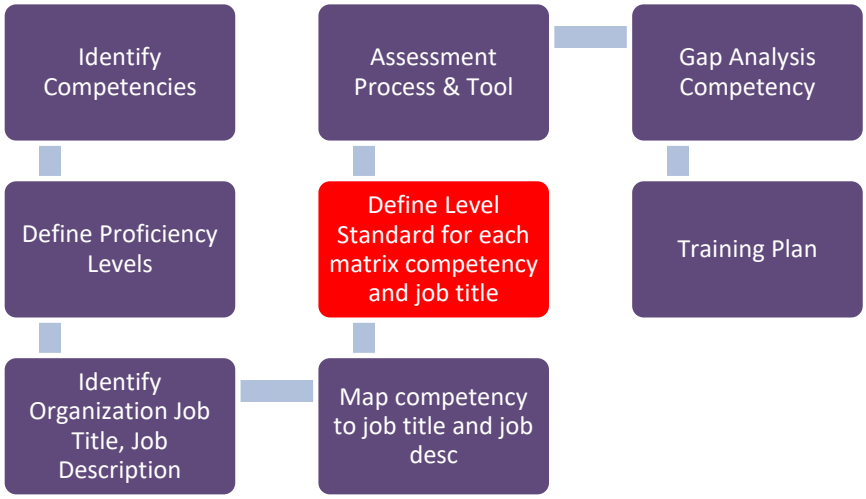
When we using Competency Framework, we can make IT people aligned with business need and business strategy to achieved business result



HR Development for IT People has a planning to get statement competence for IT people. Competence is have knowledge, skill and attitude to do their job.

1. Methodology

How to build IT people based on competency? Sometimes its look HR Department responsibility, but for Information Technology, it will be part of IT department responsibility (People, Process and Technology).



1.1 Identify Competency

Competency is knowledge, skill and attitude needed for do activities or job. Competency defined from job description and job role in an organization. In many references in Information Technology, we can define, there are 5 categories competency.

A. PLAN	A.1. IS Business Strategy Alignment
	A.2. Service Level Management
	A.3. Business Plan Development
	A.4. Product or Project Planning
	A.5. Architecture Design
	A.6. Application Design
	A.7. Technology Watching
	A.8. Sustainable Development
B. BUILD	B.1. Design and Development
	B.2. System Integration
	B.3. Testing
	B.4. Solution Development
	B.5. Documentation Production
C. RUN	C.1. User Support
	C.2. Change Support
	C.3. Service Delivery
	C.4. Problem Management
D. ENABLE	D.1. Information Security Development
	D.2. ICT Quality Strategy Development
	D.3. Education and Training Provision
	D.4. Purchasing
	D.5. Proposal Development
	D.6. Channel Management
	D.7. Sales Management
	D.8. Contract Management
	D.9. Personnel Development
	D.10. Information and Knowledge Management
E. MANAGE	E.1. Forecast Development
	E.2. Project Portfolio Management
	E.3. Risk Management
	E.4. Relationship Management
	E.5 Process Improvement
	E.6. ICT Quality Management
	E.7. Business Change Management
	E.8. Information Security Management
	E.9. IT Governance

1.2 Defines Proficiency Level

For each competency like A.2 (Service Level Management) or B.4 (Solution Development), we need to define level that can describe indicator about IT people competency.

No	Level	Indicator
1	Basic	Have limited knowledge and concept, with less experience
2	Effective	Have good understanding in concept, issues and implications in their job. This level competence based on limited experience
3	Mastery	Have detail knowledge and concept , can integrated, have good technical , can have responsibility for their job
4	Expert	Have very good concept and practical , can implementation and integration in their job, and have good procedure to finish their jobs

1.3 Identify Organization Job Title and Job Description

Each organization has job title for IT Department, and each job title have detail job description. Sometimes in an organization and other organization have same job title, like Head of Application Development, but it can they have different job description.

Head of IT Strategic Planning Division:

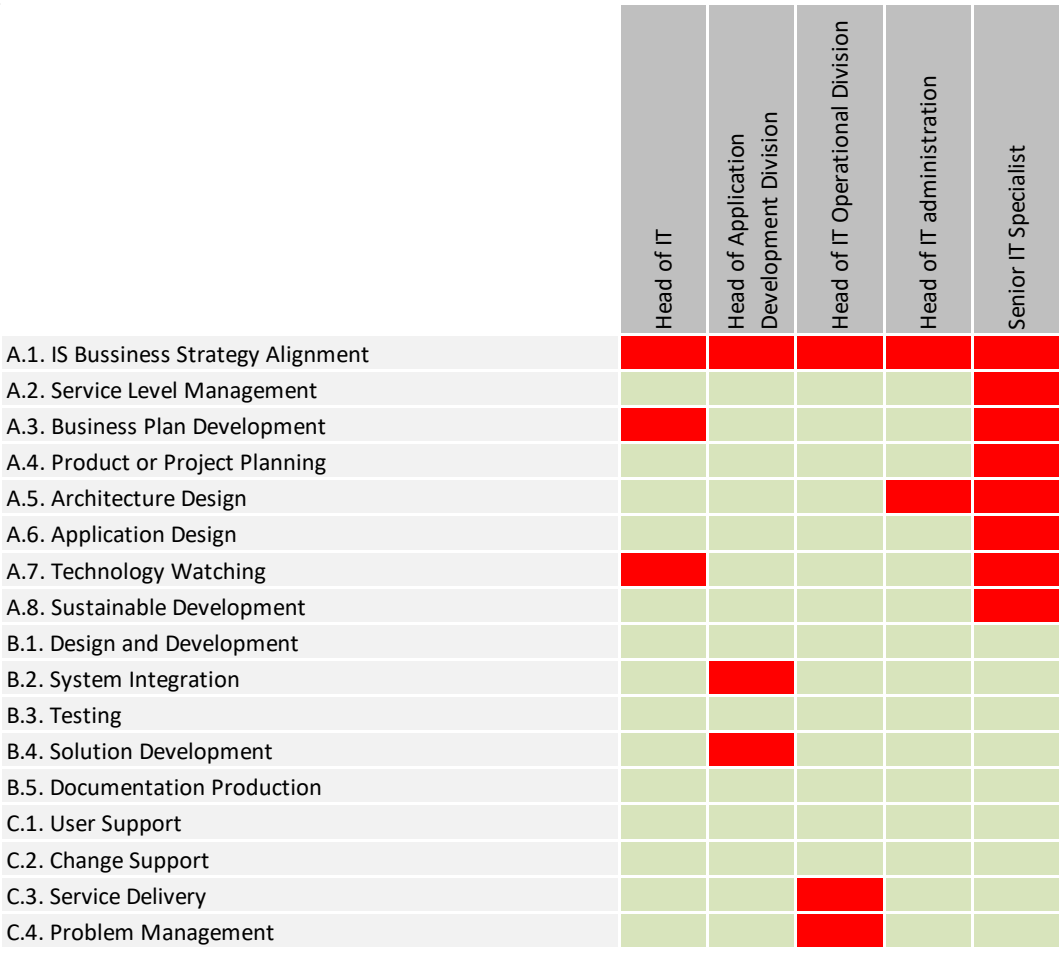
- Creating and update IT strategic planning in organization
- Creating IT Roadmap in organization
- Creating and evaluating IT performance indicator
- Creating and evaluating Service Management Planning
- Creating and evaluating Service Level Planning

Head of Application Development Division:

- User need analysis
- Creating application planning
- Creating testing system
- Developing application and database
- Creating implementation planning for application system

1.4 Map competency to job title and job description

Analysis from job title and job description to mapping into the right competency. How many competencies that need for finishing well the job description defined.



1.5 Define Level Standard for each matrix competency and job title

Each Job Title already mapped to competency, we need to define level for each matrix between job title and competency. It will be standard for competency framework, when we have definitive for competency and .level for each Job Title. Levels have range 1 to 4.

	Head of IT	Head of Application Development Division	Head of IT Operational Division	Head of IT administration	Senior IT Specialist
A.1. IS Bussiness Strategy Alignment	4	3	3	2	1
A.2. Service Level Management					3
A.3. Business Plan Development	4				3
A.4. Product or Project Planning					3
A.5. Architecture Design				1	3
A.6. Application Design					3
A.7. Technology Watching	2				3
A.8. Sustainable Development					3
B.1. Design and Development					
B.2. System Integration		3			
B.3. Testing					
B.4. Solution Development		3			
B.5. Documentation Production					
C.1. User Support					
C.2. Change Support					
C.3. Service Delivery			3		
C.4. Problem Management			3		

1.6 Assessment Process and Tool

We already have competency framework, but this is only a main part of process from building IT People based on competency. Next process is assessment IT people based on standard competency. There are 3 methodologies for assessment:

- Written Test
- Interview
- Practical Test

Each methodology assessment has point that will be summaries as result from assessment. Scenarios for do assessment are:

- Define Job Title from IT People who will do assessment
- Look up in the standard competency , kind of competency that match with their Job Title
- Make a list of competency
- Conduct the assessment for each competency using 3 methodology
- Get the result as summary from 3 methodologies

No	Level	Point Assessment
1	Basic	10 -50
2	Effective	51- 80
3	Mastery	81 – 90
4	Expert	90 -100

2.7 Gap Analysis Competency

When we have result from assessment, we can compare with standard competency that already defined before. Based on this, we found gap analysis for competency

	Competency	Result Level	Standard Level	Analysis
A. PLAN	A.1. IS Business Strategy Alignment	2	1	Excellent
	A.2. Service Level Management	2	2	Good
	A.3. Business Plan Development	1		
	A.4. Product or Project Planning	1		
	A.5. Architecture Design	2		
	A.6. Application Design	2	2	Good
	A.7. Technology Watching	3	2	Excellent
	A.8. Sustainable Development	2		
B. BUILD	B.1. Application Development	1	3	Need Improve
	B.2. System Integration	2	3	Need Improve
	B.3. Testing	2	3	Need Improve
	B.4. Solution Development	2	3	Need Improve

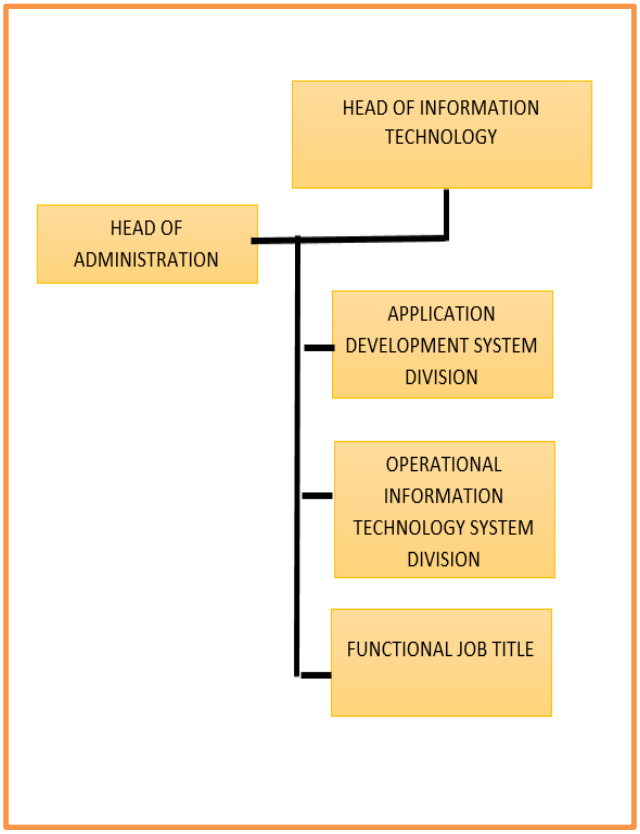
1.8 Training Plan

Training plan for personal can build from gap analysis. We can define training for each competency. A competency can consist one or more training

	Competency	Training
A. PLAN	A.1. IS Business Strategy Alignment	IT Strategic Plan
	A.2. Service Level Management	ITIL Foundation; ITIL Intermediate Service Design
	A.3. Business Plan Development	Designing Business Plan
	A.4. Product or Project Planning	Project Management ; Program Management
	A.5. Architecture Design	TOGAF
	A.6. Application Design	System Analysis and Design ; Agile Development
	A.8. Sustainable Development	Agile Development
B. BUILD	B.1. Application Development	PHP Training; Microsoft Visual Studio; Java; Android Programming
	B.2. System Integration	Linux Training; Microsoft Windows Server; Microsoft SharePoint

2. Results

An organization has a structure, this is first step for us to define or observe competency based on job title and job description. In our framework, we defined if there are 5 categories for competency in Information Technology which are Plan, Build, Run, Enable and Manage. 5 categories are mapping for job title and job description IT people in an organization. Let's take an organization structure below:



Each division has IT people who have role as a head or a staff. They have a job description. Based on best practice a head will have competency from Plan and Manage, a staff depend on their job, but most likely have competency from Build, Run and Enable.

Job Description from Head of Application Development System is:

- Supervision and direction application development based on strategic planning
- Supervision and direction in analysis and design using application development methodology
- Supervision and direction to building application based on analysis and design so that can guarantee security and user need
- Supervision and direction in creating database design
- Supervision and direction to support and maintenance application and database
- Supervision and direction in migration and cleansing database.
- Supervision and direction in application testing
- Supporting in architecture system and technology align with vision, mission and strategic objective organization
- Supervision and direction in budgeting and Term of Reference application development program.

From information above, about job description, we have to mapping to list of competency. So we will get competencies that align with their job description and job title as Head of Application Development.

A. PLAN	A.1. IS Business Strategy Alignment	3
	A.2. Service Level Management	
	A.3. Business Plan Development	2
	A.4. Product or Project Planning	2
	A.5. Architecture Design	
	A.6. Application Design	2
	A.7. Technology Watching	
	A.8. Sustainable Development	
B. BUILD	B.1. Application Development	
	B.2. System Integration	3
	B.3. Testing	
	B.4. Solution Development	3
	B.5. Documentation Production	
C. RUN	C.1. User Support	
	C.2. Change Support	
	C.3. Service Delivery	
	C.4. Problem Management	
D. ENABLE	D.1. Information Security Development	
	D.2. ICT Quality Strategy Development	2
	D.3. Education and Training Provision	
	D.4. Purchasing	
	D.5. Proposal Development	
	D.6. Channel Management	
	D.7. Sales Management	
	D.8. Contract Management	
	D.9. Personnel Development	
	D.10. Information and Knowledge Management	
E. MANAGE	E.1. Forecast Development	
	E.2. Project Portfolio Management	
	E.3. Risk Management	3
	E.4. Relationship Management	
	E.5 Process Improvement	
	E.6. ICT Quality Management	
	E.7. Business Change Management	
	E.8. Information Security Management	3
	E.9. IT Governance	3

A.1. IS Business Strategy Alignment

Anticipates long term business requirements, influences improvement of organizational process efficiency and effectiveness. Determines the IS model and the enterprise architecture in line with the organization's policy and ensures a secure environment. Makes strategic IS policy decisions for the enterprise, including sourcing strategies.

A.3. Business Plan Development

Addresses the design and structure of a business or product plan including the identification of alternative approaches as well as return on investment propositions.

A.4. Product or Project Planning

Analyses and defines current and target status. Estimates cost effectiveness, points of risk, opportunities, strengths and weaknesses, with a critical approach.

A.6. Application Design

Analyses, specifies, updates and makes available a model to implement applications in accordance with IS policy and user / customer needs

B.2. System Integration

Integrates hardware, software or sub system components into an existing or a new system. Complies with established processes and procedures such as, configuration management and package maintenance.

B.3. Testing

Constructs and executes systematic test procedures for ICT systems or customer usability requirements to establish compliance with design specifications

B.4. Solution Development

Following predefined general standards of practice carries out planned necessary interventions to implement solution, including installing, upgrading or decommissioning

D.2. ICT Quality Strategy Development

Defines, improves and refines a formal strategy to satisfy customer expectations and improve business performance (balance between cost and risks). Identifies critical processes influencing service delivery and product performance for definition in the ICT quality management system

E.3. Risk Management

Implements the management of risk across information systems through the application of the enterprise defined risk management policy and procedure

E.8. Information Security Management

Implements information security policy. Monitors and takes action against intrusion, fraud and security breaches or leaks

E.9. IT Governance

Defines, deploys and controls the management of information systems in line with business imperatives

When we already have standard competency for a job title, we can use this for assessment IT people. Standard competency that already defined will be measurement. Assessment processes have 3 methodologies which are written test, Interview and Practical.

	Competency	Result Level	Standard Level	Analysis
A. PLAN	A.1. IS Business Strategy Alignment	2	3	Need Improve
	A.2. Service Level Management	2		
	A.3. Business Plan Development	2	2	Good
	A.4. Product or Project Planning	3	2	Excellent
	A.5. Architecture Design	1		
	A.6. Application Design	2	2	Good
	A.7. Technology Watching	3		
	A.8. Sustainable Development	1		
B. BUILD	B.1. Application Development	3		
	B.2. System Integration	2	3	Need Improve
	B.3. Testing	2		
	B.4. Solution Development	2	3	Need Improve
	B.5. Documentation Production	2		
C. RUN	C.1. User Support	1		
	C.2. Change Support	3		
	C.3. Service Delivery	1		
	C.4. Problem Management	1		
D. ENABLE	D.1. Information Security Development	3		
	D.2. ICT Quality Strategy Development	1	2	Need Improve
	D.3. Education and Training Provision	2		
	D.4. Purchasing	2		
	D.5. Proposal Development	1		
	D.6. Channel Management	2		
	D.7. Sales Management	3		
	D.8. Contract Management	1		
	D.10. Information and Knowledge Management	3		
E. MANAGE	E.1. Forecast Development	2		
	E.2. Project Portfolio Management	1		
	E.3. Risk Management	1	3	Need Improve
	E.4. Relationship Management	1		
	E.5 Process Improvement	1		
	E.6. ICT Quality Management	2		
	E.7. Business Change Management	2		
	E.8. Information Security Management	2	3	Need Improve
	E.9. IT Governance	1	3	Need Improve

With result from assessment, we can create training plan that match with their competency and related to their job description. From this we can building skill IT people based on competency.

3. Conclusion

Competency is knowledge, skill and attitude needed to do a job. In Information Technology we can divide competency into 5 categories, which are Plan, Build, Run, Enable and Manage. Each category will have detail competency. This will be standard competency for Information Technology. For building skill IT people, this is a first step and will continuous with other processes.

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Millenial Disruptive Technology: An Assessment on Disrupted Banking Industry

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Abstract

Millennial are new generation that demand a new kind of market expectation and seeks new value on how industry interact with its customer. Among assessed industries in the US, Banks are the most vulnerable industry that millennial demands new kind of approach to conduct banking in the past three years facilitated by the increasing influence of digital technology in everyday life. Millennial are the generation that born in 80s and 90s where they see the dying relevant of bank [1]. The survey sees that in US 68% of them think that the way we access our money will be totally different, 70% said that the way we pay for things will be totally different, and even 33% believe that bank will not be needed at all in the next 5 year. However, the key question is what is millennial really needs on the banking services in Indonesia? Is the trend in the US and Europe is catching up soon? Is Indonesia Banks ready from the eyes of Millennial? This research focuses on current level of digital banking experiences of Indonesia Banking Millennial where assess the current satisfaction of the current banking services in Indonesia and the expected digital banking of Indonesia Banking Millennial, current and the future.

Keywords: Millennial, Banks, Indonesia Banking Millennial.

1. Introduction

In Europe, ING Bank has been experimenting with Digital Bank Cafe [2], where the teller or customer relationship officer was replaced with bank barista in the past few years. Even Citibank in the US, has similar experiment in the past few years as well. Back home, BRI has experimenting fully digital banking services with the initiative of BRI Digital Banking back in June 2016 [3].

Accenture study mentioned that in the 2020, the bank services within Europe will be disrupted by Fintech (Financial Technology Startups) and only leaving 70% of the current market size [4]. And the trend continues downward. This will be an interdisciplinary research between Information Technology and Management Business Studies.

The hypothesis is shown in the following graph. In order to achieve customer experience leadership, we should focus on the two main contributors; customer satisfaction and interaction where:

- Service quality influences the level of customer satisfaction, where the negative influence from external customer satisfaction from other competitor's services
- Customer Interactions Variety is the result of the current services portfolio
- Current service portfolio is as the result of current organizational innovation

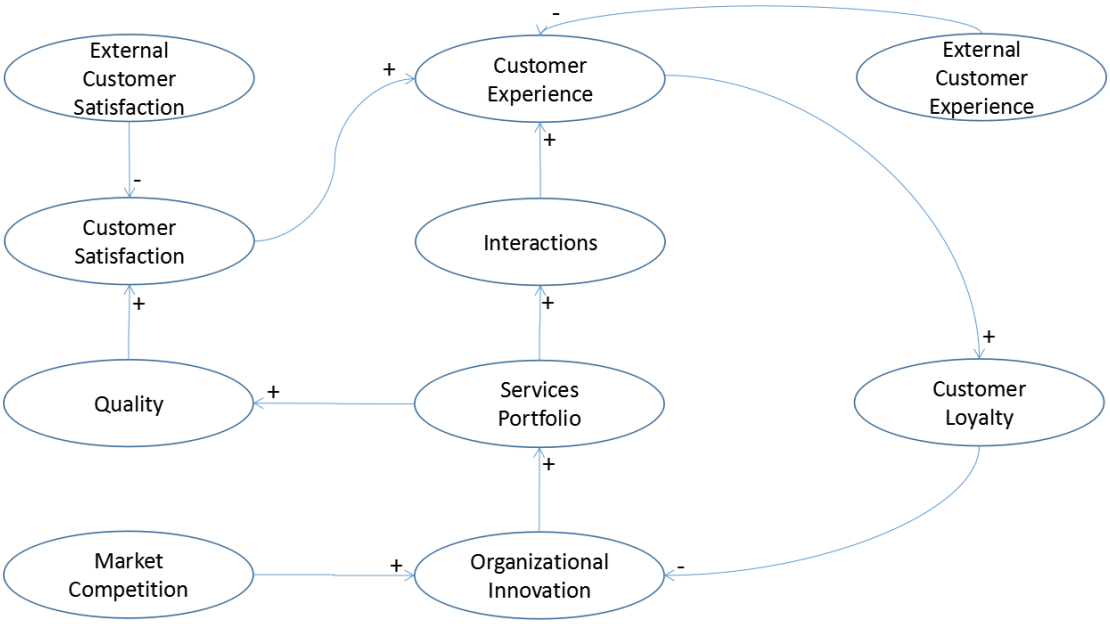

Figure 1. Hypotheses Graph

2. Methodology

There are recent questions event to the mature market like the US on the fate of banks in the future. This is another disruptive technology in the making in the industry of banking by the shift preference of millennial generation. It will soon catch up in Indonesia.

Therefore the study is conducted with the scope of the following:

2.1 Participants for the study

As mentioned in the early chapter of the questions related to the fate of banking of the future, the question are targeted on: Indonesia Urban Millennial on their expectation of the banking services in the near future; Relevant bank staff and management, as part of the question are related to the ability of the bank to can the service culture and service innovation in the age of digital technology.

2.2 The methods of study

There will be two main methods of study:

- Interview (Especially on Bank Staff and Management, and some questions that are open ended for Urban Millennial)
- Focus Group Discussion

3. Related Works

3.1 Current US Digital Banking Millennial Customer Experience.

Recent various study and sources in the US are confirming that the trend is gaining speed. More than 1600 Bank branches closed last year in the US of not being relevant to the market in 2015 [5]. The leading bank, like JP Morgan, will close by the end of 2016 to close 300 Bank Branches as well [6].

So there are more questions than answers currently on how the bank will react on this current reality. Bill Gates back in Jan 2015 has a famous quote that rattler banking industry, “People need banking, not Banks” [7]. About 2.5 billion people globally have no access to bank accounts and formal financial services. Bill Gates sees this as a big opportunity for technological innovation.

So the questions need even more relevant to Indonesia Banking Industry, particular on the views of Indonesia Urban Millennial. The following are the list of studies and sources that will give a similar question to Indonesia Urban Millennial view of what kind of banking technology and services needed that bank branch need to transform to.

- CNBC Report Quotes [8]

The study showed that 29 percent of millennial will close all accounts with that bank after an incident, compared with about 22 percent of all U.S. consumers. FICO surveyed approximately 1,000 consumers in October and November 2015. The question: Is Indonesian Urban Millennial has the same low tolerance?

In addition, "the growth of online banks and mobile banking lends itself to the ability to switch and the perception to switch," Horan said. The question: Is Indonesia Urban Millennial switch banks easily? Online Banks and Mobile Banking encourage the perception to switch?

- Banks Market Millennial [9]

Authenticity, Purpose and Mobility Are Key Things Millennial Are Looking For. The question: Is Indonesia Urban Millennial thinking it important?

More than any other generation, millennial want to do things on their own terms. It's not new to reject institutions, but that thirst to discover their own path is amplified in an age of seemingly limitless choices. The question: Indonesia UM (Urban Millennial) want to have informed choices? Indonesia UM feel more online needs?

They're on social media 24/7; they trust friends and not big business. But millennial really aren't that different. They're just better at figuring out what's authentic and what isn't, and consuming only what speaks to them. That's why it's critical to reach them through voices they trust. The question: Indonesia UM thinks virality matter most on banking choices?

- Financial Brand [10]

Millennia's Are Redefining Financial Success. "Millennial are the most educated generation in U.S. history," says Face book in its report, "and they continue to pay a heavy price for it. But whether its student loans or credit card debt, millennial say paying down debt is their top priority." The question: What is Indonesian UM thinking about financial success?

Millennial Are Looking For a New Kind of Financial Partner. Millennial are 1.5 times more likely than Gen Xers and Boomers to be engaged, and 1.4 times more likely to move. These moments have major financial implications that many Millennial do not know how to deal with. In fact, 83% of Millennial in Face book's study say they seek financial guidance during those times, with buying a home being the main trigger (at 48%). But half of all Millennial say they have no one to turn to for financial guidance. Only 36% talk to their parents about money and just 8% trust financial institutions. The question: What is Indonesia UM like to know for their banking/financial needs?

Unfortunately, Millennia's don't see a lot of viable options among today's banking providers. A third of Millennia's describe their primary financial institution in unflattering terms — e.g., "used car salesman" or "aggressor" which likely explains why they are 1.4 time more likely than other generations to switch. The good news? They are open-minded and optimistic. Nearly half (45%) say they would switch (banks, credit cards, or brokerage accounts) if a better option came along. The question: Indonesia Banks not help in understanding financial/banking needs?

- Insight Report [11]

Millennia's are a demographic that's rapidly maturing in terms of their economic strength, social influence and political power. They represent the greatest challenge and growth potential for banks today. The question: Is it the case in UM Indonesia?

Millennia's are more likely to consider non-traditional payment companies. They see value in the convenience, mobile support and ease of use. Conversely, the consideration of non-traditional payment providers decreases with age. For all age groups, customer satisfaction with a primary bank has no significant impact on consideration, with an equal number of satisfied and dissatisfied consumers now using non-traditional payment companies. The question: Is it the ase of Indonesia UM?

- American Bank Association [12]

Millennial are the largest generation in the workforce, according to Pew Research and poised to receive about $30 trillion in inheritances from their baby boomer parents. In the course of our research, millennial told us what they expect from their bank: High savings account interest rates, Low loan interest rates, No fees, especially hidden fees, Transparency, Privacy and safety, A

financial institution that isn't 'too big', Easy account management. The question: What is Indonesia UM expectation on the future?

Recognize that millennial want a banking relationship. The good news is that the vast majority (90%) of millennial use some form of banking product. Of those, 59% have a bank account, 11% have a credit union account, and 19% have both a bank and credit union account. The question: What kind of relationship expected by Indonesia UM?

- Independent Community Bankers of America [13]
  Things Millennial should consider before choosing their next bank:

Trend # 1: Being locally owned and operated is important to us. Millennial want a local connection when it comes to doing business. We seek out locally sourced food, artists and musicians, and look for locally owned and operated restaurants and stores. This passion for supporting and being a valued part of our local community is true even when it comes to banking. Fifty-four percent of millennial surveyed said they prefer to work with locally owned and locally operated community banks to handle their financial needs.

Trend # 2: We do not want to be treated like a number. As a millennial, many of us were raised with the desire to feel included, valued and recognized for what we have to offer. One of the worst things a bank can do is to treat us like a number. It shows complete disrespect for the faith we are putting in them. But our research shows that millennial are the generation that most strongly feels that banks treat us like a number (58 percent of us feel this way). Not cool.

Trend # 3: We want to own our own business –or have the option to. Our generation may come to be known as the Great Entrepreneur Generation because so many of us want to own our own business. So we need to know which types of banks make the most loans for small business—and it's probably not what you think.

Trend # 4: Cash is not king, but financial education gives us power. What this means is that we as a generation recognize that cash may no longer be king and that financial education is critical to our future. What we see is that for us millennial, our focus is not just on becoming financially successful, but also on creating a financial situation in which we can have the lifestyle we want—which often means being able to pursue activities we enjoy outside of work. This will only be possible if we get the financial education we need to start making smart decisions now.

Trend # 5: Mobile and online banking define millennial banking. This makes sense as we've come of age being able to perform and track most transactions via a screen—initially our laptop or desktop, and now a phone or tablet. Furthermore, when we think about mobile banking, we don't just want to check our balance. We want to be able to do all of our basic banking needs via our phone, including balance transfers, making payments and more.

- Millennial Banking Info graphic [14]
  Millennial want digital solutions to manage their money and help them build their finances.
  a. Three times more likely to open a new account with their phone vs. in person
  b. Say that mobile has made tracking and spending their money better
  c. Want digital budgeting tools from their bank

- Forbes [15]
  On how banks are missing the marks on millennial: Make ETC (Education, Transparency & Choices) your mantra.

Education: Brochures on financial planning advice just won't cut it with this generation. Banks need a comprehensive and interactive approach to educating Millennial. Think funny yet insightful YouTube videos, webinars (delivered by a fellow Millennial!) on how to build your credit, and info graphics on how to finance higher education.

Transparency: Make your offerings and practices as transparent as possible. This generation isn't opposed to paying for value, but they will chafe at unexplained fees and "just because" policies. Banks should also highlight all corporate social responsibility initiatives, as supporting social causes and being part of a greater movement is something this generation actively seeks

out. They want to align themselves with brands which they feel are making a greater difference in society.

Choices: The tech-savviest of consumers, this is a generation raised on choices. They have never been tethered to a single form of delivery: cable (Netflix), taxis (Uber), books (Kindle), radio (Pandora, Spotify). Banks would be wise to take a page from other industries and disrupt from within. Give Millennial choices in regards to how they bank, with which banker, and allow them to use the platform of their choice. More often than not, that platform will be mobile.

3.2 Customer Experience Leadership

Customer interaction, as the total sum of all interactions in relation to the brand, is becoming the key differentiation in today's competion. Customer willing to pay more for better customer experience [16]. There are seven lessons related to customer experience leaders [17], there are two key notes that may be relevant to this research:

- Organizational political agenda that hindering the effort in develop further customer experience that important findings:
  a. Customer experience is the business differentiation other than the product and the price
  b. Negative experience will spread easily, especially in the age of social media
  c. Most of the customer that having poor experience definitely switch to competitor
  d. Some significant number of customer will complaints in social media and will go viral
  e. Customer experience is a collective effort in the whole organization

- Many business problems are as the result of customer experience problems.
  a. Customer top needs is the main consideration of the product development
  b. Staff turnover may impact on customer experience, therefore stronger knowledge of customers and markets.
  c. Communication issues with vendors and contractors are influencing the total customer experience.

3.3 Organizational Innovation

Organization sustainable innovation that respond to the new growth, strategies, new product & services, new ventures, new markets, new business model, new partnerships, new business practices can in the form of incremental to break trough innovation with the range of serendipitous to intentional. The highest business growth is possible if this is strategic innovation quadrant [18] as shown in the next figure:

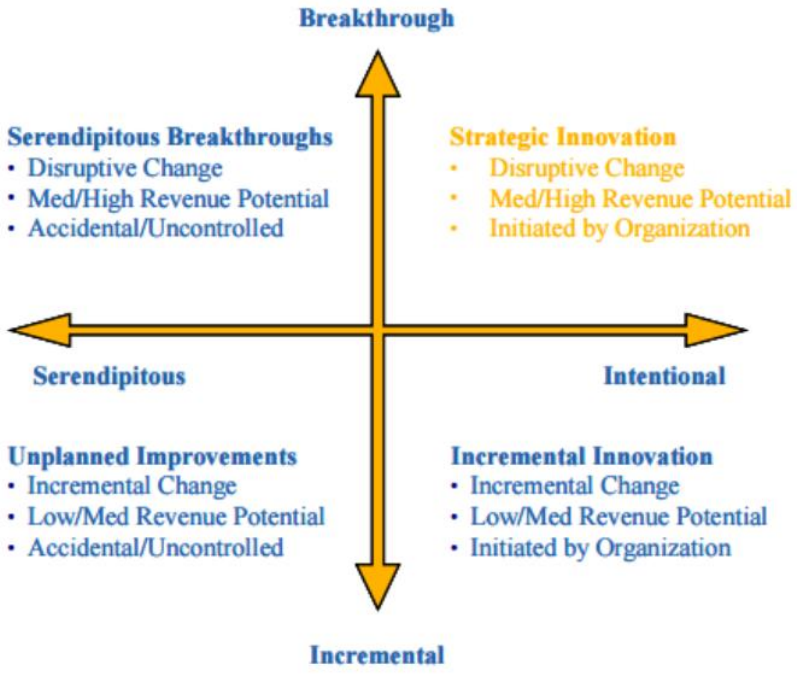

Figure 2. Strategic Innovation Quadrant [19]

There are seven dimensions to produce a portfolio of outcomes that drive growth. These dimensions are:

a. A Managed Innovation Process ; Combining Non-Traditional and Traditional Approaches to Business Strategy
b. Strategic Alignment ; Building Support
c. Industry Foresight ; Understanding Emerging Trends
d. Consumer/Customer Insight ; Understanding Articulated and Unarticulated Needs
e. Core Technologies and Competencies ; Leveraging and Extending Corporate Assets
f. Organizational Readiness ; The Ability to Take Action
g. Disciplined Implementation ; Managing the Path From Inspiration To Business Impact

4. Result Analysis

The result analysis will be incorporated the two sources of studies (interview and FGD) into draft analysis that will be further discussed with Relevant bank staff and management.

1. How the Bank's response about Fintech?	
Yoana Ustriani	Fintech became a lot of impact in the bank business
Rony Andry	Fintech development needs to be well anticipated because otherwise fintech will undermine the Bank's business
Antonius Andy Wijaya	Banks feel threatened. The bank must be a financial company that cooperates with fintech. The possibility of banks will still exist even though fintech is growing There are some bank systems that cannot be done by fintech The concept of a bank will still be needed even though fintech is growing For example the lending process at the bank

2. How the Bank's prepare to threat of Fintech ?	
Yoana Ustriani	BRI targets to become a strong bank in Southeast Asia by continuously transforming on an ongoing basis. This transformation movement is called "The Most Valuable Bank in Indonesia." BRI targets in advancing technological updates and on the basis of the transformation movement, BRI has launched a financial satellite called BRI sat in June 2016 and is the only bank in the world to have satellites. BRI is currently in progress to adopt fintech which is one of BRI's Business Strategy. In the process of adopting fintech, BRI has prepared reliable human resources because Fintech is the goal and the success of BRI.
Rony Andry	Banks have not been able to focus because there is no regulatory regulation But has done the first step in facing the threat of fintech
Antonius Andy Wijaya	The bank has made a digital transformation Banks believe fintech will have an effect The possibility of banks will still exist even though fintech is growing There are some bank systems that cannot be done by fintech The concept of a bank will still be needed even though fintech is growing For example the lending process at the bank

3. What have been or will be done banks to threats of Fintech?	
Yoana Ustriani	As for the preparation of what has been and will be done to adopt fintech, it is still a secret and cannot be published to the public.
Rony Andry	Preparation of Fintech since 2015 by holding partners MCI (Mandiri Capital Indonesia) in cooperation with Korea (Korea Telecommunications)
Antonius Andy Wijaya	Banks collect human resources to conduct research about services to the community that would otherwise be needed Has analyzed the potential for fintech that will be more developed but has not done anything

5. Conclusion

The result of this research show the digital finance of Indonesia Banking integrates several banking services in an integrated manner by providing several facilities. Banks in Indonesia have also made preparations to improve productivity through digital technology.

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ICT Helpdesk Improvement through Decentralized Strategy

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Abstract

ICT Helpdesk is the part of IT Service Management (ITSM) framework which is also mentioned in COBIT 5 in Deliver, Support and Service processes. ICT Helpdesk becomes an important part that must be owned by the company who use the information technology to leverage the business goals. The use of IT peripheral in daily operations requires the excellent support. Companies do not want to lose the opportunity in business because of the IT system had a problem. ICT Helpdesk present for deliver support with Service Level Agreement (SLA) agreed which are needs more responsive to fulfill business requirement. This research is needed to find best strategy of ICT Helpdesk implementation. Assess the existing strategy and analyze the gap between current and future condition is required. Working area that must be covered in this service and amount of the technician are the keys for improvement. Option of centralized and decentralized strategy becomes research objective to be addressed in this case to find best ICT Helpdesk strategy.

Keywords: ICT Helpdesk, IT Service Management, Service Level Agreement

1. Introduction

As modern company, PT. XYZ needs IT as a tools and part of strategy to achieve their business goals. PT. XYZ already implement the Enterprise Resource Planning (ERP) that cover end to end process from line production, supply chain management, human capital management until financial department.

In order to run ERP system in their company, PT. XYZ equipped with IT infrastructure that consist of datacenter, network, IT peripheral and also ICT Helpdesk for their support. These services become complex since ERP system has many users and accessed from wide working areas. The critical point is to maintain ERP system reliability and make sure the users can access it at all the time they needed. Disruption in the ERP system at server side or IT peripheral in client side will have impact to the business continuity. Based on that, companies expect the ICT Helpdesk with high SLA to maintain excellent IT services in order to support company core business.

The research objective to be addressed is to find ICT Helpdesk strategy to improve their performance and meet the SLA required by the company.

2. Previous Condition

PT. XYZ already has ICT Helpdesk that runs based on IT Service Management (ITSM) framework. However, the performance is not satisfying yet. It because the resolution time is not meet with the SLA. The SLA that expected by the company is 90% incident must be resolved within 3 hours. It means from 100 ticket requests in the ICT Helpdesk system, at least 90 tickets must be closed within 3 hours.
At that time total personnel of IT Helpdesk are 30 technicians and coverage area can be shown in table 1.

Table 1. Building Coverage

Area	Building
Management Office	1
Hangar	4
Workshop	3
Warehouse	1
Utility Building	1
Remote Office	3
Branch Office	5
Total	**18**

The existing strategy for running ICT Helpdesk was called centralized strategy, where the resources were pulled into IT central office. Incident request will have received by call center and recorded in the system. The incident was assigned to the available technician then he goes to the user working area. It will take time to reach the user and also sometimes when the technician arrived, the user is not in their area and troubleshooting cannot be perform yet.

With this condition, the ICT Helpdesk Performance is not meeting the SLA yet. SLA for September to November 2016 can be shown in table 2.

Table 2. IT Helpdesk Performance

Resolution Time	2016		
(in minuntes)	Sep	Oct	Nov
< 30	148	250	150
30 - 60	83	86	68
61 - 120	101	120	56
121 - 180	71	64	27
> 180	451	483	295
SLA	**47.19%**	**51.84%**	**50.50%**

3. Gap Analysis

A gap analysis is a method of assessing the differences in performance between a business' information systems or software applications to determine whether business requirements are being met, and if not, what steps should be taken to ensure they are met successfully [1].

5W1H from Kipling question will be used to run gap analysis. It questions work because they are short and direct. They are also largely general, and 'What' can be applied to many different situations, making them a flexible resource [2].

For this case, gap analysis will assess why the performance is not meet with the SLA yet. The result of gap analysis will be shown in table 3.

Table 3. Gap Analysis

Current Condition	Resolution Time more than 3 hours
What	Time for rectification the incident
Who	IT Technician
Where	At the user site
When	At office hours (7 am - 4 pm)
Why	- User complain at the same time - Lack of technician who will handle it - Covered area too wide
How	- Close enggagement with user to reduce uncontrol incident - Make users feels that there are dedicated technicians in their area - Do preventive maintenance instead of reactive maintenance - Knowing the user behavior

Based on result above, then the new strategy will change from centralized resources into decentralized resources. It will place a technician in the user's area to speed up the resolution time. It will have the benefits as follow:

- The closer relationship between technician and user in that area.
- The span of control will reduce to the specific area.
- Technicians will have responsible to their territory.

4. Implement the New Strategy

Based on gap analysis recommendation, team was change the strategy of IT Helpdesk operation from the current centralized to be decentralized resources. There was 2 steps strategy to do it as follows:

- New IT Helpdesk Business Process
- Calculate the Capacity Planning (workload vs. man power) on distributed area

3.1 New IT Helpdesk Business Process

The new concept of decentralize strategy for IT Helpdesk can be shown in picture below.

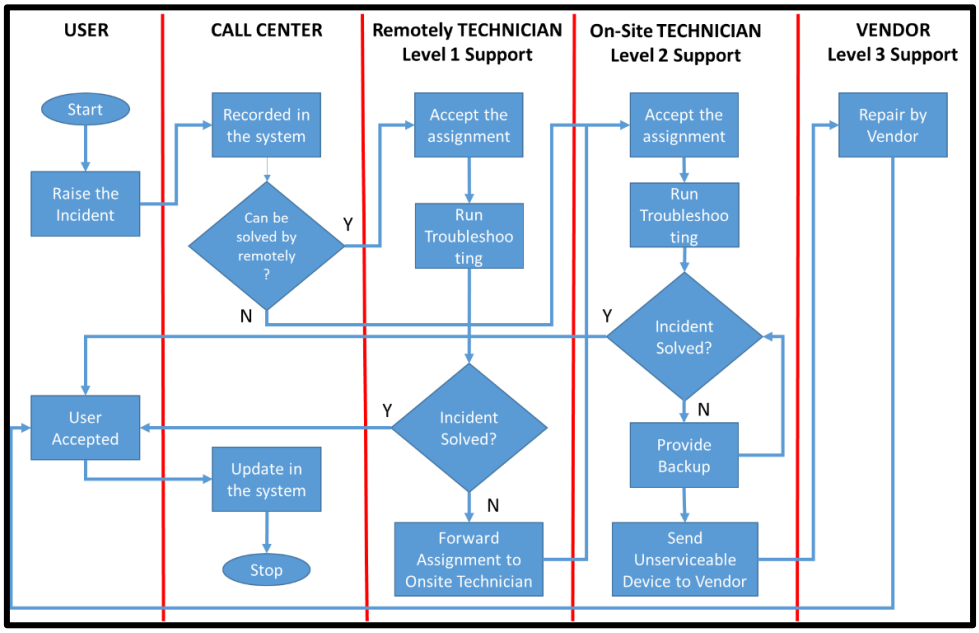

Figure 1. New IT Helpdesk Business Process

The major change from the existing business process is convert pooling technician into two type distribute technicians called Remotely Technician and On-Site Technician. Remotely Technicians is a group of technicians that use the remote application as a tool to connect to user computer's during troubleshooting. It is limited only for the incident that can solve by remotely.

On-Site technician is group of technicians that have responsibility to support the user in the specific building or branch. The activity of on-site technician is based on ticket that assigned from the call center. If there is no incident to that area, then the on-site technician has to do preventive maintenance. It is parts of their responsibility to make sure all IT peripherals in their area are running normally.

3.2 Calculate the Capacity Planning

The important things to be considered while identify the working area was about the size of the areas and populate of the users. Regarding to this, the working area to be covered can describe in table 4.

Table 4. Workload vs. Technicians

Buildings	Users	PC Desktop	Notebook	Printer	Network Devices	On Site Technician
Management Office	183	37	163	25	23	4
Hangars:						
Hangar 1	234	84	15	25	17	2
Hangar 2	157	38	7	13	14	1
Hangar 3	211	121	13	23	15	3
Hangar 4	284	203	27	28	20	4
Workshops:						
Workshop 1	87	32	15	17	8	1
Workshop 2	105	46	19	21	10	2
Engine Shop	184	132	53	27	19	4
Warehouse	153	53	15	24	6	2
Utility Building	73	45	18	13	4	2
CGK Terminal Office:						
Terminal 1	35	3	1	1	2	1
Terminal 2	69	15	5	3	2	1
Terminal 3	92	20	9	5	2	1
Branch Office						
Denpasar	158	36	24	12	15	2
Makasar	128	20	17	6	13	1
Balikpapan	58	13	7	4	3	1
Surabaya	114	18	16	8	11	1
Medan	78	14	5	4	4	1
Total	**2403**	**930**	**429**	**259**	**188**	**34**

The initial comparison between technician and user are 1:75. And the total man power of IT Helpdesk support can be shown in table 5.

Table 5. Total Man Power of New IT Helpdesk

Role	Resources
Team Leader	1
IT Repair	2
Call Center	2
Remote Engineer	1
IT Data Center	4
IT Support (on-site)	34
Total Man Power	**44**

4. Measure the Implementation

The new business process was implemented in December 2016 and start to measure from January 2017. The performance of IT helpdesk since January to April can be shown in table 6.

Table 6. SLA Performance in New ICT Helpdesk

Resolution Time	**2017**			
(in minuntes)	**Jan**	**Feb**	**Mar**	**Apr**
< 30	319	184	160	274
30 - 60	105	141	144	271
61 - 120	101	159	130	220
121 - 180	46	50	66	69
> 180	479	235	161	102
Total Incident	1050	769	661	936
SLA	**54.38%**	**69.44%**	**75.64%**	**89.10%**

5. Conclusion

Even the performance result still below the SLA, but the trend was positive. The incident that handled more than 3 hours was decrease. It means the strategy to decentralize technicians was work.

Another goal with this strategy is to decrease total incident occurred. It because the on-site technicians do the preventive maintenance and also close engagement with the user in their territory. Close engagement means the technicians will interact to the users and educate them about the IT knowledge. It almost works since the total incident from January to March decreases, except in April. It will be new hypothesis for next research that knowledge IT at end user is related with the total incident raised.

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Risk Management of Process Moving from Traditional to Agile Software Development

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Abstract

Agile programming is the popular software project development method in this era. Many company moving from Traditional software development to agile software development. They move to agile to reduce delivery time, user gap and improve quality. When use traditional method, we usually find big gap when we deliver to user. The solution of this problem is agile method. In Agile, we frequently come to users to tell them what we have done to their requirements. So the gap is not too big and we can solve it fast. But moving to agile software development is not easy. There are some risks when we move to new method. The data for this study were drawn from PT. XYZ. This company trying to move from traditional method into agile method. This company wants to move of the development method in all business units. The notion of this paper is to propose the risk management when company moving their method from Traditional into Agile software development based on study PT XYZ.

Keywords: Moving, Agile Software Development, Risk management

1. Introduction

Software Development Life Cycle provides a sequence of system designer and developers activities to follow for developing software 0. The common used method is Waterfall and Agile development.

1.1 Traditional Software Development

A software development methodology like waterfall is called traditional software development methodologies. These methodologies follow the sequential series of steps-Requirements, Design, Implementation, Testing, Deployment and Maintenance. Documenting a stable set of requirements is needed at the beginning of a project. In other words, we can say that traditional software development methods are dependent on set of predetermined processes and on-going documentation 0.

Waterfall model is a linear sequential software development life cycle (SDLC) model. The various phases followed are requirements analysis, design, coding, testing and implementation in such a manner that the phase once over is not repeated again and the development does not move to next phase until and unless the previous phase is completely completed 0. The waterfall model is a sequential design process, often used software development processed, in which progress is seen as flowing steadily downwards(like a waterfall) through the phases of Conception, Initiation, Analysis, Design, Construction, Testing, Production/Implementation and Maintenance 0.

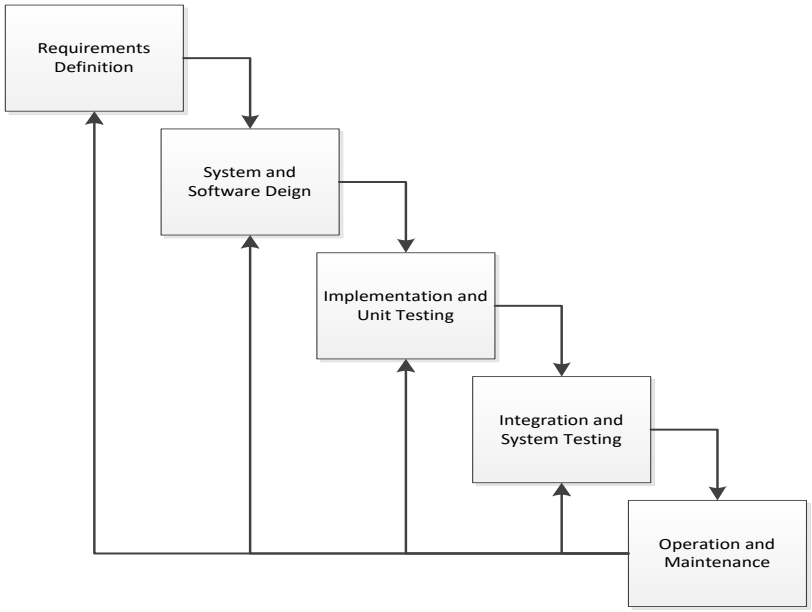

Fig. 1. Waterfall model

1.2 Agile software development

Agility is the capability of software to choose and react expeditiously and fittingly to various changes in its surround and to the demands imposed by surround. An agile process is the one that supports high degree of flexibility. Agile software development is based on the idea of incremental and iterative development in which phase within development cycle are reviewed over and over again. The agile manifesto was written based on:

- Individuals and interactions over process and tools
- Responding to change over following plan
- Early customer involvement
- Working software over comprehensive document
- Self-organizing teams
- Adaption to change 0

Extreme programming, an easy development process, is becoming increasingly influential for rapid software development. XP come from real customer involvement and quickly moves towards working code. In XP the development process is split into iterations where the beginning of each iteration includes planning and user stories. After that acceptance tests are done for each user story. The core values for XP are communication, simplicity, feedback, courage and respect. XP consists of 12 practices and is suitable for small to medium sized teams 0.

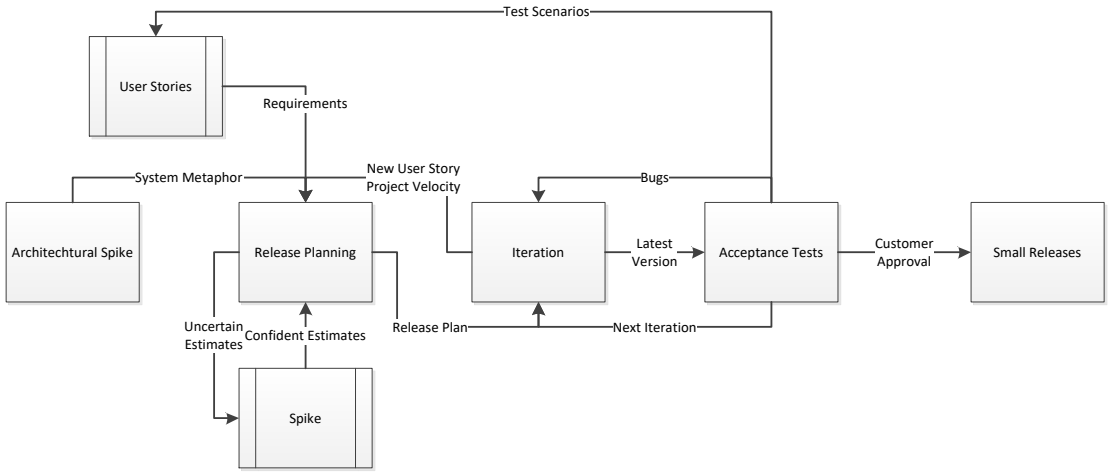

Fig. 2. Extreme Programming 0

2. Results and Discussion

This paper proposed the risk management when the company that usually use traditional method move into Agile software development. In this paper use ISO 31000 methodology as the guideline to do risk management. Figure 3 shows the steps in ISO 31000 method:

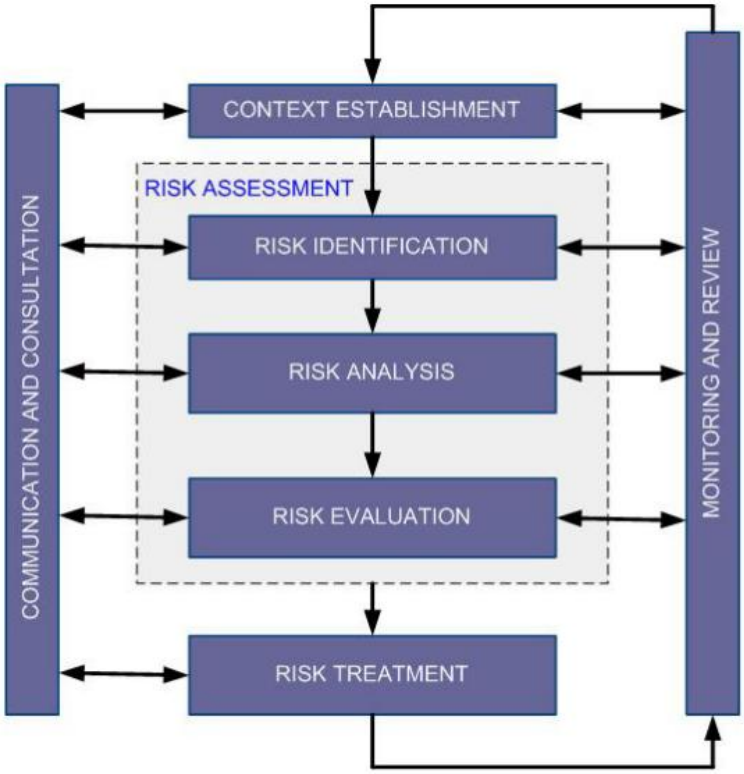

Fig. 3.The risk management process 0

2.1. Establishing Context

This research problem is about managing risk while the company wants to change the development method from traditional into agile development method. The companies have some problem while moving from traditional into agile development method 0. This research purpose to manage the risk of the transformation.

2.2. Risk Assessment

Risk assessments have three steps to do. This step should consider the categories of risk.

2.2.1. Risk Identification

The risks will be happen in company that wants to move their development method from traditional to agile software development. PT XYZ did Focus Discussion Group (FGD) with the team of business analyst, system analyst, quality assurance, and developer (total 9 participants) about this issue. The purpose of the FGD is to do exploration to find the issue that each team has in this situation 0. Based on the FGD above, PT XYZ has listed the risks that happened in their company when process moving are:

- The employee can't accept this transformation.
- Project delay.
- Customer confuse about development method.
- Lack of documentation.
- Lack of knowledge about the method.

2.2.2. Risk Analysis

From the risks list that we have identified, now we must categorize the risk based on control rating, consequence rating, and likelihood rating. Control rating is to measure how effective the control to the risk. This rating will give the output of risk categorization by the control that have implemented in the company 0.

Table 1. Controls Rating Table ISO 31000

Risk	Controls Rating	Description
The employee can't accept this transformation	Non-Existent	There are some people that don't want to go out from comfort zone. Some people lazy to learn new knowledge. The company doesn't have control method to this case.
Project delay	Good	The company has some control to handle project delay.
Customer confuse about development method	Poor	Customer will confuse about the method because they never do it in the traditional method.
Lack of documentation	Poor	Agile software development has high pressure, so it often doesn't have time to write down the document of the meeting result. The result of meeting often write down in the paper or notepad.
Lack of knowledge about the method	Fair Risk	Not many resources have knowledge about this method. Sometimes have ever heard about Agile development but doesn't know how to do it correctly.

Consequence rating is the step that categorized the risks by the impact of the risks. Based on the sequence rating in ISO 31000 0, we can see the consequence rating of the risks in PT XYZ in table 2.

Table 2. Consequence Rating Table ISO 31000

Risk	Consequence Rating	Description
The employee can't accept this transformation	Major	The impact of this risk is project will fail. It often happen as a form of rejection to this transformation because they already comfort with traditional method.
Project delay	Moderate	Project delay have the moderate consequence rating because the impact can reduce customer's trust to the company.
Customer confuse about development method	Minor	The customer just need the adaptation to the method.
Lack of documentation	Major	Human memory is limited. So we must documented the meeting result or create FSD to guide us and share to team member.
Lack of knowledge about the method	Major	The impact of this risk is each activity of this method doesn't work properly.

Likelihood is the frequency of the risk. This rating categorized the risk based on the frequently happen in the software development method. Table 3 shows the result of the risk in likelihood rating. The likelihood rating is also based on ISO 31000 0.

Table 3. Likelihood Rating Table ISO 31000

Risk	Likelihood Rating	Description
The employee can't accept this transformation	Possible	People that doesn't want to move from their comfort zone. This often happen in our real life.
Project delay	Almost Certain	In normal traditional method, almost 70% project delay. It will almost certainly happen in process moving.
Customer confuse about development method	Unlikely	Not all of the customer doesn't know about this method. At least they ever heard about this method.
Lack of documentation	Likely	This happened in some unit that moving from traditional to agile development method.
Lack of knowledge about the method	Likely	Many of the resources doesn't know about this method. Some resources know nothing and the other one have ever heard about this method but don't know how to do it correctly.

2.2.3. *Risk Evaluation*

The next step is risk evaluation. This step will determine the priority of the risk. It can help the company to allocate the resource by the priority of the risks 0.

Table 4. Risk priority

Risk	Priority	Description
The employee can't accept this transformation	1	The resource must be brainwashed about traditional and agile development method. If they already know about the benefit of the new method, they will do it by their soul and it will give the good impact to the project.
Project delay	4	The resources have many experience about handling project delay.
Customer confuse about development method	5	The customer need to adaptation to the new method.
Lack of documentation	2	Control of documentation must be get attention from the team. Because when people in the meeting, everybody can explain the case clearly. But if it is not documented clearly, it will be time bomb.
Lack of knowledge about the method	3	The resource should know about the method, because they are the responsible person in this step.

2.3. Risk Treatment

The next step is risk treatment. In this step is determining the action to this risk. There are some options in risk treatment 0:

- Avoidance
- Reduction
- Transfer
- Acceptance
- Sharing

Table 5 is the action that PT XYZ to each risk.

Table 5. Risk Treatment

Risk	Treatment	Description
The employee can't accept this transformation	Reduction	• Explain the resources about agile software development and why we should move to agile software development. • Give the reward if the teams finish the project in agile software development method.
Project delay	Acceptance	Give explanation to customer that we are in process moving to new development method. The impact of this transformation is better software quality.
Customer confuse about development method	Reduction	Give the explanation to customer that the project will use Agile software development, so make sure the customer can meet in short time because there are user stories in this method.
Lack of documentation	Sharing	Create new mini unit that create documentation of our routine meeting.
Lack of knowledge about the method	Sharing	• Give the project member the mini project as their exercise before handle big/mega projects • Do seminar to all employee about agile software development. • Do training to all employees about agile software development.

3. Conclusion

Many companies want to move into the new methodology software development, agile development, because of the better result into the projects they do. Moving into the new method that don't we do before have many risk. The risk can be come from the resources and the customer. The company should can control the risk to get the good result of their moving process.PT XYZ finally can control the risk and now they are work in the new method. For the future work perhaps there is research on how to mitigate risk treatment on reduction level particularly.

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The Work of the Future Will Be What Robots Can Not Do

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Abstract

Robot Revolution is coming. Recent business prediction warns that, in just five years of time by 2021, we can already see 6% of our workforce will be replaced by robots or artificial intelligence machines. Currently, the world is in the middle of crisis where changes take place every day. The world and technology move so fast we are having difficulty keeping up with all of the changes altogether. These changes can bring fortune and disaster depending on how we see and embrace it. Everyday new inventions are made from one person's idea passed on to the next. This idea may bring new hopes to one person and may put an end towards someone else's works. Throughout this paper, a detailed analysis is discussed to cover on how these changes in technology affect the labor force. Some of the questions to help us begin this innovative research are: What are the riskiest jobs in the market that will be most affected by disruptive technology? A short overview of what jobs that will most likely survive through changes of technology in 5 years of time. What is the predicted outcome of IT related workers?

"Life is like riding a bicycle. To keep your balance, you must keep moving." – Albert Einstein. Therefore, let's begin this research by evaluating the possible association between jobs and technology.

Keywords: Robots; Technology; labor force; jobs; employment; projections; occupations

1. Introduction

First, I would like to thank Michio Kaku, a theoretical physicist who inspired me to begin researching and analyzing further about the importance of understanding how our jobs in the future may be affected by the birth and growth of artificial intelligence.

The jobs that we hold right now may not be valued the same or may not even exist anymore in the future. Therefore, it is important to also find meanings in life other than to stick to one particular job. We, as citizens, demand and need jobs - high paying jobs to be exact. However, we are sometimes ignorant to the fact that in order for us to get high paying jobs, we have to increase our working capitals and compete with robots thus, keeping up with the technology. Throughout this paper, I will talk about my research findings on what kind of jobs in what industry are affected by this change in technology and what kind of jobs will most likely survive in the next 10-20 years of time.

"Today, your cell phone has more computer power than all of NASA back in 1969, when it placed two astronauts on the moon." – Michio Kaku.

There are many things that artificial intelligence are capable of doing like helping humans works faster, inputting data faster and responding to given tasks. This will lead us later to our analysis on how it will affect our works in the workplace.

However, before we move further into analyzing what particular jobs are affected by the growth of Artificial Intelligence, we first need to familiarize ourselves with the characteristics of this Artificial Intelligence.

According to Michio Kaku in his book *The Future of the Mind* and his research studies on artificial intelligence, robots still have capabilities that make them inferior compared to humans. This significance of studies will help us understand how we can sustain our jobs by understanding these capabilities so our work won't be replaced easily by robots.

"Robots have very bad eyesight. They can see shapes but not object like faces, cups or chairs." – Michio Kaku.

Artificial Intelligence has difficulties in recognizing patterns and common sense related to human behavior and the world. Robots don't understand the feelings like humans do which may affect their decision making process related to human life.

It is very important to understand the risk associated between human labors and artificial intelligence which is now considered the big component of the disruptive technology. It is important to understand that all creations on this earth including artificial technology have some sort of limitation. This limitation helps us grow in many aspects in life. In fact, artificial intelligence is created because of our limitations as humans. We need help to achieve the impossible and that is why we continue with innovation. We want to innovate and conquer what we think is impossible. We, as humans, are filled with curiosity which leads us to our knowledge and innovation. With innovation of artificial intelligence in mind, we need to remember that it still has capabilities that differentiate them with us, humans.

This brings us to the second capability of artificial intelligence which is the lack of creative minds. Artificial intelligence can never be humans. It is programmed to mimic our works to do it faster and so on. However, it cannot innovate like humans. Therefore, the risk mitigation for this disruptive technology issue in the workplace is to seek out creative new skills that are needed and potential jobs that will require human works.

2. Methodology

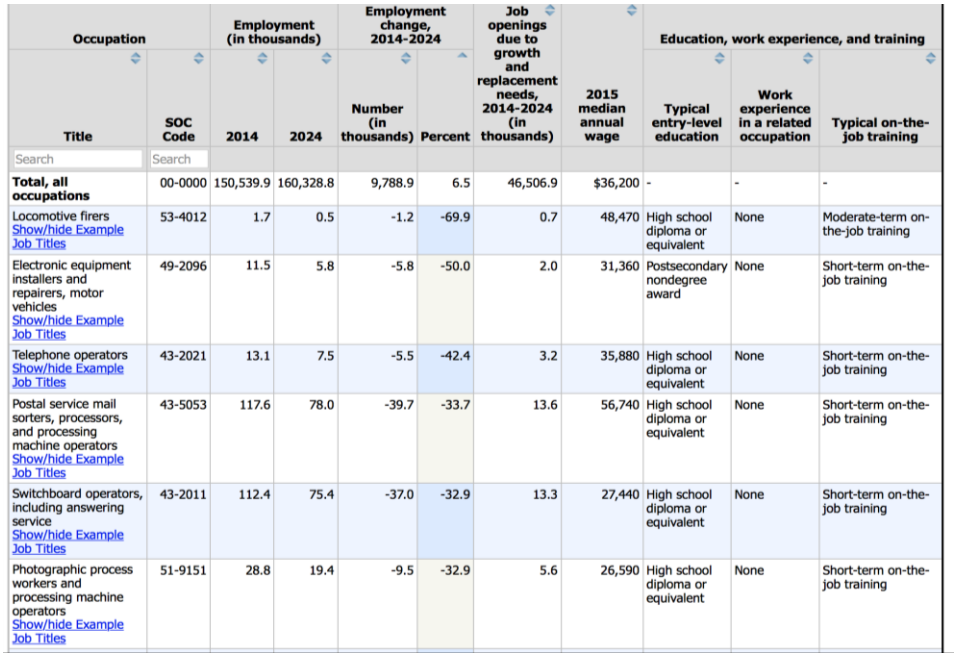
The methodology used is from BLS- Bureau of Labor Statistics of United States of America Department of Labor - USDL-15-2327.

EMPLOYMENT PROJECTION PROCEDURE— 2014-24

- The size and demographic composition of the labor force.
- Aggregate economic growth.
  Produced by using the MA/ US model, licensed from Macroeconomic Advisers, LLC (MA).
- Commodity final demand
  Supported by the National Income and Product Accounts (NIPA)2 and the Input Output Accounts, both published by the Bureau of Economic Analysis (BEA).
- Input–output.
  BLS developed historic input–output tables.
- Industry output and employment
  Combination of data from two BLS sources: (1) the Current Employment Statistics (CES) survey and (2) the Current Population Survey (CPS).
- Occupational employment and openings.
  BLS develops a set of industry–occupation matrices. These matrices include a base-year employment matrix and a projected-year employment matrix.

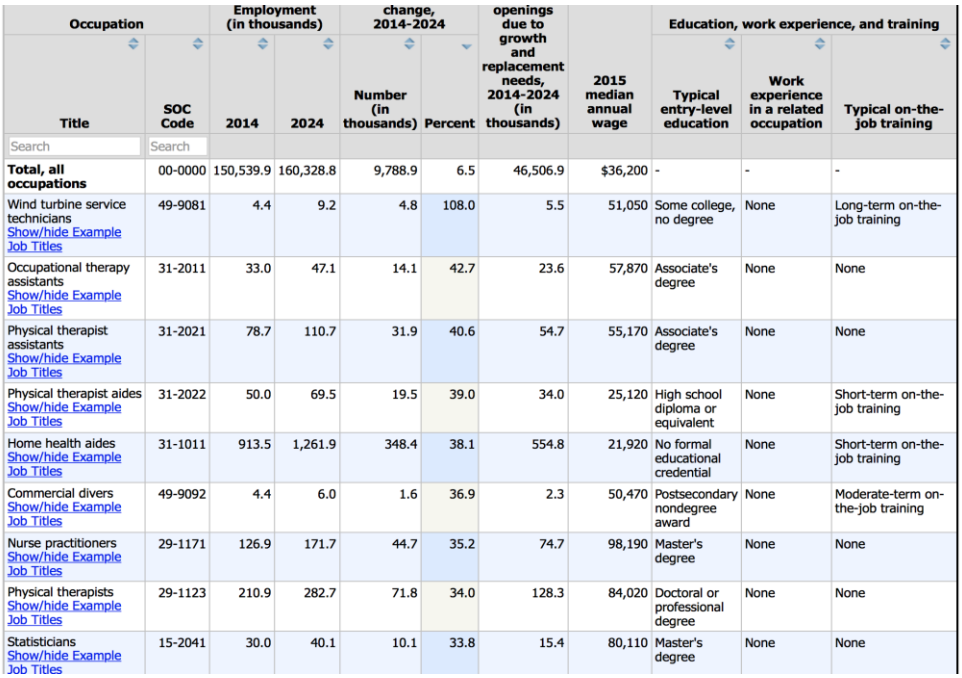
3. Detail Analysis

According to the Employment Projection by Bureau of Labor Statistics of U.S. Department of Labor, these are the top six examples of the most predicted risky jobs by the year 2024 as shown in Fig. 1. The Locomotive firer who includes Diesel Locomotive Firer, Dinkey Engine Firer and Railroad Firer are in the highest position shown as the most affected occupations with 69.9 % decrease in demand. Other occupations such as electronic equipment installer, telephone operators and other business operators show decreases in demand as well and included in the top list of the riskiest jobs by the year of 2024.



Occupation		Employment (in thousands)		Employment change, 2014-2024		Job openings due to growth and replacement needs, 2014-2024 (in thousands)	2015 median annual wage	Education, work experience, and training		
Title	SOC Code	2014	2024	Number (in thousands)	Percent			Typical entry-level education	Work experience in a related occupation	Typical on-the-job training
Search	Search									
Total, all occupations	00-0000	150,539.9	160,328.8	9,788.9	6.5	46,506.9	$36,200	-	-	-
Locomotive firers Show/hide Example Job Titles	53-4012	1.7	0.5	-1.2	-69.9	0.7	48,470	High school diploma or equivalent	None	Moderate-term on-the-job training
Electronic equipment installers and repairers, motor vehicles Show/hide Example Job Titles	49-2096	11.5	5.8	-5.8	-50.0	2.0	31,360	Postsecondary nondegree award	None	Short-term on-the-job training
Telephone operators Show/hide Example Job Titles	43-2021	13.1	7.5	-5.5	-42.4	3.2	35,880	High school diploma or equivalent	None	Short-term on-the-job training
Postal service mail sorters, processors, and processing machine operators Show/hide Example Job Titles	43-5053	117.6	78.0	-39.7	-33.7	13.6	56,740	High school diploma or equivalent	None	Short-term on-the-job training
Switchboard operators, including answering service Show/hide Example Job Titles	43-2011	112.4	75.4	-37.0	-32.9	13.3	27,440	High school diploma or equivalent	None	Short-term on-the-job training
Photographic process workers and processing machine operators Show/hide Example Job Titles	51-9151	28.8	19.4	-9.5	-32.9	5.6	26,590	High school diploma or equivalent	None	Short-term on-the-job training

Fig. 1. Employment Projection based on lowest percentage value



Occupation		Employment (in thousands)		change, 2014-2024		openings due to growth and replacement needs, 2014-2024 (in thousands)	2015 median annual wage	Education, work experience, and training		
Title	SOC Code	2014	2024	Number (in thousands)	Percent			Typical entry-level education	Work experience in a related occupation	Typical on-the-job training
Search	Search									
Total, all occupations	00-0000	150,539.9	160,328.8	9,788.9	6.5	46,506.9	$36,200	-	-	-
Wind turbine service technicians Show/hide Example Job Titles	49-9081	4.4	9.2	4.8	108.0	5.5	51,050	Some college, no degree	None	Long-term on-the-job training
Occupational therapy assistants Show/hide Example Job Titles	31-2011	33.0	47.1	14.1	42.7	23.6	57,870	Associate's degree	None	None
Physical therapist assistants Show/hide Example Job Titles	31-2021	78.7	110.7	31.9	40.6	54.7	55,170	Associate's degree	None	None
Physical therapist aides Show/hide Example Job Titles	31-2022	50.0	69.5	19.5	39.0	34.0	25,120	High school diploma or equivalent	None	Short-term on-the-job training
Home health aides Show/hide Example Job Titles	31-1011	913.5	1,261.9	348.4	38.1	554.8	21,920	No formal educational credential	None	Short-term on-the-job training
Commercial divers Show/hide Example Job Titles	49-9092	4.4	6.0	1.6	36.9	2.3	50,470	Postsecondary nondegree award	None	Moderate-term on-the-job training
Nurse practitioners Show/hide Example Job Titles	29-1171	126.9	171.7	44.7	35.2	74.7	98,190	Master's degree	None	None
Physical therapists Show/hide Example Job Titles	29-1123	210.9	282.7	71.8	34.0	128.3	84,020	Doctoral or professional degree	None	None
Statisticians Show/hide Example Job Titles	15-2041	30.0	40.1	10.1	33.8	15.4	80,110	Master's degree	None	None

Fig. 2. Employment Projection based on highest percentage value

According to the Employment Projection by Bureau of Labor Statistics of U.S. Department of Labor, these are the top nine examples of the most predicted jobs that have the highest probability to survive by the year 2024 as shown in detail in Fig. 2. The wind turbine service technicians are in the top of the list with prediction to increase by 108% in demand by the year of 2024. Many other occupations that offer services such as occupational therapy assistants and physical therapy assistants are also predicted to survive and highly increase in demand in 2024.

Occupation		Employment (in thousands)		Employment change, 2014-2024		Job openings due to growth and replacement needs, 2014-2024 (in thousands)		Education, work experience, and training		
Title	SOC Code	2014	2024	Number (in thousands)	Percent		2015 median annual wage	Typical entry-level education	Work experience in a related occupation	Typical on-the-job training
Information	Search									
Total, all occupations	00-0000	150,539.9	160,328.8	9,788.9	6.5	46,506.9	$36,200	-	-	-
Computer systems analysts Show/hide Example Job Titles	15-1121	567.8	686.3	118.6	20.9	191.6	85,800	Bachelor's degree	None	None
Information security analysts Show/hide Example Job Titles	15-1122	82.9	97.7	14.8	17.9	25.5	90,120	Bachelor's degree	Less than 5 years	None
Medical and health services managers Show/hide Example Job Titles	11-9111	333.0	389.3	56.3	16.9	140.5	94,500	Bachelor's degree	Less than 5 years	None
Computer and information systems managers Show/hide Example Job Titles	11-3021	348.5	402.2	53.7	15.4	94.8	131,600	Bachelor's degree	5 years or more	None
Medical records and health information technicians Show/hide Example Job Titles	29-2071	188.6	217.6	29.0	15.4	71.2	37,110	Postsecondary nondegree award	None	None
Computer and information research scientists Show/hide Example Job Titles	15-1111	25.6	28.3	2.7	10.7	6.0	110,620	Doctoral or professional degree	None	None

Fig. 3. Employment Projection based on keyword "Information"

According to the Employment Projection by Bureau of Labor Statistics of U.S. Department of Labor, these are the top six examples of job market trend related to Information Technology by the year 2024 as shown in Fig. 3. Occupations that are related to Information Technology are predicted to increase in demand by the year 2024. The first example of occupations generated using the keyword "Information" in this data set is the Computer System Analysts which shows 20.9% increase in demand by the year 2024.

From this information, we can analyze that some jobs really are predicted to be impacted by the changes in technology. From the data above, we can see the business trend where administrative jobs and other occupations that are repetitious in nature are the riskiest and impacted ones to be replaced by artificial intelligence or robots by the year 2024.

Given these points, by studying this valuable information and understanding which jobs will survive in the year 2024, we can better envision our careers for the next five to ten years of time by expanding and investing on the right skillsets that are required to learn for the demandable jobs. Thus, hopefully with this mitigation of risk in mind we can reduce the risk in our workplace where our works and job industries are affected.

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Effect of Aerodynamic Drag and Mass in Trajectory Motion

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Abstract

Trajectory motion in the air is mainly affected by the coefficient of the aerodynamic drag, gravitation, mass of the object to be thrown and also the degree of angle use in trajectory. Any change between these factors could result in the change of trajectory motion and displacement. These papers is focusing on comparing the effect of aerodynamic and mass of the object and see which has the most significant impact on the trajectory motion and the displacement, the other factor is ignored and assumed to be in the same condition even when the value is large.

1. Introduction

There are two things that affect the trajectory motion. It is aerodynamic drag and mass of the object. Each of these two factors contributes in the change of displacement of trajectory motion. The problem that is being analyzed is about what factors affect the most in the trajectory displacement. Below is the description of these two factors:

1.1 Aerodynamic Drag

The Aerodynamic drag is one of the key factors in changing the displacement of the trajectory motion. It is considered as the enemy of every object that travelling through air due to fact that it cause an air friction to the object that crossing the air [2]. To change the value of aerodynamic drag there are several things that can be set. The first is the drag force. The second factor is the frontal area of the object. The third factor is the speed of object that is travelling and the last is the density of the air, and it is related to the humidity and the temperature of the weather in the air [1]. To summarize it, the formula of aerodynamic drag is written as below [1]:

$$Fd = \frac{Cd\ pAV^2}{2} \quad (1)$$

Cd	= Coefficient Drag
Fd	= Aerodynamic drag force
ρ	= Density of Air
A	= Frontal Area of Object
V	= Velocity of the Object

In more detail, the component variable in the formula above can be break down to smaller pieces to identify any kind of thing that affect the coefficient drag.

- **Density of the air**
  It is shown in the formula above that the increase in density of the air can make the aerodynamic drag bigger This is because the more level of compact in the substance of air then there will more air resistance and friction and it will result higher value of aerodynamic drag. The formula of density of air is listed as below [3]:

$$\rho = \frac{P}{R\,T} \quad (2)$$

ρ	= Density of Air
P	= Total air Pressure
R	= Gas Constant
T	= Temperature

In this formula the increase of total pressure is directly proportional to the increase of density. Total pressure (P) is related to the altitude. The higher the altitude then the air pressure will be smaller [4]. The other thing that effect density is gas constant symbol as R. This value of gas constant is very from every location depends on the mixture of the compounds of it [5]. The last thing that effect density of air is the temperature. Increase in the temperature can make the density is smaller. The greater the altitude, the temperature will be smaller, and then to decrease temperature high altitude is need.

- **Frontal area of the object**
  Frontal area of object is related to circumference are of the object. The relation is that the greater the value of area of the object, then the coefficient of drag will be smaller.

- **Velocity of object**
  The relationship between velocity of object with density of air is that the greater the velocity than the aerodynamic drag will be bigger.

- **Coefficient drag**
  In most definition, coefficient of drag is identified as dimensionless quantity that is used to quantify the drag or resistance of an object in the air or hydro environment. The value of coefficient drag is varying between its shape and it is merely experimental. In aerodynamic shape optimization the most important uncertainties are the flow related ones, arising from the different range of operation conditions related to the Mach number and angle of attack, as well as Reynolds number for a viscous flow modeled by the Navier–Stokes equations [7]. The relation between coefficient of drag and aerodynamic drag is that the greater the coefficient of drag then the aerodynamic drag will be bigger. Below is the example figure describing the different coefficient of drag between different shapes [6]:

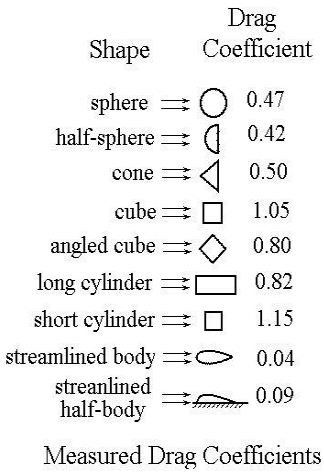

Fig. 1. Drag coefficient value in different shape. Taken from: http://www.wikiwand.com/en/Drag_coefficient

1.2 Mass of Object

The other variable that is use the change the trajectory motion is the mass of object. The formula that describes mass is:

$$m = D \; x \; V \quad (3)$$

In the formula above, it is described that there are two things that affect mass. First is density of the object. Density is related to compactness in a substance and volume is about the total space that object occupy. This two factors have directly proportional effect on the mass. This is the end about introduction of two variables that will be use in this paper. Next chapter will cover about the mathematic in this research.

2. Mathematical Model

The first force from that is coming from trajectory motion is weight. The formula of weight is w = m g. The component of acceleration from this are:

$$ax = 0 \text{ and } ay = -g \quad (4)$$

The second force that affect is the aerodynamic drag. The value of this force is equal to proportional to the square of the projectile's speed relative to the air:

$$f = Cd \; v^2 \quad (5)$$

v^2 in the equation above is consist of 2 component from the velocity from the x-axis and y-axis $v^2 = {v_x}^2 + {v_y}^2$ or it can also mean as $v = \sqrt{{v_x}^2 + {v_y}^2}$. The newton second law gives.

$$\Sigma F_x = -Cd \; v v_x = m \; ax \quad \text{and} \quad \Sigma F_y = -m \; g - Cd v v_y = m \; ay \quad (6)$$

Then the component acceleration that involving gravity and coefficient of drag are :

$$ax = -(Cd / m) \; v v_x \text{ and } ay = -g - (Cd / m) \; v v_x \quad (7)$$

3. Analysis

To simulate the effect of aerodynamic drag and mass in the displacement of trajectory. The mathematical model $ax = -(Cd / m) \; v v_x$ and $ay = -g - (Cd / m) \; v v_x$ is transpose into matlab program with the detail and initial condition as below.

Mass (m)	= 10 kg
Cd	= range from 0.1 to 0.9 (increment 0.2)
Gravity	= 9.81 m /s^2
Weight	= Mass * Gravity
yp	= zeros(4,1)
yp(1)	= y(2)
yp(2)	= ((-Cd/m)*y(2)*(y(2)^2+y(4)^2)^(0.5))
yp(3)	= yp(4)
yp(4)	= ((-w/m)*y(2)*(y(2)^2+y(4)^2)^(0.5))

In the program above, the variable that being modified is the aerodynamic drag, symbol as Cd. The other variable is remaining constant. The result from the above program is in the below:

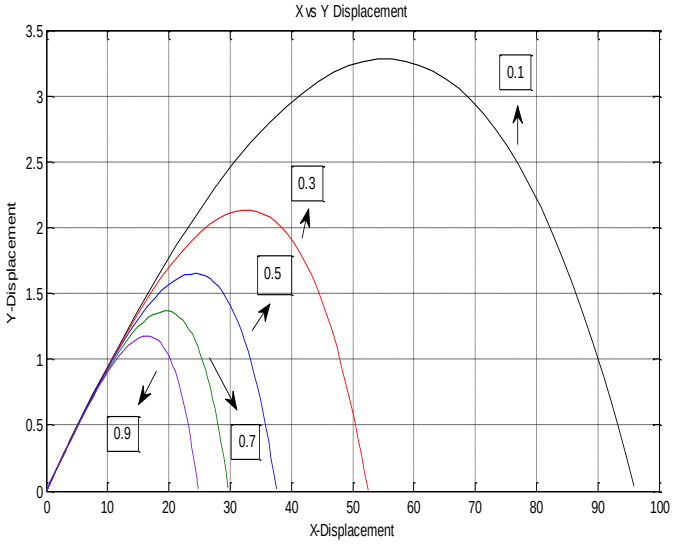

Fig. 2. The effect of different coefficient drag variable between 0.1 until 0.9 (interval 0.2) when other variable is at constant value

The chart above describe the trajectory motion with range coefficient of drag between 0.1 to 0.9 and 0.2 in each incremental and the other factors assume as constant (mass= 10kg, gravity = 9.81, x (0) = 100 m/s, y(0) = 10 m/s). It shows that X and Y displacement of the trajectory motion is reduce if the drag coefficient is increase due to the air resistance is bigger and that air resistance opposes the vector of motion the object.

In the next simulation the variable that being modified is the mass of the object. The other variable is in a constant value.

Mass (m) = range from 10 to 90 (increment by 20)
Cd = 0.5
Gravity = 9.81 m /s^2
Weight = Mass * Gravity
yp = zeros(4,1)
yp(1) = y(2)
yp(2) = ((-Cd/m)*y(2)*(y(2)^2+y(4)^2)^(0.5))
yp(3) = yp(4)
yp(4) = ((-w/m)*y(2)*(y(2)^2+y(4)^2)^(0.5))

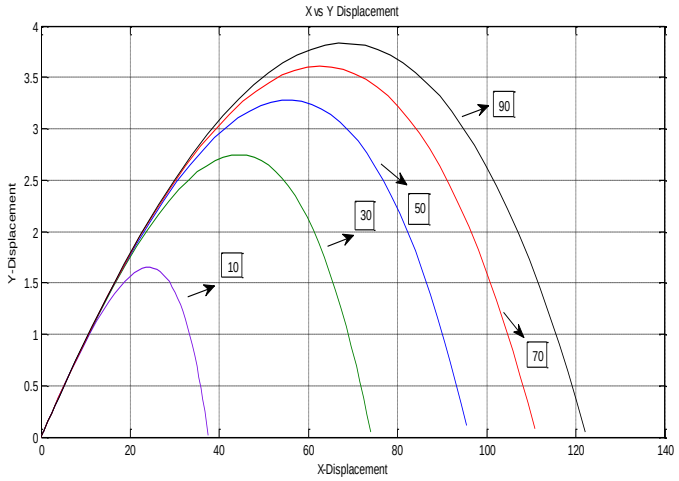

Fig. 3. The effect of different of mass variable between 10 to 90 kg (interval 20 kg) when other variable is in constant value

The chart above describe the trajectory motion with range of mass between 10 to 90 and 20 in each incremental and the other factors assume as constant (Cd= 0.5, gravity = 9.81, x(0) = 100 m/s, y(0) = 10 m/s). It shows that X and Y displacement of the trajectory motion is reduce as the mass is decrease. The

greater the value of the mass has impact in increasing the value of weight. It is reflected in the equation (7).

Then the summary of the effect of coefficient drag is as below:

Table1 Effect of coefficient drag vary from 0.1 to 0.9 to the displacement of trajectory

Cd	0.1	0.3	0.5	0.7	0.9
X Displacement	96	52	38	30	25
Y Displacement	3.3	2.12	1.65	1.35	1.2

The average effect in decreasing coefficient of drag is:

Cd = 0.7 compare to Cd = 0.9
X displacement is change from 25 to 30 then it is an increase by 20 %
Y displacement is change from 1.2 to 1.35 then it is an increase by 12.5 %

Cd = 0.5 compare to Cd = 0.7
X displacement is change from 30 to 38 then it is an increase by 26.6%
Y displacement is change from 1.35to 1.65 then it is an increase by 22%

Cd = 0.3 compare to Cd = 0.5
X displacement is change from 38 to 52 then it is an increase by 36.8%
Y displacement is change from 1.65 to 2.12 then it is an increase by 28.4%

Cd = 0.1 compare to Cd = 0.3
X displacement is change from 52 to 96 then it is an increase by 84.6%
Y displacement is change from 2.12 to 3.3 then it is an increase by 55.6%

Average X displacement increase = 42%
Average Y displacement increase= 29.6%

The summary of the effect of changing mass is as below:

Table 2 Effect of mass vary from 10 to 90 kg to the displacement of trajectory

Mass	10	30	50	70	90
X Displacement	38	75	97	112	122
Y Displacement	1.65	2.75	3.25	3.6	3.8

m = 30 compare to m =10
X displacement is change from 38 to 75 then it is an increase by 97 %
Y displacement is change from 1.65 to 2.75 then it is an increase by 66.7 %

m = 50 compare to m =30
X displacement is change from 75 to 97 then it is an increase by 29.3 %
Y displacement is change from 2.75 to 3.25 then it is an increase by 18.1 %

m = 70 compare to m =50
X displacement is change from 97 to 112 then it is an increase by 15.4 %
Y displacement is change from 3.25 to 3.6 then it is an increase by 10.7 %

m = 90 compare to m =70
X displacement is change from 112 to 122 then it is an increase by 8.9 %
Y displacement is change from 3.6 to 3.8 then it is an increase by 5.5 %

Average X displacement increase = 37.65%
Average Y displacement increase = 25.25%

The final comparison result between decreasing coefficient of drag and increasing mass is as below:

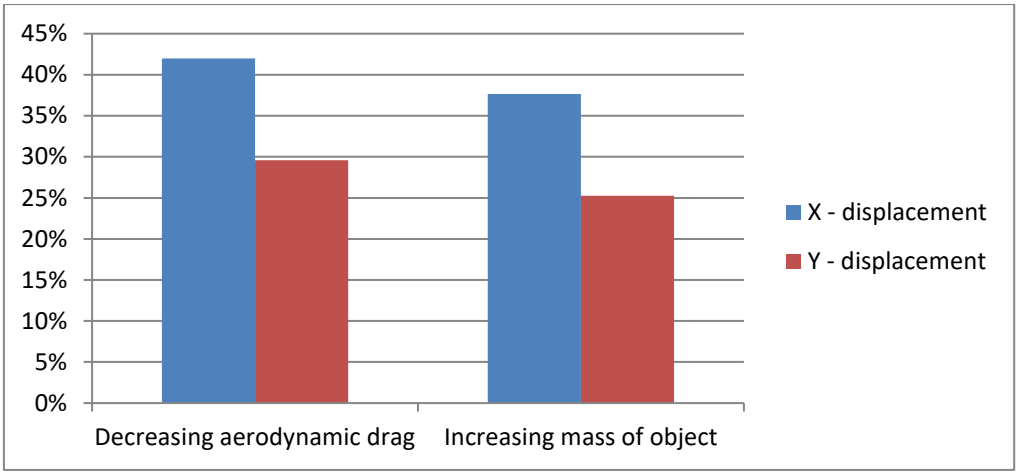

Fig. 4. The effect of decreasing aerodynamic compare to increasing mass in the displacement of the trajectory

Average of X displacement increase	=	42% : 37.65%	= 1.11 : 1
Average of Y displacement increase	=	29.6 : 25.25	= 1.17 : 1

4. Conclusion

Mass of the object, gravity, initial velocity and as well as aerodynamic drag is several things that affect the trajectory displacement. In this paper other variables except aerodynamic drag and mass of the object is remain constant. This is done to compare the effectiveness of mass of the object and the aerodynamic drag to the trajectory displacement. In order to modify the value of aerodynamic drag there is several things that can be change; there are coefficient drag, density of the air, frontal area of the object and velocity of the object. To change the value of the mass the required variable to be change is the density of the object and the total volume of the object.

In this paper to measure the effects of mass and aerodynamic drag. The experiment is conducted by increasing the mass and decreasing the aerodynamic drag. Based on the result that has been presented in the table, decreasing the coefficient of drag is proved to be more effective than increasing the mass. The X displacement is increased around 11% better than increasing mass and in Y displacement; the increase effect is around 17 % higher. Air friction is once again proved to be the main reason that trajectory motions in the air become obstructed.

5. Acknowledgements

I would like to thank you to Dr. Ary Syahriar PhD for contributing the idea so I can write paper regarding this topic.

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Risk Management on Information Security in ABC Company

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Abstract

From long, long time ago until nowadays information still takes a serious position for all aspect of life, from individual to organization. In ABC company information is somewhat very sensitive, very important. But how we keep our information safe, well we have many ways to do that: in hard drive, removable disc etc. with other organizations they even have data centre to save their information. The objective of information security is to keep information safe from unwanted access. We applied Risk Mitigation Action framework on our data management system and after several months we have a result far better than before we use it: information more secure, quickly detect incidents, improve internal and external collaboration etc.

Keyword: Information Security; Risk management; Mitigate information leaking

1. Introduction

Nowadays, with a development of Information Technology, many devices were created such as laptop, smart phone, tablet, USB and they prove how important they are, they make our life more exciting, working faster. We can store our data as much as possible inside these devices and bring them everywhere. But on the other side, they are easy to be stolen or lost by their portability and mobile accessed by the hacker who always waiting for our mistakes. In ABC company, the employee always works with laptop, Smartphone, tablet and sometimes work outside the office but most of them don't consider information security as the top priority. Because of that protecting data inside these devices become a tough mission.

2. Background

In ABC Company, we have an experiment as below:

A, the regional sales manager was told that three laptops worth about $6,000 had been stolen. Three members of her team went out for a meeting without locked the door. When they came back, they found out their laptops were missing, probably taken by a thief who could get in the offices, picked up the laptops, and ran away without any doubt from anybody.

By the fact data were stored on the hard disk of the laptops; they lost most of their precious information such as e-mails and sales logs, customer contact lists and detailed product specifications files. Besides that, they also lost a large amount of other important data stored on the laptops, cost estimated at $65,000 in value.

This example gives us a lesson how important to secure data especially business data. Therefore "How to mitigate the loss of information?" is the question that should be answered in this paper.

3. Threats and vulnerabilities identification

3.1. Threats

Table 1. List of Threats [1]

Threats	Description
Accidental Disclosure	The unauthorized or accidental release of classified, personal, or sensitive information.
Acts of Nature	All types of natural occurrences (earthquakes, hurricanes, tornadoes) that may damage or affect the system/application.
Alteration of Software	An intentional modification, insertion, deletion of operating system or application system programs, whether by an authorized user or not, which compromises the confidentiality, availability, or integrity of data, programs, system, or resources controlled by the system. This includes malicious code, such as logic bombs, Trojan horses, trapdoors, and viruses
Bandwidth Usage	The accidental or intentional use of communications bandwidth for other than intended purposes.
Electrical Interference/ Disruption	An interference or fluctuation may occur as the result of a commercial power failure. This may lead to inaccessible to authorized users or a modification of data.
Intentional Alteration of Data	An intentional modification, insertion, or deletion of data, whether by authorized user or not, which compromises confidentiality, availability, or integrity of the data produced, processed, controlled, or stored by data processing systems.
System Configuration Error (Accidental)	An accidental configuration error during the initial installation or upgrade of hardware, software, communication equipment or operational environment.
Telecommunication Malfunction/ Interruption	Any communications link, unit or component failure sufficient to cause interruptions in the data transfer via telecommunications between computer terminals, remote or distributed processors, and host computing facility.

3.2. Vulnerabilities

Table 2. List of Vulnerabilities [2]

Vulnerabilities	Used by	Threats Action
Terminated employees ID are not removed	Terminated employee	Dialing into the company's network and accessing
Firewall allows inbound telnet, and guest user is enabled on server	Unauthorized user (hackers, terminated employees, computer criminals, terrorist)	Using telnet to server and browsing system files with the guest user
The vendor has identified vulnerabilities in the system but patches have not applied to the system yet	Unauthorized user (hackers, disgruntled employees, computer criminals, terrorist)	Take the right to access to system based on vulnerabilities

With the development of technique today, more application has been created which mean more vulnerability inside them. Vulnerabilities can be one of this:

- Missing data encryption
- OS command injection
- SQL injection
- Buffer overflow
- Missing authentication for critical function
- Missing authorization
- Unrestricted upload of dangerous file types
- Reliance on entrusted inputs in a security decision
- Cross-site scripting and forgery
- Download of codes without integrity checks
- Use of broken algorithms
- URL redirection to entrusted sites
- Path traversal
- Bugs
- Weak passwords
- Software that is already infected with virus

This list has become bigger year after year as never ending. [3]

4. Methodology

We use Mitigation action point's framework to deploy in our system and meanwhile apply some solutions to reduce threats and vulnerabilities. After that we do monitoring to see whether it helps improve system security.

4.1. Mitigation Action Points

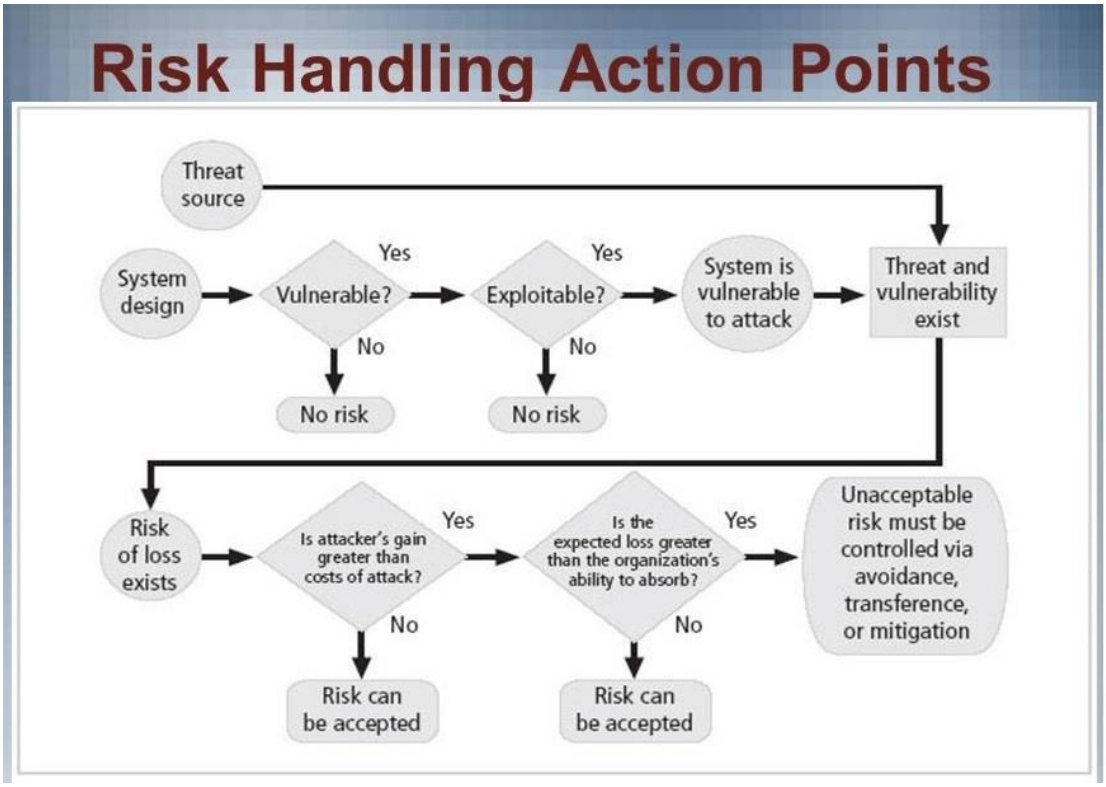

Fig.1. Risk Mitigation Action Points

The risk mitigation action points can be described as below:

- When risk or vulnerabilities exist ➡ implement assurance techniques to reduce the likelihood of vulnerability's being exercised.

- When vulnerability can be exercised ➡ applied layered protections, architectural designs, and administrative controls to minimize the risk or prevent this occurrence.
- When the attacker's cost is less than a potential gain ➡ apply protections to decrease an attacker's motivation by increasing the attacker's cost
- When loss is too great ➡ apply design principles, architectural design, technical and non-technical protections to prevent extend of the attack, therefore reducing potential for loss.

4.2. Solutions to reduce Threats and Vulnerabilities [4]

- Vulnerabilities scanner
- Penetration testing
- Create a regulation when using devices to all company's employee
- Deploy CCTV, security officer
- Data must be stored in many places such as cloud, portable hard drive, server…
- Important data must be encrypted
- Employ RDS environment with as-needed permissions
- Encrypt private information such as social security numbers, birthdays in the database and use KMS for encryption
- Utilize EC2 servers that act as a middle service layer behind the same VPN that the RDS is in
- When appropriate, use a separate EC2 environment for the Viewer/Presentation layer which is behind a load balancer and Cloud Front (all through the same VPN)
- Use powerful on-call monitoring tool for when something goes awry or a website goes down
- Segment permissions based on minimum access requirements
- Require multi factor authentication
- Monitor file integrity

4.3. Result after apply security framework

With a security framework and solutions applied, after several months monitoring system we get a result that describe in a chart below. Overall our system security reaches a better result than before.

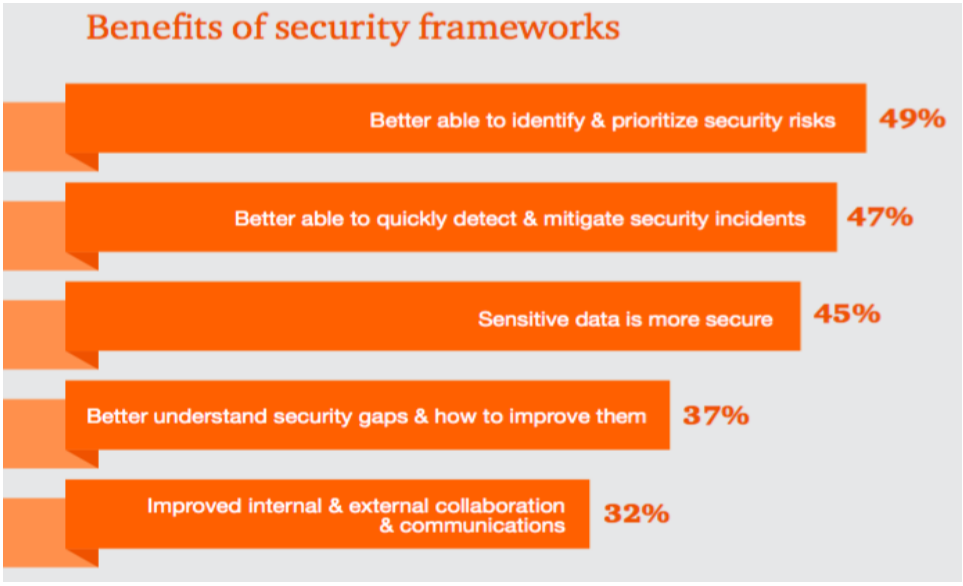

Fig.2. Benefit gain when applying security framework

- The capable of identify and prioritize increase 49%.
- Quickly detect and mitigate security incidents increase 47%.
- Data more secure, especially sensitive data increase 45%.
- Understanding security gaps and improve them increase 37%.
- Internal and external collaboration & communication increase 32%.

All results above make our company more reliable, more confident when working under many pressure of secure information.

5. Conclusion and Future works

With the rapid development of technology and business today, information becomes more important than ever. Sometimes it costs a fortune, protects and keeps information safe also become on the top priority of every organization and person. More threats are coming and put our data in danger. The security framework is necessary to prevent and mitigate vulnerabilities; it also can help us identify the gap in our security policy. From that we can propose solutions and new policy to adapt situations can happen. Figure 3 describes security issues in the world.

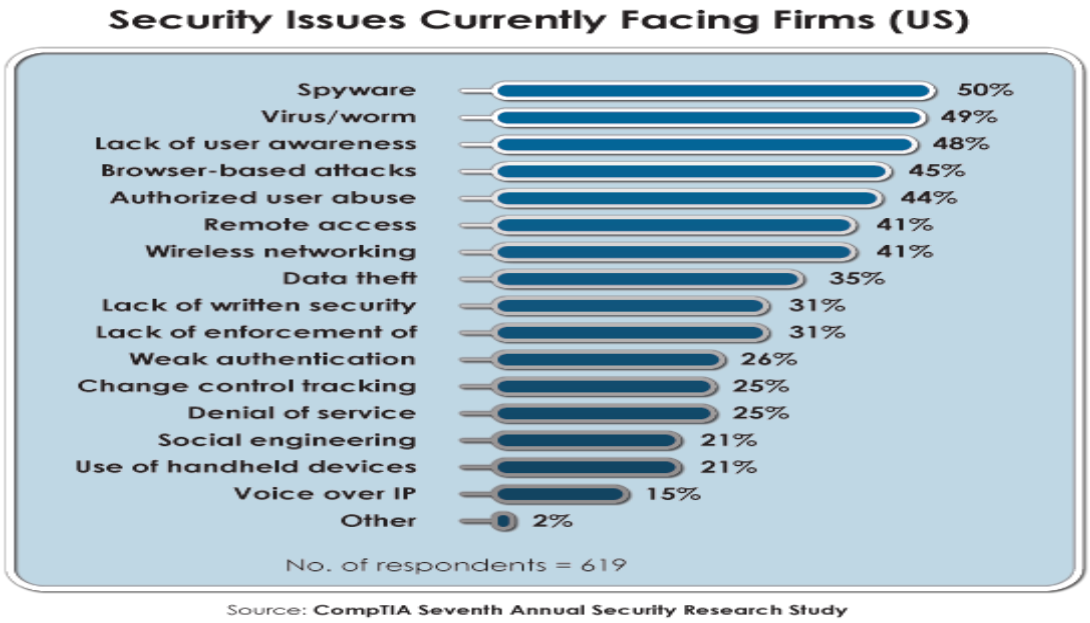

Fig.3. Security chart [5]

After apply Risk mitigation action points framework and solutions, we realize how important they are with our system for present and future. With the development of technology, vulnerabilities and flaws come as well. We should keep update to any change in framework and solutions to make the best effort against them.

6. Acknowledgements

I would like to say thank you to ABC Company's managers and employee who support me doing this paper and my friends who encourage me from the beginning to the end.

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Design and Simulation of Automatic Room Temperature by Using Fuzzy Control

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Abstract

In air conditioning system, efficient operation of air conditioning equipment to suit the user demand is important and to achieve that, Fuzzy Logic controller can play a key role in formulating the next generation of control technology for the traditional air conditioning equipment. The target of this research is to develop a fuzzy logic control which will allow less usage of energy by optimum operation of air conditioning which would also promote Conservation of Energy. The control system in this study also would need to achieve a Stable Climate Condition in the room within the limits of control set points and promote convenient to the users by automatic control. The control strategy proposed in this thesis work is fuzzy logic controller (FLC). A MATLAB fuzzy program tool is used to develop a fuzzy logic controller to achieve within the comfort parameters of temperature and artificial lighting as well as energy savings. Simulink program in MATLAB will also be used to simulate the fuzzy logic in this Thesis work. Based on the findings observed on the case study described in this Thesis Report, the savings achieved by the Fuzzy Logic Air Conditioning System is about 66%.With these results, it can be concluded that the objective of this Thesis work has been full filled)

Keyword: Fuzzy, Split Air Conditioning Control, Lighting Control

1. Introduction

There has been a rising concern in reducing the energy consumption in buildings. Heating, ventilation and air-conditioning system is the biggest consumer of energy in buildings while Lighting is the second largest electrical energy use next to air- conditioning. In modern society, air conditioners are commonly found in homes and in public enclosed spaces due to the natural demand for thermal comfort. A basic of an air conditioning system consist of a conventional single speed air conditioning system to that of a variable speed type. A variable speed of air conditioning is the system that could distribute conditioned air at different temperatures.

A system with variable speed control can control the cooling capacity by changing the rotational speed of the compressor for load matching and thermal comfort; therefore, it must be complemented with a good control scheme to maintain comfort under any conditions.

The energy consumption of the compressor accounts around 90% of the total energy consumption of an air conditioning system. Most Air Conditioning Designers claimed that they intentionally oversized air conditioning design for about 10 to 15% because for future extension, renovation and change of usage.

Nowadays, the air conditioning is widely used especially in warm countries including Indonesia. Usually the conventional air conditioning is always cooling the room depending on the fixed temperature setting and is not automatically adjusted for the comfort of the users. In the central air conditioning control field, excellent real- time, high reliability, and good intelligence are proposed by many researchers. The traditional PID algorithm is, in fact, still playing a main role in the control process. The air conditioning system has becoming a field to be researched to improve the user convenience by applying intelligent system such as Adaptive Fuzzy controller. While the enhanced air conditioning system is being designed, the consideration of the type of control system must be included in a modeling design. In particular the controller must be able to avoid the inefficiency of having the air conditioning operate all the time.

Several control options will be considered which would turn the air conditioning and lighting off when people are not in the room with the air conditioning and a temperature sensor

input, which would change the air conditioning operation depending on room temperature [1].

Based on the observation of the using the present conventional air conditioning application, it always working all the time without a systematic control. Therefore, the control of the air conditioning is adjusted through a feedback control system to monitor and maintain a constant temperature based on the data input from the sensors.

This project will carry out a study on the air conditioning temperature control system by using the current temperatures in the room and at outside. Input from these temperature sensors and set point will be used tool the compressor speed to achieve the desired point. This research will only focus on the main component, which is the compressor system in air conditioning which significantly affects the temperature change.

2. Design and Simulation

2.1 Problem

The problem happens when the air conditioning is still functioning although in the event of cold weather. The function is uncontrolled and must be manually turned on and off. Sometimes it can lead to high usage of electricity which in turn raises the electricityy bill when the user forgot to switch it off. The system also does not have the capacityy to adjust the room temperature regardless of the ambient temperature. In some cases, both air conditioning and lighting were left switched on during when the users have left that location and no longer present there. Also, at locations where daylights are provided sufficiently, users usually fail control the Lighting based on daylight condition at a different time of the day. To address the problem, an automatic controller that can control the temperature automatically is proposed. The advantages of such a system are less energy usage and provides more convenient to the consumers.

2.2 Research Objectives and Significance of study

To find the mathematical model of an air conditioning system. To find control logic for the Lighting System Control. To simulate the design of AC and Lighting System controller using Fuzzy Logic in MATLAB. To analyze the performance of the control system. Efficient energy usage due to Optimum operation of air conditioning and Lighting which promote Conservation of Energy, Efficient usage of electricity which in turn reduce the electricity bill.

Stable Room Thermal Comfort as the air temperature, air humidity and air velocity in the room will be maintained within the limits of control set points. Stable Visual Comfort as the Lux level in the room will be maintained within the limits of control set points.

2.3 Literature Review - Function of compressor that affects the temperature

The function of compressors are similar to pumps both increase the pressure on a fluid and both can transport the fluid through a pipe. As gases are compressible, the compressor also reduces the volume of a gas. Liquids are relatively incompressible while some can be compressed, the main action of a pump is to pressurize and transport liquid. The compressor will inhaling refrigerant from the evaporator coil and then compressing it into the condenser coil. The compressor is usually driven by electric motors that require high electrical power to drive the compressor. The compressor is usually controlled by a thermostat that measures the room air temperature. If the room temperature was quite cold, the thermostat will turn off the compressor. Adjusting the motor speed can control the refrigerant mass flow rate. The refrigerant mass flow rate, in turn is the main factor governing heat exchange in the condenser and evaporator, which exchange determines temperature. In summary then, adjustments of compressor motor speed can control the temperature of an air- conditioned room.

2.4 Analytical Method and the Process Flow

The flow of the process will be started with the studying of the journal and documentation that related with this research and understand the flow to design. The first step will be to derive the mathematical model of the system. This is very important because all the parameter must be accurate to get the

best result. But for this research, since the air conditioning system is very complicated equation if the all aspects are taken into account. Hence, this study will only focus on the compressor speed and the temperature of the room. The Figure 3.2 illustrates the flow of the process to study the air conditioning control system.

In order to find the mathematical model of the plan, firstly the calculation of room BTU is taken into account. The heat from the room will affect the actual room temperature. To find the value of the BTU, the all aspect heat load must be considered. The heat load depends on a number of factors, by taking into account those that apply in your circumstances and adding them together a reasonably accurate measure of the total heat can be calculated. Factors include the floor area of the room, the size and position of windows, and whether they have blinds or shades, the number of room occupants, the heat generated by equipment and the heat generated by lighting.

Based on the BTU room value, the air conditioning system is selected. From the air conditioning system, the type of compressor will be known. The compressor that affects the temperature room equations is very complicated. The process of heat transfer starts from the compressor speed to evaporator coil and the condenser coil. The condenser coil then changes the output temperature. To find the relationship between speed compressor and output temperature, the evaporator and condenser will be ignored. The parameters that are involved will be obtained through the experiments that have been done by the others researches.

The controller will be based on the Fuzzy Controller and will be realized using Mat lab programming and Simulink. The fuzzy block parameters will be designed using the fuzzy.fis that is available in MATLAB. The System will be controlled with Fuzzy Controller. As for the Lighting Control, the control logic of it will be using direct input from the motion detectors which detect the present of occupants in the room and Light Sensors which detect the level of Lux level in the room. The Figure 3.3 illustrates the flow of the process to Design the Lighting Control system.

2.5 Control System Block Diagram

The block diagram of the propose system is illustrated in Figure 1. For Air Conditioning System Control, the two input variable will be from the actual room temperature and the outside room temperature. Data from these Temperature inputs and Set Point input will allow the controller to control the speed of the compressor to achieve the desired set point temperature. As the speed of an induction motor is proportional to the frequency of the AC, the compressors runs at different speeds. A controller can then sample the current ambient air temperature and adjust the speed of the compressor appropriately. The output of fuzzy controller will be the compressor speed, fan coil fan speed and outdoor fan speed that has several different modes which are in the range of low, medium and fast.

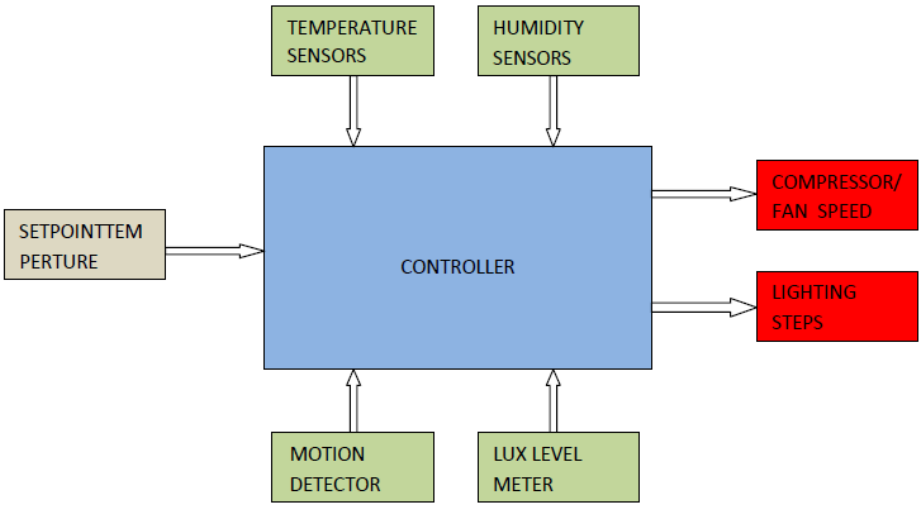

Figure 1 Block Diagram System

2.6 Basic of Fuzzy Logic and Simulink Program Preparation

A university teaching classroom (Typical) as shown in the Figure 2 below will be utilized as a reference in the preparation of the Fuzzy Logic and Simulating Program. The study will be on how the Air Conditioning System and Lighting System in these typical classrooms can be controlled to improve the comfort level as well as energy efficiency and hence, provide saving in the energy cost. After establishing the savings achieved for each typical classroom, it can be multiply with the number of classrooms that the University has so that the result obtained will show the overall monthly savings achieved by the University for All Classrooms.

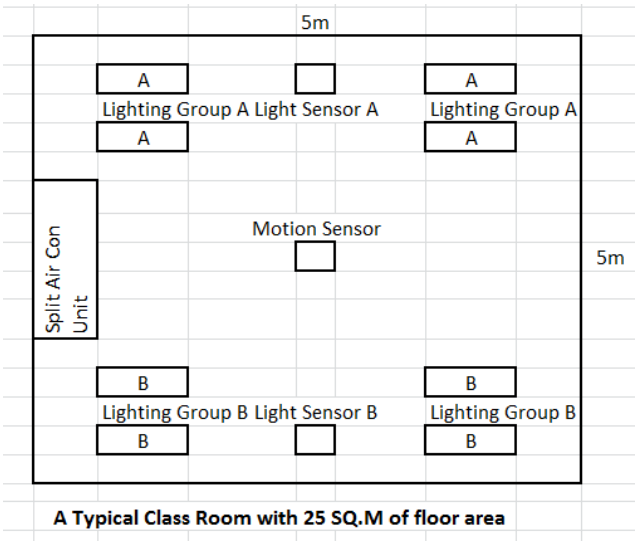

Figure 2 Typical university class room design

- **Desired Room Condition in this case study**
  a. Desired Room Temperature of 22C'+/- 1
  b. Desired Room RH level of 60%'+/- 5
- **Data of Sensors used in this case study**
  a. 1 no. of Motion Sensor
  b. 1 no. of Indoor Temperature Sensor
  c. 1 no. of Relative Humidity Sensor

Note: Input from the above mentioned sensors will be connected to Fuzzy Logic Controller as feedback of the room condition at real time.

- **Data of Air Conditioning and Mechanical Ventilation Equipment used in this case study**

*Calculated Cooling Load of the Room in this case study is **2.64kW**. **One unit of 2.64kW with Model No (FTNE25JEV14 & RNE25JEV14)** is selected for the purpose of this case study. (refer to the Table below for the detail specifications)*

***It is assumed that the actual Power Consumption of Air Conditioning unit is at 690W** which is as per data provided in the Table below. It is also assumed that **600W** of that **690W** is consumed by the Compressor while the remaining **90W** is consumed by the Fan in the Indoor Unit.*

Specifications

DAIKIN

Model Name	Indoor Unit		FTNE15JEV14	FTNE20JEV14	FTNE25JEV14
	Outdoor Unit		RNE15JEV14	RNE20JEV14	RNE25JEV14
Capacity		kW	1,35	2,00	2,64
		Btu/h	4.610	6.820	9.000
Power Consumption		W	340	540	690
COP		W/W	3,97	3,70	3,82
Indoor Unit			FTNE15JEV14	FTNE20JEV14	FTNE25JEV14
Fan Speed			3 Speed and Automatic		
Sound Pressure Level	H/L	dB(A)	30/22	35/26	34/23
Dimensions	H x W x D	mm	265 x 790 x 174		265 x 790 x 170
Sound Pressure Level		dB(A)	8.5	9	

Figure 3 Technical Specification of Daikin 2.64kW Split Unit

Calculated Capacity of the Outdoor Air Fan in this case study is ***840CMH and One Unit of below mentioned Fan is selected****.*

It is assumed that actual Power Consumption of Outdoor Fan is 80W which is as per data provided in the AXAIR equipment catalogue as follow:

AXAIR FANS UK LIMITED

AC Axial Compact Fan 218x218x83
840m³/h 80w 230V Ball Bearing

Dimension	218x218x83
Rated Voltage	230Va.c
Rated Power (50/60Hz)	80/95
Max Air Flow (m3/h)	840/940
Static Pressure (50/60Hz)	200/217
Rated Speed (50/60Hz) (RPM)	2500/2750
Noise (50/60Hz) (dB(A))	65.0/68.0
Bearing Type	Ball

Figure 4 Technical Specification of 840CMH 80W Outdoor Air Fan

3.4.4 Preparation of Fuzzy Rules and Fuzzy Program

In this Thesis work Fuzzy Logic for the Control of both Lighting System and air Conditioning system will be done in separate Fuzzy program but both program will be integrated in a common control to control the same room. Fuzzy program in Mat lab is used to prepare the Fuzzy Logic of both Air Conditioning control system and Lighting control system. In order to do that, rules need to be established and it is established based on the expected inputs and desired outputs. A few round of fine tuning to the rules need to be carried out in order to achieved most workable Fuzzy Logic program.

3.4.5 Preparation of Simulink Program for Simulation

Simulink Library in Mat lab is used to prepare the Simulink Program of both Air Conditioning control system and Lightng control system. In order to do that, input and output blocks in Simulink Library need to be used to establish the Simulink program and it is established based on the numbers of inputs needed and types of input for it. In the same Simulink program, the numbers of outputs needed and types of output for it. A few round of fine tuning to the Simulink program need to be carried out in order to achieved most workable Simulink program.

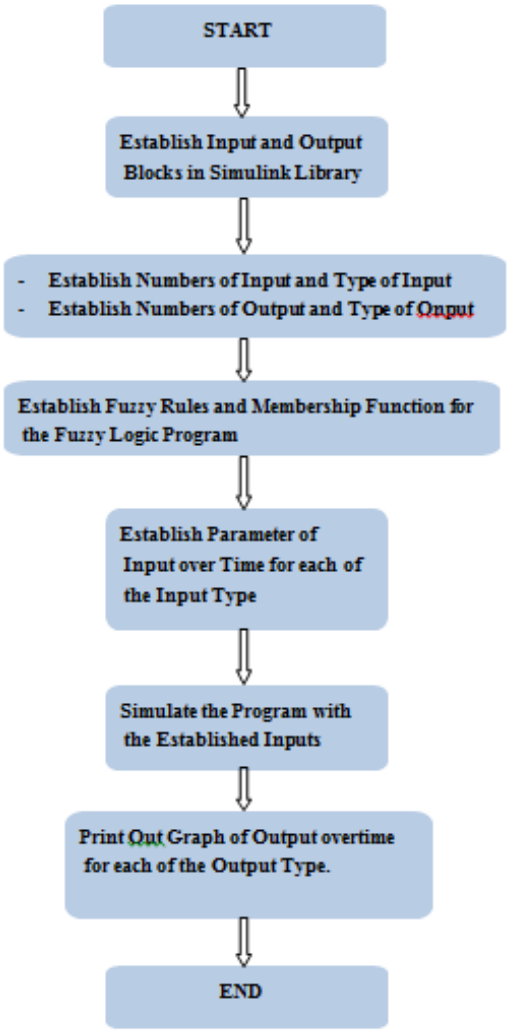

Figure 5 - Flow Chart for the Preparation of Simulink Program for the Fuzzy Logic Controller

2.7 Fuzzy Rules Developed

Fuzzy Rules developed for the Air Conditioning System

After studying on the input and output requirements of the Fuzzy logic program, the following most workable Fuzzy rules as shown in **Table 1** were established for the Air Conditioning System while Fuzzy Program for it is shown in **Figure 6.**

Range of Power for the Input (Air conditioning System)

- **Relative Humidity**
  Low: Below 50
  Medium: 51 to 75
  High: Above 76
- **X = Current Indoor Temp. - Setpoint**
  Low: 0 to 6
  Medium: 4 to 10
  High: 8 to 14

Table 1 Rules for the Air Conditioning Control System

Rule No	INPUT			OUTOUT		
	Relative Humidity [A]	(Room Temp. [B] - Set Point. Temp	Motion Sensor	Compressor Speed	Aircon Fan Speed	Outdoor Fan Speed
1	High	High	On	Fast	Fast	Off
2	Medium	High	On	Fast	Fast	Off
3	Low	High	On	Fast	Fast	Off
4	High	Medium	On	Normal	Normal	Off
5	Medium	Medium	On	Normal	Normal	Slow
6	Low	Medium	On	Normal	Normal	Normal
7	High	Low	On	Slow	Slow	Off
8	Medium	Low	On	Slow	Slow	Slow
9	Low	Low	On	Slow	Slow	Normal
10	None	None	Off	Slow	Slow	Off

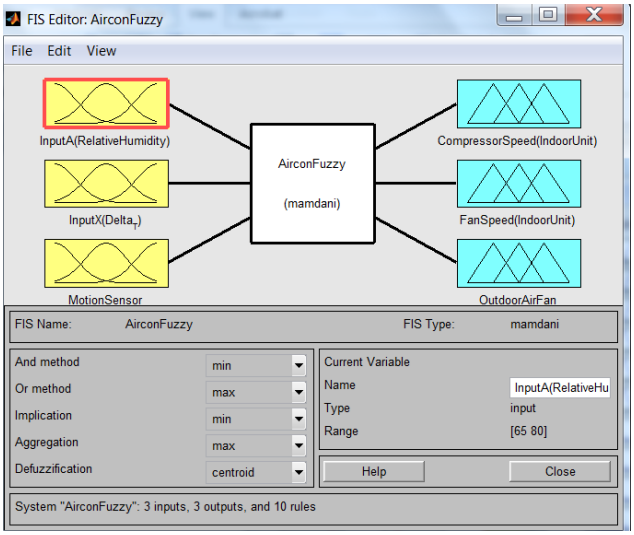

Figure 6 Overall Membership Functions for the Air Condition ing Control System

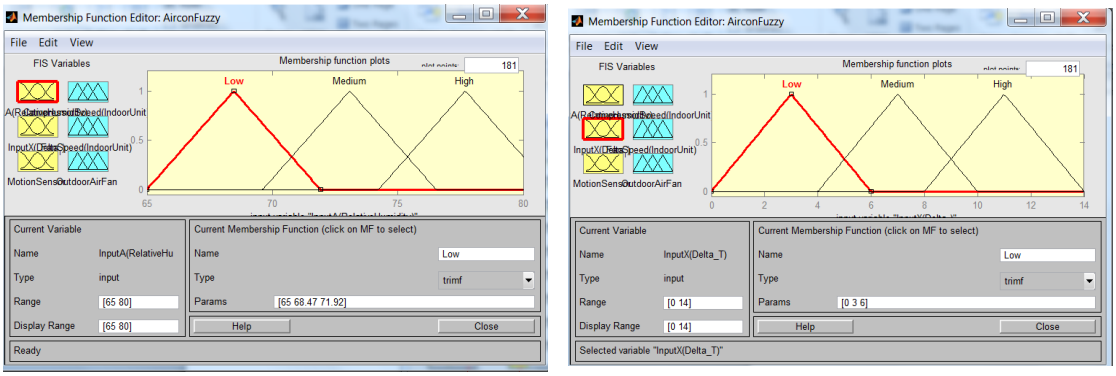

Figure 7 Membership Functions for the Air Conditioning Control System (Part 1)

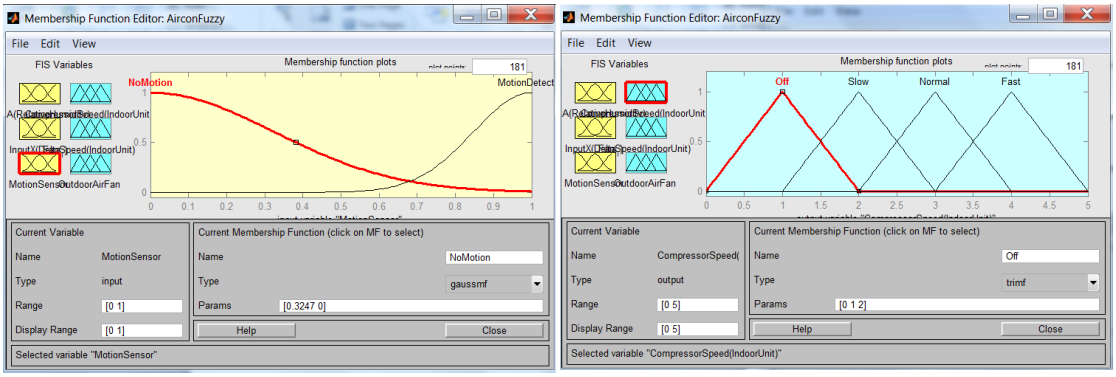

Figure 8 Membership Functions for the Air Conditioning Control System (Part 2)

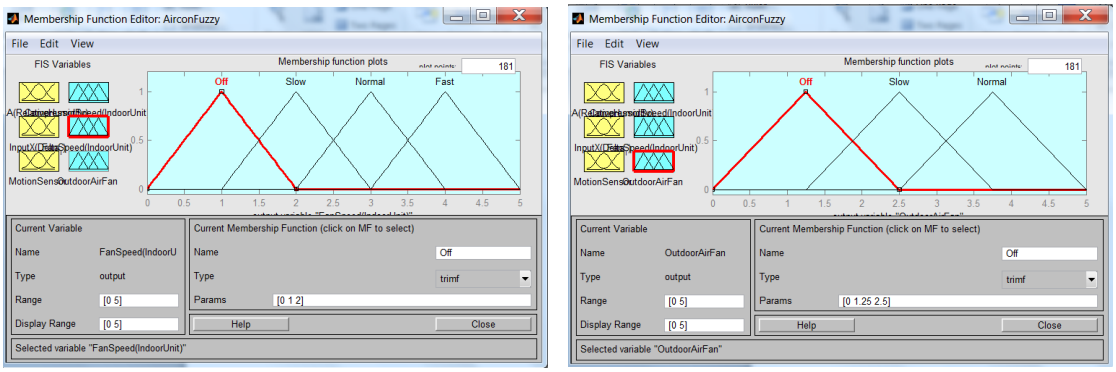

Figure 9 Membership Functions for the Air Conditioning Control System (Part 3)

Simulink Program developed for Air Conditioning

- **Control System**

  Simulink Library in Mat lab is used to prepare the Simulink Program of Air Conditioning control system. After a few round of fine tuning, the following most workable Simulink program (Figure 10) for the Air Conditioning Control System is established.

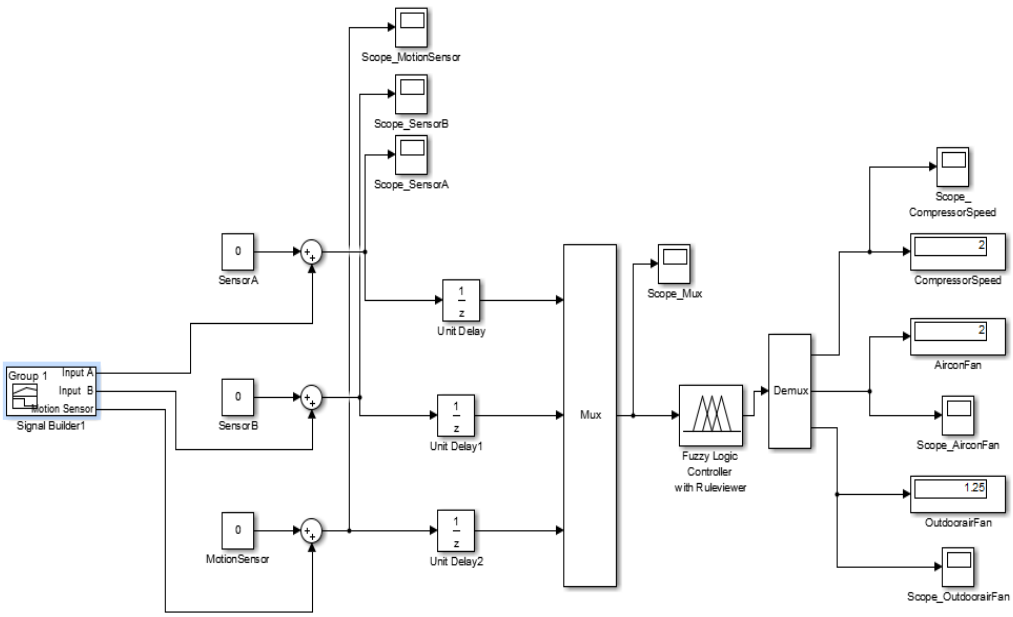

Figure 10 Simulink Program developed for Air Con Control System

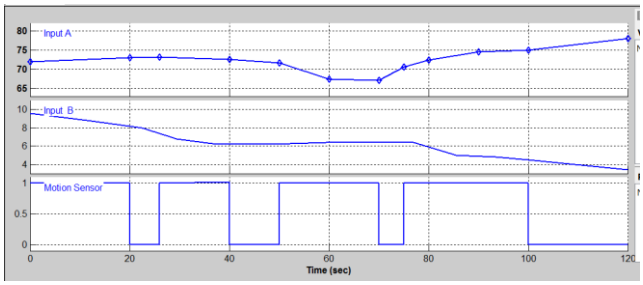

Figure 11 Inputs for Simulink Program for Air Con Control System

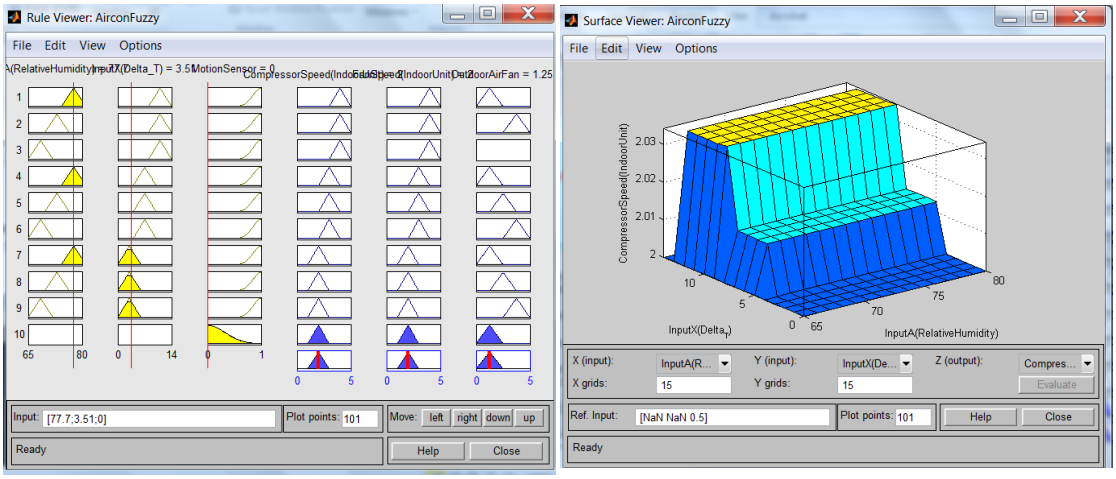

Figure 12 Surface Viewers, Fuzzy Rules and Rule Viewer for the Air Conditioning System

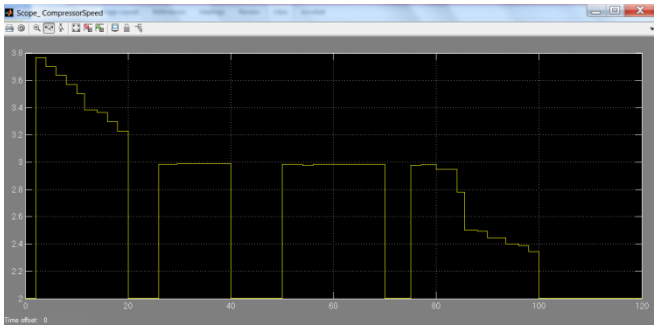

Figure 13 Simulink Output for Compressor Speed of the Air Conditioning System

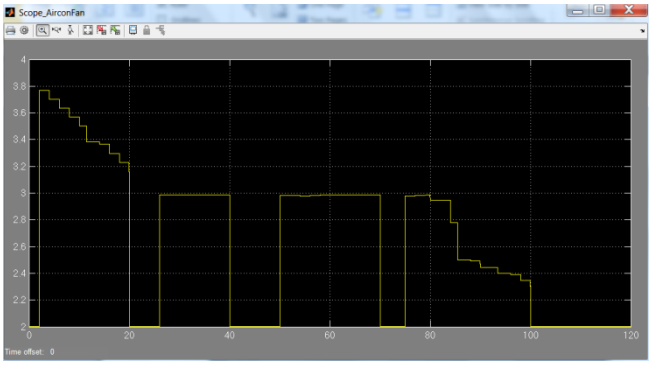

Figure 14 Simulink Output for Air Con Fan Speed of the Air Conditioning System

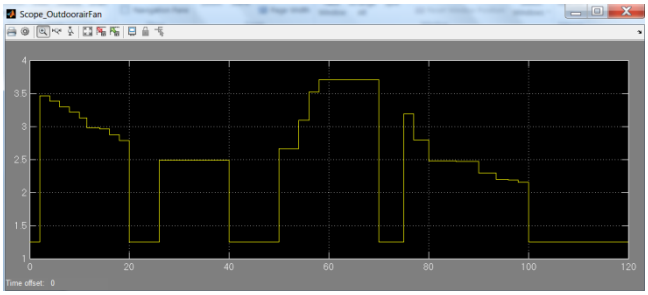

Figure 15 Simulink Output for Outdoor Air Fan Speed of the Air Conditioning System

2.8 Input and Output Results

Summary of Inputs and Output Results for Air Conditioning System

The following Tables shows Range of Power Input, Input data and the Summary of Output results against the given Inputs and savings achieved due to the use of Fuzzy Logic Control System for the Air Conditioning System Control Systems.

Table 2 Range of Power for Air Con System Equipment

RANGE OF POWER FOR THE EQUIPMENT (AIR CONDITIONING SYSTEM)

COMPRESSOR SPEED AND POWER

2 – 5 (Fuzzy Output) 0 - 600 W

AIR CON FAN SPEED AND POWER

2 – 4 (Fuzzy Output) 0 - 90 W

OUTDOOR AIR FAN SPEED AND POWER

1.25 – 2.75 (Fuzzy Output) 0 - 80 W

Table 3 Input for Air Conditioning Control System

	INPUT					
Time	Cumulative Time	Relative Humidity RH% (A)	Room Temp.C' (B)	Set Point. Temp C' (C)	X (B- C) C'	Motion Sensor
8am	0	72	29.5	20	9.5	On
9am	10	72.5	28.5	20	8.5	On
10am	20	73	28	20	8	Off 30Mins
10:30am	25					On 30Mins
11am	30	73.2	27.5	20	7.5	On
12pm	40	72.6	27	20	7	Off
1pm	50	71.6	27	20	7	On
2pm	60	67.5	27	20	7	On
3pm	70	67.2	27	20	7	Off 30Mins
3:30pm	75	70.6				On 30Mins
4pm	80	72.5	26	20	6	On
5pm	90	74.5	25	20	5	On
6pm	100	75	24.5	20	4.5	Off
7pm	110	77	24	20	4	Off
8pm	120	78	23	20	3	Off

Note:

1) Changes in Room Temperatures are based on assumed expected Temperatures

2) Increase in Heat Load to the Room is ignored for the purpose of this study (with Power Consumption of 720W(600W for Compressor and 120 for Fan Coil)

Table 4 Output 2 (Air Con Fan) for Air Conditioning Control System

OUTPUT (COMPRESSOR)									
Time		Fuzzy Control					Conventional Control		
		Fuzzy Output	Motor Power (% of Total Power)	Maximum Motor Power	Motor Power	kWh	Cycle - On	Motor Power	kWh
0	10	3.6	53%	600	320.0	0.32	mins at	0.0	0.00
10	20	3.3	43%	600	260.0	0.26	mins at	450.0	0.45
20	25	2	0%	600	0.0	0.00	mins at	450.0	0.45
25	30	2.99	33%	600	198.0	0.10			
30	40	2.99	33%	600	198.0	0.20	mins at	450.0	0.45
40	50	2	0%	600	0.0	0.00	mins at	450.0	0.45
50	60	2.98	33%	600	196.0	0.20	mins at	450.0	0.45
60	70	2.98	33%	600	196.0	0.20	mins at	450.0	0.45
70	75	2	0%	600	0.0	0.00	mins at	450.0	0.45
75	80	2.97	32%	600	194.0	0.10			
80	90	2.7	23%	600	140.0	0.14	mins at	450.0	0.45
90	100	2.4	13%	600	80.0	0.08	mins at	450.0	0.45
100	110	2	0%	600	0.0	0.00	mins at	450.0	0.45
110	120	2	0%	600	0.0	0.00	mins at	450.0	0.45
TOTAL						1.59			4.95

Table 5 Output 3 (Outdoor Air Fan) for Air Conditioning Control System

OUTPUT (OUDOOR AIR FAN)									
Time		Fuzzy Control					Conventional Control		
		Fuzzy Output	Motor Power (% of Total Power)	Maximum Motor Power	Motor Power	kWh	On	Motor Power	kWh
10	20	2.8	56%	80	45.1	0.05	on	80.0	0.08
20	25	1.25	0%	80	0.0	0.00	on	80.0	0.08
25	30	2.5	45%	80	36.4	0.02			
30	40	2.5	45%	80	36.4	0.04	on	80.0	0.08
40	50	1.25	0%	80	0.0	0.00	on	80.0	0.08
50	60	3.3	75%	80	59.6	0.06	on	80.0	0.08
60	70	3.75	91%	80	72.7	0.07	on	80.0	0.08
70	75	1.25	0%	80	0.0	0.00	on	80.0	0.08
75	80	2.8	56%	80	45.1	0.02			
80	90	2.5	45%	80	36.4	0.04	on	80.0	0.08
90	100	2.2	35%	80	27.6	0.03	on	80.0	0.08
100	110	1.25	0%	80	0.0	0.00	on	80.0	0.08
110	120	1.25	0%	80	0.0	0.00	on	80.0	0.08
TOTAL						0.32			0.88

3. Conclusion

Summary of Savings achieved by Fuzzy Logic Control System

The following Two Tables (**Table 6 and 7**) summaries the amount of savings can be achieved by using Fuzzy Logic Control System against conventional Control System for both Lighting Control system as well as Air Conditioning Control System. The savings achieved by the Fuzzy Logic Air Conditioning System is about 66% while the savings achieved by the Fuzzy logic Lighting Control System is about 23%. With these results, it can be concluded that the objective of this Thesis work has been full filled.

Table 6 Energy and Cost savings achieved for Air Conditioning Control System

	USING FUZZY LOGIC CONTROL SYSTEM (A)	USING CONVENTIONAL (B)
COMPRESSOR POWER CONSUMPTION (kWh)	1.59	4.95
AIR CON FAN POWER CONSUMPTION (kWh)	0.39	0.99
OUTDOOR AIR FAN CONSUMPTION (kWh)	0.32	0.88
TOTAL POWER CONSUMPTION/DAY (kWh):	2.3	6.82
TOTAL POWER CONSUMPTION/MONTH(kWh):	69	204.6
TOTAL POWER CONSUMPTION (kWh): (FOR 120 CLASS ROOMS IN THE UNIVERSITY)	8280	24552
ESTIMATED ELECTRICITY COST/MONTH (RP) (ASSUME RP1200/Kwh)	9,936,000.00	29,462,400.00
COST SAVING /MONTH (RP) [B-A]	19,526,400.00	
COST SAVING /MONTH (%) [(B-A)/B)X100]	66%	

Table 7 Energy and Cost savings achieved for Lighting Control System

	USING FUZZY LOGIC (A)	USING CONVENTIONAL (B)
TOTAL POWER CONSUMPTION/DAY (kWh):	2.81	3.648
TOTAL POWER CONSUMPTION/MONTH(kWh):	84.36	109.44
TOTAL POWER CONSUMPTION (kWh): (FOR 120 CLASS ROOMS IN THE UNIVERSITY)	10123.2	13132.8
ESTIMATED ELECTRICITY COST/MONTH (RP) (ASSUME RP1200/Kwh)	12,147,840.00	15,759,360.00
COST SAVING /MONTH (RP) [B-A]	3,611,520.00	
COST SAVING /MONTH (%) [(B-A)/B)X100]	23%	

4. Recommendation

It is recommended that further research on similar topic should be carried out by the next generation of Master students to understand more about how Fuzzy logic Control System can be applied in efficient control of Air Conditioning system in a large building.

It is recommended that the next generation of Master students should do further research on the same subject but focusing on using the Outdoor Temperatures and Outdoor Relative Humidity as feedback inputs .It is expected that more accurate Room Temperature and Room Humidity Control can be achieved with such additional feedback inputs.

5. Acknowledgment

I wish to thank the members of my Thesis committee for their support, patience and good humor. Their gentle but firm direction has been most appreciated. Thesis Advisors was particularly helpful in guiding me toward a qualitative methodology.

Finally, I would like to thank Dr. Ir. Hanny Johanes Berchmans, M.T., M.Sc., Dena Hendriana B.Sc., S.M.,Sc.D., and Dr. Ir. Gembong Baskoro, M.Sc. They have provided me with confidence to complete my Master degree with excellence.I have found my Master Degree program to be stimulating, effective and thoughtful, providing me with the tools and knowledge to explore into the world of Mechatronics engineering.

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Analysis of Coupled Mass-Spring-Damper System by Changing Spring Constant, Mass, and Force

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Abstract

Mass-Spring-Damper System has been widely used in both structural and technological aspect. In this paper a second degree of freedom mass-spring-damper forced system is used to study the effect of changing some parameters value (spring constant, mass and self-excitation force) to the system stabilization. MATLAB program is part of the aiding tools to do the simulation of the whole system and resulting infrequency Response Graph, "Frequency versus Amplitude" and "Frequency versus Phase". The mentioned three parameter value affects mostly the amplitude but little on the system phase.

Keywords: spring constant; spring-mass-damper system; self-excitation force; two degree of freedom

1. Introduction

Mass-Spring-Damper (MSD) varies from one to more than one Degree of Freedom (DOF) [1] based on the purpose of the system usage. It has been used for a long time in industrial and constructions field. Another classification of MSD is free vibration in which there is no external force applied, and the one caused by external force is called forced vibration MSD, last is self-excitation vibration that appears when the objects in the system moves and disappears as it stops. Spring to store potential energy, mass to store kinetic energy and damper that absorbs energy loss are necessary equipment to analyze the system [2]. Many methods have been applied to evaluate the MSD system, such as Laplace Transform, Space-State, Time-Domain, and Frequency Response Method (Fast Fourier Transform) [3-4].

In MSD system, vibration is inevitable and it influences the equilibrium state of a system, causing disturbance of the whole system. Vibration causes energy loss; fatigue and increase stress [3-4]. Since then, reducing the vibration effect becomes the main objective when building a system [5-7]. Analyzing MSD can be done from many aspects, such as the number of DOF, number of limiting stops; ways of limiting stops, type of forces in the system, and characteristics of the forces [7]. In order to understand deeper about MSD, there is a need to acknowledge the principle of Hooke's Law [8]:

$$F = -kx \tag{1}$$

Where F is the force caused by spring constant k and displacement x after the spring is applied to the system. Damping Force F_d is another crucial point to analyze MSD system, consists of damping constant (actual damping) c and change of displacement (velocity)$\frac{\mathrm{dx}}{\mathrm{dt}}$. The force is derived as below [8]:

$$F_d = c\frac{dx}{dt} \tag{2}$$

Newton's First Law is also part of the combination of the system for the analysis. It can be seen through the next section of the MSD theory.

2. Two Degree of Freedom (Coupled) Mass-Spring-Damper System

2.1 Theory of Mass-Spring-Damper System

MSD system is a system which distributes an object and links it to spring and damper. It is actually applied in some application which the mass is attached to an object that deforms. Fixed base configuration and base-excited configuration is a classification of MSD System [9]. Despite the

classification, there are other two types of one DOF MSD System, unforced and forced response, which is similar to the explanation in the introduction of free and forced MSD. Forced response system generally has an equation as below [9]:

$$m\ddot{x} + c\dot{x} + kx = f \tag{3}$$

Meanwhile, the forced response's equation is [10]:

$$m\ddot{x} + c\dot{x} + kx = 0 \tag{4}$$

As there are many types of spring, hence the spring constant differs depend on the spring material. The motion experienced by the MSD system also varies based on the parameter of each item, mostly are spring constant and mass. However, there is another condition that affects the system, such as the damper constant (c) and the force (*f*). Table 1 explains the damper characteristics based on c[10].

Table 1. Characteristic based on damper constant

c ***(N sec/m)***	**Conditions**
$<2\sqrt{mk}$	Under damped
$= 2\sqrt{mk}$	Critically damped
$>2\sqrt{mk}$	Over damped

The difference between one and more than one DOF MSD System is the calculation in which each object gets different force to be analyzed. There are also possibilities of having different value of spring and damper constant. However, each system has the same basic concept and need to use Equation (3) and (4) to analyze them.

In addition, damping ratio can also determine system stabilization, which formulated as below with$c_c$symbolizesthe critical damping [11]:

$$\zeta = \frac{c}{2\sqrt{mk}} = \frac{c}{c_c} \tag{5}$$

Meanwhile the three different value of damping ratio on table 2 shows the system stabilization. When the system is unstable, the step response grows to infinity following with the time. It shows longer oscillations of step response graph with big amplitude. A system is called stable if the response isn't oscillating or does oscillate, but slowly reach into zero in certain time.

Table 2. System stabilization based on damping ratio

ζ	**Conditions**
< 0	Unstable
= 0	Stable
> 0	Stable

2.2 Model of Coupled Mass-Spring-Damper System

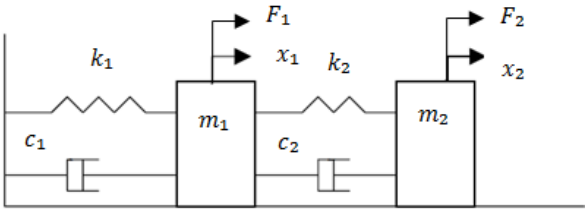


Fig. 1. Coupled MSD System Model

Figure 1 is the model of Coupled Mass-Spring-Damper (CMSD) System that is used to analyze the amplitude and phase of each mass. From the figure above, it can be determined that both objects experience different self-excitation force. Each mass undergoes different motion due to this different value of force, spring constant and damper constant. Mass 1 received not only first spring and damper effect, but also the second one. Meanwhile, Mass 2 only receive the second spring and damper effect. Below is the equation of the system when all the parameters are applied [12]:

$$m_1\ddot{x_1} = F_1 + k_2(x_2 - x_1) + c_2(\dot{x_2} - \dot{x_1}) - k_1x_1 - c_1\dot{x_1} \quad (6)$$

$$m_2\ddot{x_2} = F_2 - k_2(x_2 - x_1) - c_2(\dot{x_2} - \dot{x_1}) \quad (7)$$

And it can be simplified into

$$m_1\ddot{x_1} + (c_1 + c_2)\dot{x_1} - c_2\dot{x_2} + (k_1 + k_2)x_1 - k_2x_2 = F_1 \quad (8)$$

$$m_2\ddot{x_2} - c_2\dot{x_1} + c_2\dot{x_2} - k_2x_1 + k_2x_2 = F_2 \quad (9)$$

From equation (8) and (9), it is shown that CSMD has similar equation with MSD, as equation (4); it is the development of the MSD's forced response concept. The above equation can also be derived as [13]:

$$[\boldsymbol{M}][\ddot{\boldsymbol{x}}_{\boldsymbol{i}}] + [\boldsymbol{C}][\dot{\boldsymbol{x}}_{\boldsymbol{i}}] + [\boldsymbol{K}][\boldsymbol{x}_{\boldsymbol{i}}] = [\boldsymbol{F}_{\boldsymbol{i}}]\, sin\, \omega t \quad (10)$$

Whereas each component has meaning:

$[\boldsymbol{M}] = \begin{bmatrix} m_1 & 0 \\ 0 & m_2 \end{bmatrix}$ is the matrix of mass;

$[\boldsymbol{C}] = \begin{bmatrix} c_1 + c_2 & -c_2 \\ -c_2 & c_2 \end{bmatrix}$ is the matrix of damper constant;

$[\boldsymbol{K}] = \begin{bmatrix} k_1 + k_2 & -k_2 \\ -k_2 & k_2 \end{bmatrix}$ is the matrix of spring constant;

$[\ddot{\boldsymbol{x}}_{\boldsymbol{i}}] = \begin{bmatrix} \ddot{x_1} \\ \ddot{x_2} \end{bmatrix}$ is the acceleration of mass 1 and 2;

$[\dot{\boldsymbol{x}}_{\boldsymbol{i}}] = \begin{bmatrix} \dot{x_1} \\ \dot{x_2} \end{bmatrix}$ is the velocity of mass 1 and 2;

$[\boldsymbol{x}_{\boldsymbol{i}}] = \begin{bmatrix} x_1 \\ x_2 \end{bmatrix}$ is the displacement of mass 1 and 2 (in this case it also called amplitude of the motion);

$[\boldsymbol{F}_{\boldsymbol{i}}] = \begin{bmatrix} F_1(t) \\ F_2(t) \end{bmatrix}$ is the self-excitation force, with ω as natural frequency.

Suppose at steady state, the displacement of the system is

$$x_{iss}(t) = x_{is}\, sin\, \omega t + x_{ic}\, cos\, \omega t \quad (11)$$

$$X_i = \sqrt{{x_{ic}}^2 + {x_{is}}^2} \quad (12)$$

$$\emptyset_i = tan^{-1}\left(\frac{x_{ic}}{x_{is}}\right) \quad (13)$$

When the derivatives of $x_{iss}(t)$ are transferred to equation (8), we will get new simplified matrix equation [13]:

$$\begin{bmatrix} -\omega^2[\boldsymbol{M}] + [\boldsymbol{K}] & \omega[\boldsymbol{C}] \\ -\omega[\boldsymbol{C}] & -\omega^2[\boldsymbol{M}] + [\boldsymbol{K}] \end{bmatrix} \begin{Bmatrix} x_{ic} \\ x_{is} \end{Bmatrix} = \begin{Bmatrix} 0 \\ f_i \end{Bmatrix} \tag{14}$$

Another important equation which will be used to analyze the system will be [14]:

$$\omega = 2\pi f = \sqrt{\frac{k}{m}} \tag{15}$$

$$f = \frac{1}{T} \tag{16}$$

Where f denotes the frequency and T denotes the period.

3. Numerical analysis

The equations above are used to calculate and simulate the whole system by using MATLAB program. There are several inputs that have been changed in order to see the different results through some graphs.

Table 3. Different input value of k and m

No. of Fig.	$\boldsymbol{k_1}$ ***(N/m)***	$\boldsymbol{k_2}$ ***(N/m)***	$\boldsymbol{m_1}$ ***(kg)***	$\boldsymbol{m_2}$ ***(kg)***	$\boldsymbol{F_1}$ ***(N)***	$\boldsymbol{F_2}$ ***(N)***
Fig. 2 – 18	1	1	1	2	1	1
Fig. 6 – 9	1	1	5	10	1	1
Fig. 6 – 9	1	1	0.1	0.2	1	1
Fig. 10 – 13	5	5	1	2	1	1
Fig. 10 – 13	0.1	0.1	1	2	1	1
Fig. 14 – 17	1	1	1	2	5	5
Fig. 14 – 17	1	1	1	2	0.1	0.1
Fig. 18 – 21	5	5	5	10	1	1

Assume the default parameter is when first spring constant $k_1 = 1$ N/m, second spring constant$k_2 =$ 1N/m, first mass $m_1 = 1$ kg, second mass $m_2 = 2$ kg, damper constant $c_1 = c_2 = 0.001$ N sec/m, first and second self-excitation force $f_1 = f_2 = 1$ N.

As these default parameters has been calculated and put into MATLAB for simulation, there are some graphs showing the system's phase and amplitude against frequency with the explanations.

3.1 Default Parameter Analysis for CMSD

First is the "Frequency versus Amplitude of Mass 1" graph. In figure 2, the second amplitude indicates that the value is smaller than the first amplitude. This means that there is energy loss which causes the change value of amplitude. The rapid change of expand and contract movement can be seen from the bottom to peak of each amplitude concludes that the system moves very fast. Furthermore, the alteration from first to second amplitude isn't linear, which determines that there is non-linear acceleration occurs when the mass go through the second phase. This acceleration determines that Mass 1 decelerates slowly.

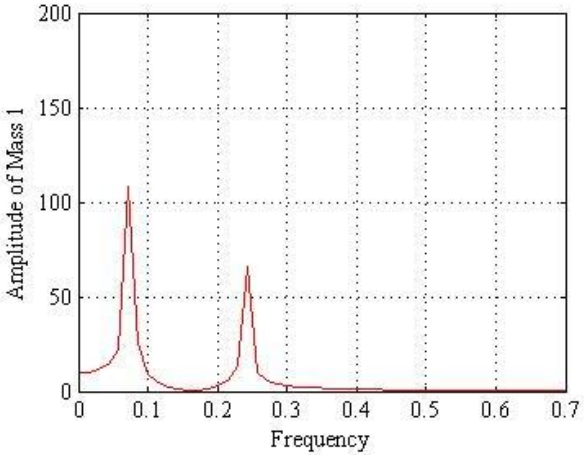


Fig. 2. Frequency versus Amplitude of Mass 1

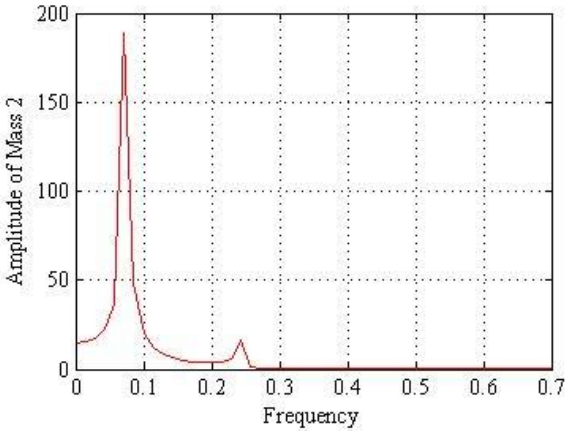


Fig. 3. Frequency versus Amplitude of Mass 2

"Frequency versus Amplitude of Mass 2" graph is the second one. The amplitude resulting from the motion is different with Mass 1. The first amplitude of Mass 2 is larger than the first amplitude of Mass 1, while Mass 2 second amplitude is far smaller than Mass 1 second amplitude. It is because when the system is moving, Mass 2 has more space to move and Mass 2 value is double of Mass 1 value. Non-linear motion also occurs in Mass 2 after the first move is transferring into second move. There is a possibility where Mass 1 and Mass 2 collide, causing Mass 1 move backwards in a larger value of displacement than Mass 2.

The other two graphs are "Frequency versus Phase of Mass 1" and "Frequency versus Phase of Mass 2", which can be seen directly from the graph that two graphs are showing different phase of motion. These phases indicate that the system undergoes non-simple harmonic motion. The graph shows that the phase can only travel in maximum value of 180˚ to -180˚. In addition, from the figure 1, it can be assumed that when the object moves to the right, it has positive value, on the other hand when the object moves the left, it has negative value.

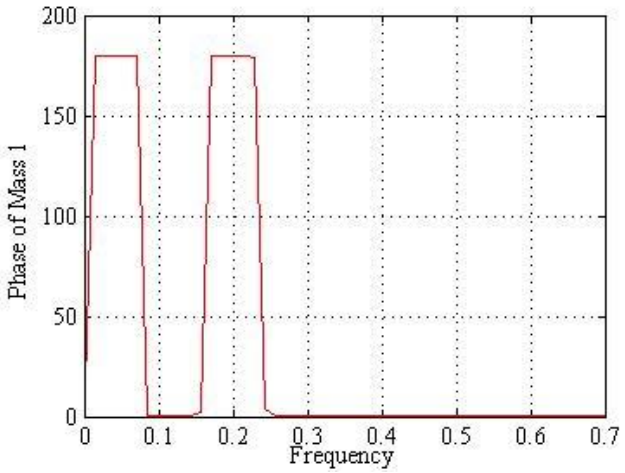


Fig. 4. Frequency versus Phase of Mass 1

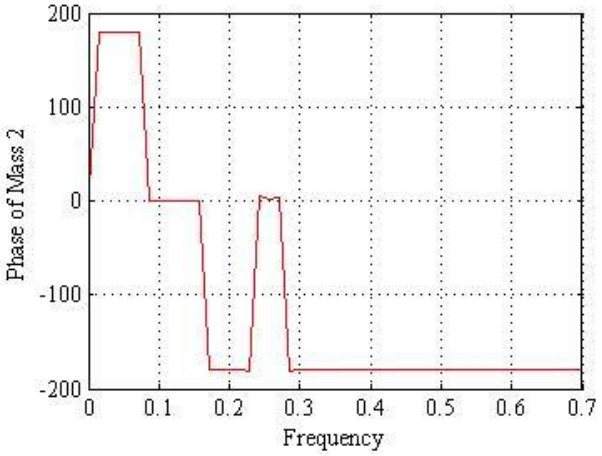


Fig. 5. Frequency versus Phase of Mass 2

Mass 1 travelled to the right and returned back to the original position, and again to the right but in different displacement (amplitude). The graph in figure 4 clearly implies that Mass 1 can only travels to the left or right, but not other direction of which generates another angle (such as upward or downward). The force that is resulting from first object is smaller than the second object (the difference of second mass force and first mass force is a positive), and this leads to the impact that Mass 1 travels positively together with Mass 2.

Despite the phase, another main difference between figure 4 and 5 is when Mass 1 has only positive value phase, Mass 2 has negative one. Mass 2 can move more freely, and only being controlled by second springk_2, damper c_2 (left side) and self-excitation forceF_2. Hence, it is possible for Mass 2 to have negative phase, in which it is easier to bounce back (travels to left direction). Furthermore, in figure 5, there is a pause from the first phase to the second phase. Some possibilities might happen in this rest time, such as the change of momentum, shifting impulse or collision of Mass 1 and Mass 2. When the system is with default parameter, after the first expand and contract, there is a faster but smaller phase of contract due to energy loss.

Another detailed point is for the first peak of each motion happened to be in the same frequency both for Mass 1 and Mass 2. It occurs in the expanding process of the CMSD system. While for the second peak of second mass also located in the same frequency in figure 5. But, the second amplitude of the first mass lies in the position where the first mass returned to original position and stopped.

3.2 Change of Mass Analysis for CMSD

Figure 6 – 9 are the figures of "Frequency versus Amplitude" and "Frequency versus Phase" that compare the default parameter with new parameter as has been written in Table 1. There are in total has 3 different amounts of each parameter for the comparison.

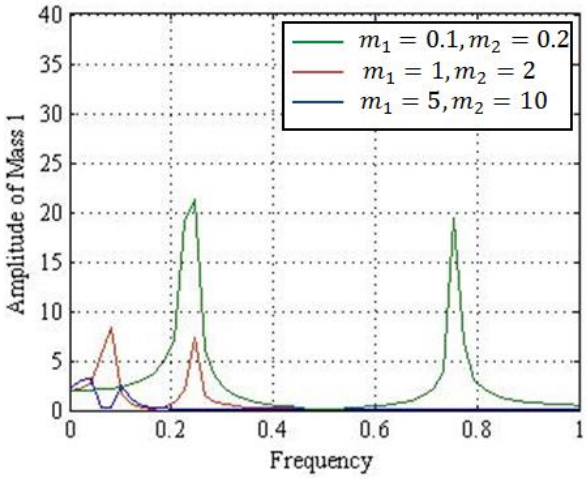


Fig. 6. Frequency versus Amplitude of Mass 1 with m varies

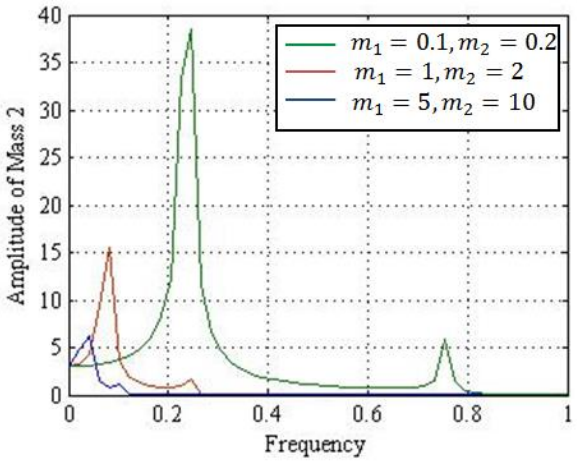


Fig. 7. Frequency versus Amplitude of Mass 2 with m varies

The whole system moves faster frequency with smaller amplitude as the mass getting bigger is shown in figure 6 and 7. When the mass increase, the damper has to work more in order to stabilize the system. Theoretically, based on equation (15), when mass increases, the natural frequency and frequency decreases, lead to a lower amplitude (calculating through equation (11)). The system works on the opposite as the mass decreases.

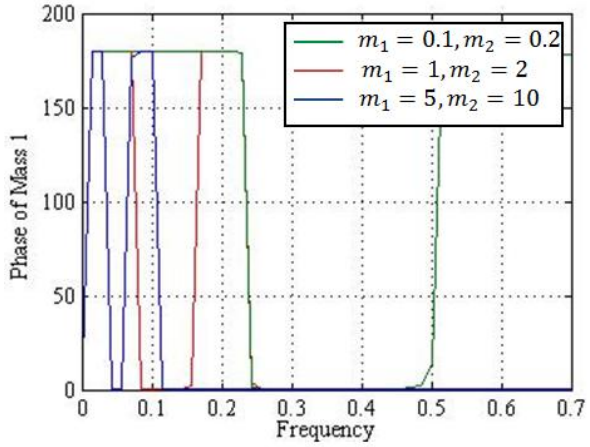


Fig. 8. Frequency versus Phase of Mass 1 with m varies

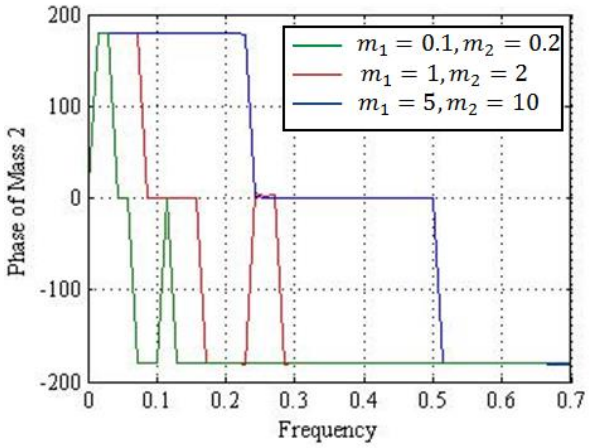


Fig. 9. Frequency versus Phase of Mass 2 with m varies

As for the "Frequency versus Phase of Mass" graph, figure 1 implies that Mass 1 has the same motion even though the mass value has been changed, but different in frequency of each phase. The reason has been explained in the previous paragraph. Meanwhile, figure 9 has a slight different of the second phase. When the mass decreases, it leads to a smaller force, since then the whole system only moves for a short time and stops. However, it still travels in the same movement, forward and backward.

3.3 Change of Spring Constant Analysis for CMSD

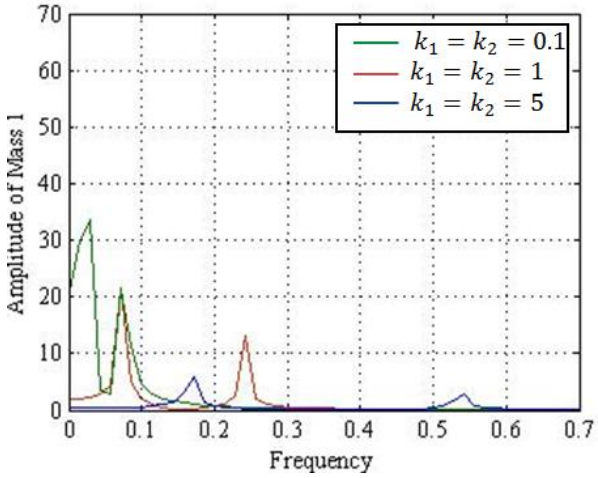


Fig. 10. Frequency versus Amplitude of Mass 1 with k varies

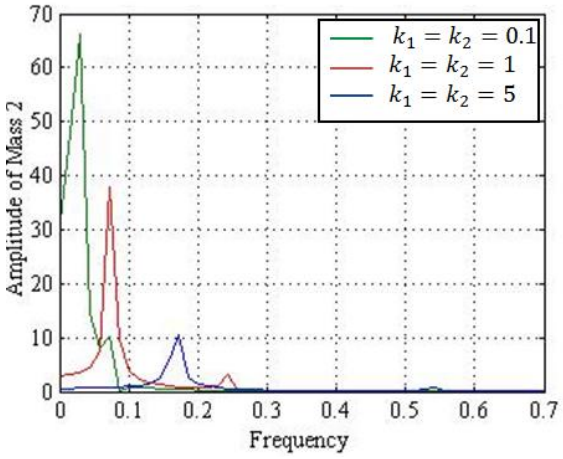


Fig. 11. Frequency versus Amplitude of Mass 2 with k varies

The less spring constant, the loose spring will be. It eases the object to move more free even there is no external force is applied. The figure proves the point, and it can be seen through the line which begin in the bigger amplitude. The system becomes hard in stabilizing itself and causes sway movement. Furthermore, it takes shorter time to do the second expand and contract. It doesn't even back to the original position, but directly travels back positively after reach a certain distance.

When the value of *k* increase, the system will take longer time to stabilize. From the Hooke's Law, once the spring constant increase, the spring force will increase, which cause more work to stop the movement. Thus, the graphic shows when bigger *k* is applied, it will take more frequency in the system.

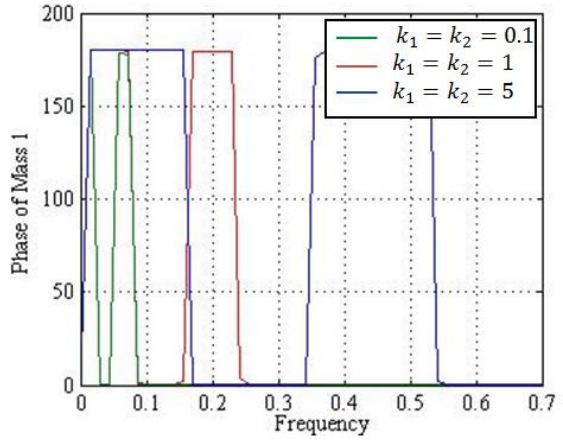


Fig. 12. Frequency versus Phase of Mass 1 with k varies

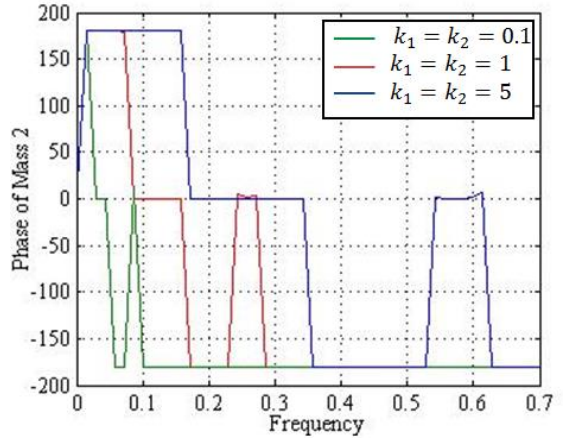


Fig. 13. Frequency versus Phase of Mass 2 with k varies

As for phase, the value of k doesn't change the shape of phase for Mass 1. Figure 12 is similar to Figure 8, with the phase when k=1 is steeper. Also, figure 13 and figure 9 is similar, showing that phase takes longer frequency in condition of k gets larger, takes shorter frequency at the moment k gets smaller.

3.4 Change of Self-Excitation Force Analysis for CMSD

Self-excitation force is another parameter that has been changed to analyse the alteration of simulation through graphs. Figure "Frequency versus Amplitude" shows a change of amplitude that follows the change of self-excitation force. As the force increases, the amplitude also increases. This can be acknowledged by doing calculation of equation (6) and (7) with notes that mass, sping constant and damper constant is still in default parameter. For the "Frequency versus Phase" graphs, it shows no difference with Figure 4 and 5. The line is overlapping with each other, which means the value of self-excitation force didn't bring any shifting phase.

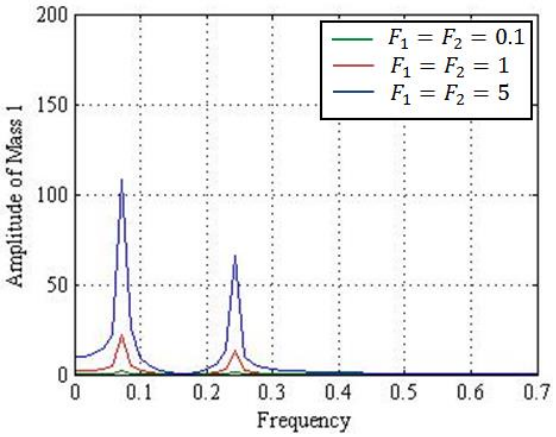


Fig. 14. Frequency versus Amplitude of Mass 1 with f varies

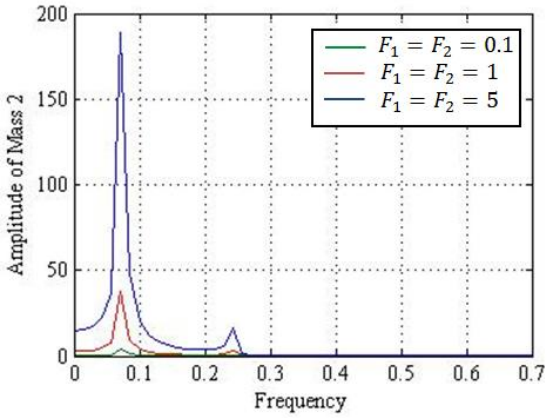


Fig. 15. Frequency versus Amplitude of Mass 2 with f varies

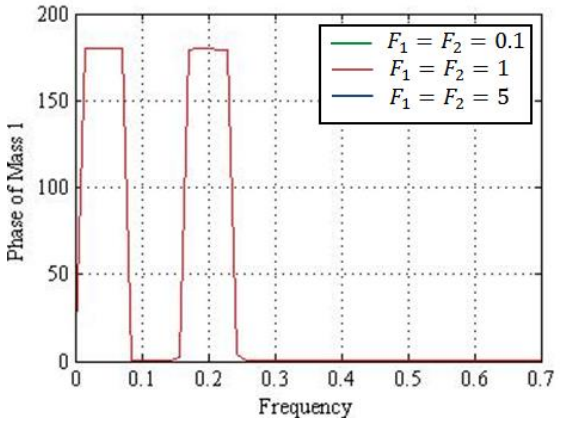


Fig. 16. Frequency versus Phase of Mass 1 with f varies

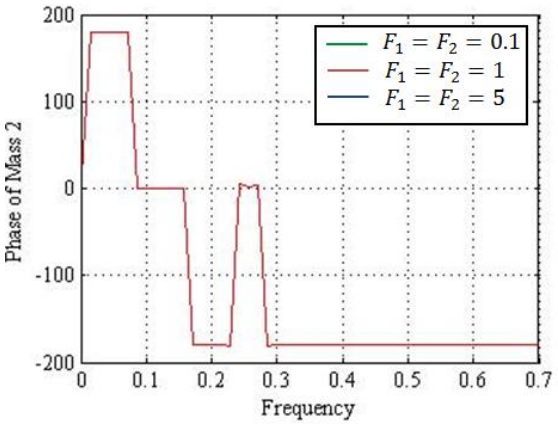
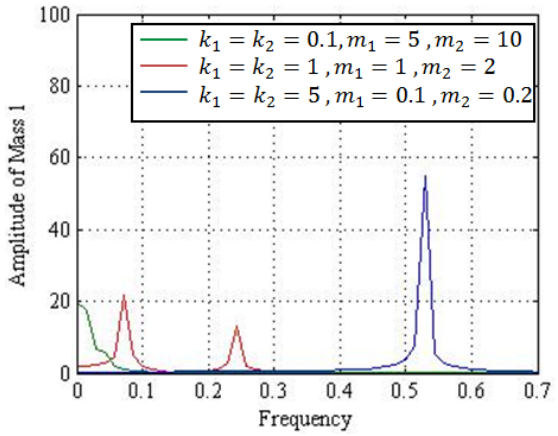


Fig. 17. Frequency versus Phase of Mass 2 with f varies

3.5 Change of Mass and Spring Constant Analysis for CMSD

Figure 19 – 21 determines when both spring constant and mass value are modified. In this case, it is put that when constant k is big, small m will be taken, and vice versa. At the moment k is very small and m is big enough, Mass 1 barely move at all, it just happens to have an amplitude as the original position, then travels to left direction. Based on equation (11) and (15), if the spring constant is of small value, while the mass is of high value, the natural frequency will be very low, lead to a decreasing frequency and amplitude.



Frequency versus Amplitude of Mass 1 with m and k vary

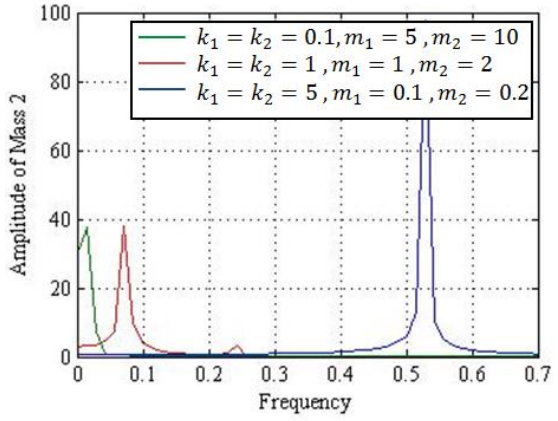


Fig. 18. Frequency versus Amplitude of Mass 2 with m and k vary

On the other hand, in condition of bigger spring constant and smaller mass, at first Mass 1and Mass 2 didn't move at all, until a period of time, it suddenly shows a big change of amplitude. This can be explained by examining figure 20 and 21, at the moment $f = 0$, the phase already started to change, linearly increasing to 180˚, decreasing to 0˚ at the frequency position around 0.5 Hz. It can be analyzed that Mass 1 and Mass 2 has been applied with a force until a period of time which finally make them move back to original position. The amplitude in the graph shows the distance of which the force succeed in making the objects contract.

While in "Frequency versus Phase of Mass", the phase of both mass experience the same motion. It expands (travels to the right, positive direction) and contracts (travels back to the left) in the same position of frequency. Both object experience different value amplitude but at the same moment.

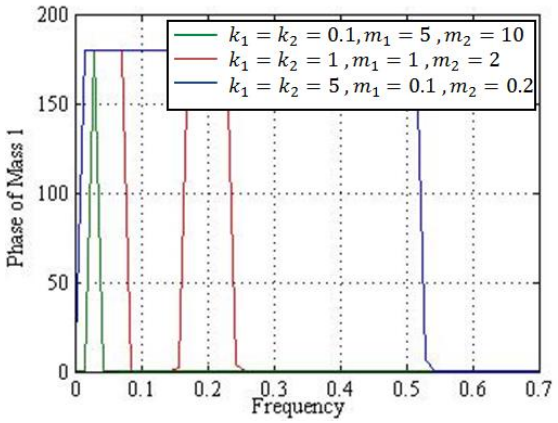


Fig. 19. Frequency versus Phase of Mass 1 with m and k vary

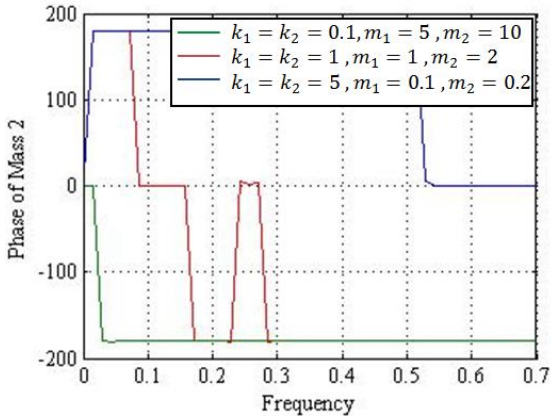


Fig. 20. Frequency versus Phase of Mass 2 with m and k vary

4. Conclusion

MSD can be evaluated in many ways to get a more stable system. Hooke's Law, Newton's First Law and damper equation are the basic principles that have to be understood before analyzing the system. Because of the analysis is done by using Frequency Response Method, thus the resulting graph are "Frequency versus Amplitude" and "Frequency versus Phase". MSD has some main equations to analyze the simulation, equation (4), (11), and (15). In this paper the value of mass, spring constant and self-excitation force have been modified. From all figures "Frequency versus Amplitude", it can be seen that as three parameters have change, the value of amplitude also alter according to the parameters. However, the shapes of the phase are still the same, in different position of frequency.

5. Acknowledgment

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Correlation between Technology Usage Behavior and Employee Affectivity: A Literature Review, Case Study

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Abstract

When employee working in a company they are act as a single and in a group working together to achieve common goals in a organized and structured way. An employee as a human has their own considerations that can drive them to be highly effective employee. There are many researches that focus on employee engagement and employee enablement to understand the drivers that makes an employee have positive behavior that can have positive impact to the performance of the company to achieve its goal. So that the employee will enthusiast to use technology that company provide.

Keywords: UTAUT, Employee Effectivity, Employee Engagement, Employee Enablement, ERP

1. Introduction

PT. GMF Aero Asia as a company that engaged in aircraft Maintenance, Repair and Overhaul (MRO) industry has very complex business process that encompass four major areas that are MRO, Supply Chain Management (SCM), Human Resource (HR), Finance (FI) and Sales Distribution (SD) and very strict in adherence to aviation safety regulation. The complexity of its operational process cycle generally depicted in Figure 1. In order to be able to run such a complex business processes and realize the company vision as **"*Top 10 MRO's in the world*"** arises the need to implement an integrated information system that has been successfully proven and appropriate to the aircraft maintenance business processes and it must has been used by world-class company. Previous research in integrated management system shows that reasons that a company want to implementing integrated system are increased efficiency, possibility to link quality related and environmental related aspects with ethics and organizational profitability, and the possibility to develop management systems better matching stakeholder interests [Sten Abrahamsson, 2010].

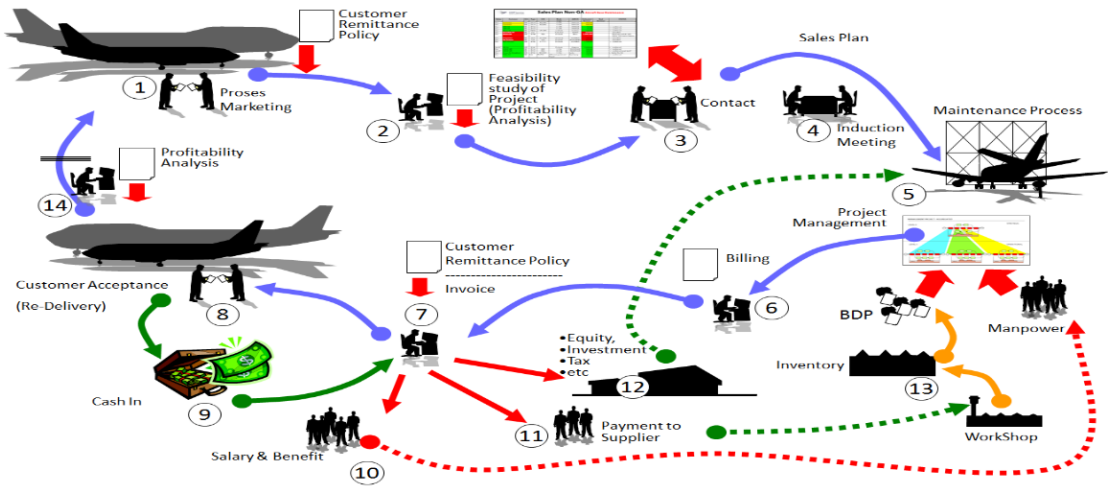

Figure 1. General Review of PT. GMF Aero Asia Operational Process Cycle

After several study visits to several companies in Europe that have business processes of aircraft maintenance PT. GMF Aero Asia finally decided to adopt the SAP-based Enterprise Resource Planning (ERP) system (SWIFT) that already successfully implemented in British Airways Engineering. Board of directors decided to adopt SWIFT and its business processes without any modification or very minimal modifications if necessary. So it was impacted on major changes to business processes, organizational structures and policies that had been applied by PT. GMF Aero Asia for a long time, therefore SWIFT implementation project is not just about the ERP system implementation project but also business transformation project. In 2013 GMF started a project to implement SWIFT with very minimal modifications and ready to initial go live in 2014. SWIFT implementation will bring big impact to the employee working behavior and culture that they will adapt with the new business processes and new technology implemented. These research objectives are to get knowledge about the user usage behavior while interacting with ERP and to find correlation with the employee affectivity survey result that Hay Group conducted in PT. GMF Aero Asia. Thus, the knowledge can be used to improve current change management program in PT. GMF Aero Asia.The result of this research will be add more insight for the company that want to implement large information system so the company can give appropriate attention on people behavior as well as technical area.

2. Literature Review

2.1 Employee Effectiveness

In this era of tight business competition each company vying to win the competition by always presenting innovations in every product and services that are produced both in terms of quality, offering unique value proposition and maintain the reputation in the eyes of its customers. In order to achieve these objectives every company will establish a business strategy that fits the targeted business competition field. A well known of business strategy is to increase company competitive advantage. Competitive Advantage is an advantage gained over competitors by offering customers greater value, either through lower prices or by providing additional benefits and service that justify similar, the or possibly higher, prices [Ehmke, 2008]. One of the popular competitive advantage theories is Resource Based View (RBV), its emphasis is on the links between the internal sources of the firm, its strategy, and its performance [McWilliams et al, 1993]. Employee as one of internal company resource in human capital can be considered as a competitive advantage resource when he is utilized in the process of value creation that in line with company goal using his knowledge's, skills and abilities this statement in line with Boxal (1986) that human resource advantage can be understood as the product of two key categories: the firm human capital (this can be considered as better human capital such as high skills, knowledge's and abilities) and its organizational process (this can be considered as cooperation between management and labor) advantages. To get the maximum value of human capital competitive advantage the company should understand the drivers that can make their employee highly effective to achieve the company goals. To achieve employee effectiveness company should give much attention in employee engagement and employee enablement. As stated in survey research report that conducted by Aon Hewitt (2014) that best employer companies drive higher engagement, revenue growth and shareholder value than do companies with top quartile engagement levels alone. Same with Harvard Business Review survey research report (2013) showed that the more employees engaged to the company the more have impacted positively with customer satisfaction and further will be impacted in business performance. When employee working in a company they are act as a single and in a group working together to achieve common goals in a organized and structured way. Employees as a human has their own considerations that can drive them to be highly effective employee because humans is a complex and multifaceted organism they represent cognitive and affective behavior as mentioned in neuroscience research cognitive typically being first among those committed to intellectual views and affective being foremost among the more emotionally inclined [Panksepp, 2002]. There are many researches that focus on employee engagement and employee enablement to understand the drivers that makes an employee have positive behavior that can have positive impact to the performance of the company to achieve its goal. Since this paper work will use employee effectiveness survey methodology that conducted by Hay Group in PT. GMF Aero Asia in 2017, this paper will use their Employee Effectiveness Framework (figure 2)

that taken from their survey results report document as the basis of employee effectiveness model and will be accompanied and supported by explanations from related researches.

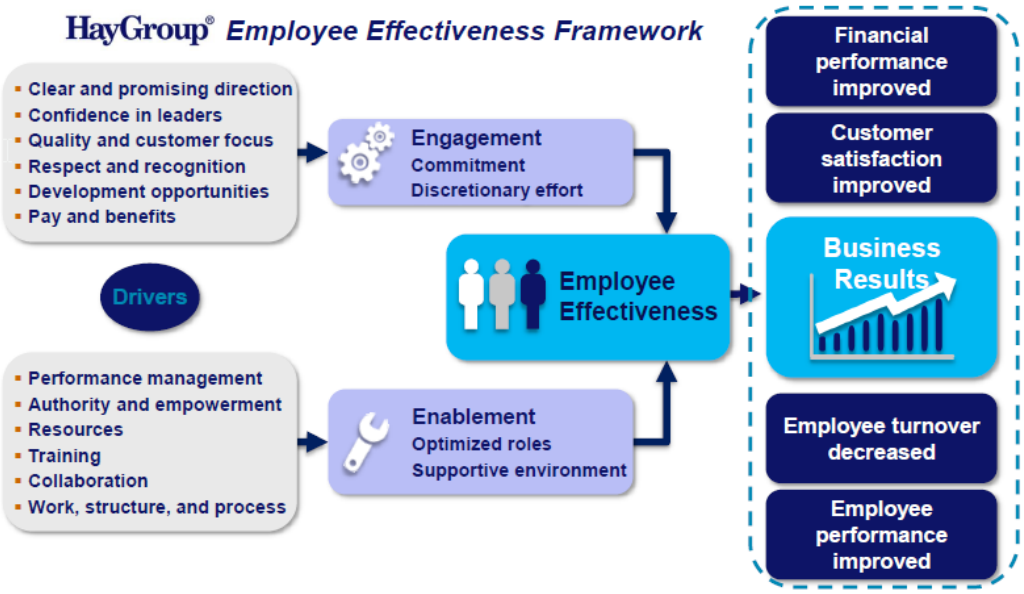

Figure 2. Hay Group's Employee Effectiveness Framework (2017).

2.2 Employee Engagement

Employee engagement is the result organizations achieve when they stimulate employees' enthusiasm for their work and direct it toward organizational success. It includes: Commitment & Discretionary effort [Hay group, 2017].

Hay group's view there are two important components that shape employee engagement that is:

- **Commitment**: Affective attachment to, and intention to remain with, an organization.
- **Discretionary Effort**: The willingness to go above and beyond formal job requirements.

In line with other researcher's opinion as outlined in their publication as shown in Table 1 listed definition of Employee Engagement.

Table 1. List of Employee Engagement definition

Reference	**Definition**
Erickson (2005)	Engagement is above and beyond simple satisfaction with the employment arrangement or basic loyalty to the employer—characteristics that most companies have measured for many years. Engagement, in contrast, is about passion and commitment—the willingness to invest oneself and expend one's discretionary effort to help the employer succeed.
Vance (2006)	The degree to which employees fully occupy themselves in their work, as well as the strength of their commitment to the employer and role.
Schaufeli& Bakker (2010)	In essence, engagement is defined in terms of: (1) organizational commitment, more particularly affective commitment (i.e., the emotional attachment to the organization) and continuance commitment (i.e., the desire to stay with the organization), and (2) extra-role behavior (i.e., discretionary behavior that promotes the effective functioning of the organization)
Wicaksono et al (2015)	Employee engagement can be treated as "the intensity of employee's emotional connection (i.e. attachment) that they feel for their organization, which influences them to exert greater discretionary effort (i.e. extra effort) committed to achieving their work goals.

There are drivers in Figure 4 that makes employee feeling engaged to the company as listed below:

- **Clear & Promising Direction**: Clarity of organizational direction to employees is essential to effective execution [Hay group, 2017]. Previous studies showed that job satisfaction resulted from when the employee feels that their job and role fit with organization strategy and goals [Vance, 2006; Wellins et al, 2006; Van Dyne, 2004] since it will raise long-term commitment.
- **Quality & Customer Focus**: Being focused on its customers, delivering high quality products and services, and being innovative in developing new offerings is critical to building employee confidence in the direction and future market position of the organization [Hay group, 2017]. Previous studies showed that organizational resources (Training, Autonomy, Technology) can affect work engagement and supportive working environment that focus on delivering service quality can enhance employee performance & job satisfaction [Salanova et al, 2005; Ram et al, 2011; Ellinger & Musgrove, 2012].
- **Confidence in Leaders**: Measures the extent to which employees have confidence that senior leaders are capable of executing on strategic objectives [Hay group, 2017]. Based on study on 19 countries IBM has concluded that leaders who inspire confidence in the future as one of employee engagement driver [IBM, 2014]. To raise confidence feelings about the future among the followers that eventually will bring vigor and excitement in their job, a leader should be able to articulate and communicating the organization's vision, purpose, and goals and use their charisma and intellectual stimulation to inspire their follower to be innovative and creative [Gumusluoglu & Islve, 2007; Castelano, 2015; Wicaksono et al , 2015].
- **Respect & Recognition**: The extent to which the organization takes personal interest in employees and makes a commitment to employees as more than factors of production [Hay group, 2017]. Beside formal recognition employee still need of day-to-day informal recognition and need to be convinced that management acknowledges their contribution in ideas and effort [Khalifeh & Mat Som, 2013; Wicaksono et al, 2015].
- **Development Opportunities**: The extent to which employees are able to expand their capabilities and grow within this organization [Hay group, 2017]. Organization must give much attention to employee development in skill and career progression to maintain and increase employee motivation to not to burnout to accomplish their job and their willingness to keep stay in the company [Bakker & Demerouti, 2006; Anderton & Bevan, 2014].
- **Pay & Benefits**: Clarifying the equity of pay systems both internally and externally is critical to building employees' confidence that they are receiving an appropriate return on their investments in the organization [Hay group, 2017]. A Research Report by the Society for Human Resource Management (SHRM) in Employee Job Satisfaction and Engagement Survey of 600 U.S. employees on 2013 indicated that compensation/pay took the lead among job satisfaction contributors in 2013: 60% of employees indicated that it was very important to their job satisfaction. With four common competition factors: being paid competitively with the local market, base rate of pay, Opportunities for variable pay (e.g., bonuses, commissions, other variable pay, monetary rewards for ideas or suggestions), stock options [SHRM, 2013]. Same with Castellano, 2015 stated that rewards and benefit can help motivate employees to behave in ways that benefit the organization.

2.2.1 Employee Enablement

Employees are 'enabled' when jobs and work environments support them to channel their enthusiasm into productive action. Enablement includes: Optimized roles & supportive environments [Hay group, 2017].

Hay group's view there are two important components that shape employee enablement that is:

- **Optimized Role**: Challenging and interesting work where people are able to use their skills and abilities.
- **Supportive Environment**: Productive conditions and a lack of barriers to getting the job done.

In line with other researcher's opinion as outlined in their publication as shown in Table 2 listed definition of Employee Enablement.

Reference	Definition
Wright (2008)	Enablement is defined as giving employees what they need to do their jobs well: organizational structures, information technologies, and other resources that let employees make decisions that contribute to the firm's profitable growth.
Schwartz (2008)	Enablement refers to the organizational structures, information technologies, and other resources that make it possible for employees to make decisions.
Tower-Watson (2011)	They call enablement as to influence employees' performance and their willingness and ability to "go the distance," employers can focus on two aspects of the work environment. First, they can provide the support employees need to do their work efficiently and effectively.
Wicaksono et al (2015)	Employee enablement as "the extent to which employees feel they are provided with what they need to do their jobs well and are provided with an environment in which they feel comfortable to perform to the best they can be".

Table 2. List of Employee Enablement definition

There are drivers in Figure 4 that makes employee feeling enabled to the company as listed below:

- **Performance Management**: Clarity regarding personal goals and priorities enables performance by allowing employees to focus their efforts on essential, value-added tasks. Also helps ensure that employee capabilities are optimally developed and used [Hay group, 2017]. Professional development can help employee to master their duties and responsibilities in their current role and the degree of employee understanding of organization vision and mission are essential to enable employees to think their time and efforts contributing to the greater picture [SHRM, 2013]. By understanding vision and mission of the organization it can stimulate energy, focus and intensity of the employee to their job and managers can assign job to the employee that fit to their skills, needs and values [Grumman and Saks, 2011].
- **Authority & Empowerment**: Measures extent to which employees have appropriate autonomy and discretion, to better able to structure their work arrangements and promote personal effectiveness [Hay group, 2017]. Employee empowerment as the extent to which employees feel they are given problem-solving and decision-making authority to take responsibility for using the organization's resources to achieve results [Wicaksono et al , 2015].
- **Resources**: Measures extent to which environment is supportive in ensuring employees have the information and resources (e.g., tools, equipment, supplies) required to do their jobs effectively [Hay group, 2017]. Wicaksono et al (2015) refer from Towers-Watson (2011) that adequacy of work equipment and supplies is the extent to which an employee perceives how adequately the organization provides well-functioning equipment and the necessary supplies of work materials, which play significant roles in how well the employee gets the job done.
- **Training**: Measures extent to which employees are well equipped with the necessary knowledge and skills to carry out key tasks and to deal effectively with internal and external customers [Hay group, 2017]. When employee has appropriate training it can increase their confidence level to perform better in their job and can remove obstacles in their work will increase better service climate [SHRM, 2013, Gruman & Saks, 2011, Markos & Sridevi, 2010, Salanova et al, 2005]
- **Collaboration**: Measures prevalence of effective working relationships to support employees in delivering their best work and enable optimum contributions [Hay group, 2017]. When employees have the support and cooperation of their coworkers, they are able to accomplish more and share ideas to come up with creative solutions [Wellins et al, 2006].
- **Work Structure & Process**: Measures operating efficiency and extent to which employees feel that the organization introduces barriers to getting their jobs done [Hay group, 2017]. Wicaksono et al (2015) refer from Towers-Watson (2011) that effective work process is the extent to which an employee perceives that the organization provides effective work processes, which contribute to her/his ability to the job done.

2.2 Unified Theory of Acceptance and Use of Technology (UTAUT)

Since there are many research area in information technology acceptance has been conducted that created new model , criticize a model and modified existing model it raise a need to evaluate all of those researches to make one single unified model. Unified Theory of Acceptance and Use of Technology (UTAUT) model has been proposed as seen in Figure 3.

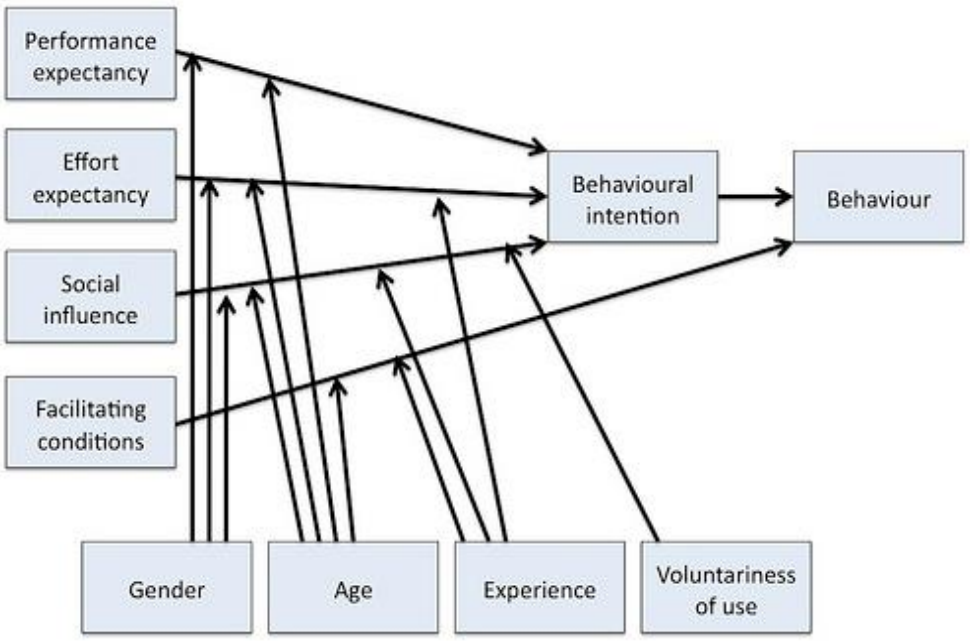

Figure 3. UTAUT Model [Venkatesh et al, 2003]

- **Performance Expectancy**
  Performance expectancy is defined as the degree to which an individual believes that using the system will help him or her to attain gains in job performance. With construct items as listed below:
  a. I would find the system useful in my job.
  b. Using the system enables me to accomplish tasks more quickly.
  c. Using the system increases my productivity.
  d. If I use the system, I will increase my chances of getting a rise.
- **Effort Expectancy**
  Effort expectancy is defined as the ease associated with the use of the system. With construct items as listed below:
  a. My interaction with the system would be clear and understandable.
  b. It would be easy for me to become skillful at using the system.
  c. I would find the system is easy for me.
  d. Learning to operate the system is easy for me.
- **Social Influence**
  Social influence is defined as the degree to which an individual perceives that important others believe he or she should use the new system. With construct items as listed below:
  a. People who influence my behavior think that i should use the system.
  b. People who are important to me think that i should use the system.
  c. The senior management of this business has been helpful in the use of the system.
  d. In general, the organization has supported the use of the system.
- **Facilitating Conditions**
  Facilitating conditions is defined as the degree to which an individual believes that an organizational and technical infrastructure exists to support use of the system. With construct items as listed below:
  a. I have the resources necessary to use the system.
  b. I have the knowledge necessary to use the system.

c. The system is not compatible with other systems i use.
d. A specific person (or group) is available for assistance with system difficulties.

- **Behavioral intention to use the system**
  Behavioral intention to use the system is defined as the degree of intention to use of the system in the future to present their acceptance of the system.With construct items as listed below:
  a. I intend to use the system in the next <n> months.
  b. I predict i would use the system in the next <n> months.
  c. I plan to use the system in the next <n> months.

For gender, age, voluntariness and experience are the key moderators that influence above determinants.

2.2.1 ERP User Acceptance Model

The ERP system is a complex system which impacts large numbers of end-users in the organizations [Chen & Zeng, 2012] that's why it is so important to understand its acceptance among users that using it. Chen and Zeng (2012) had identified factors that may affect of the acceptance of ERP post implementation; they adopt UTAUT as their base research model with adapted construct or construct items regarding ERP post implementation adoption factors that found in previous researches.

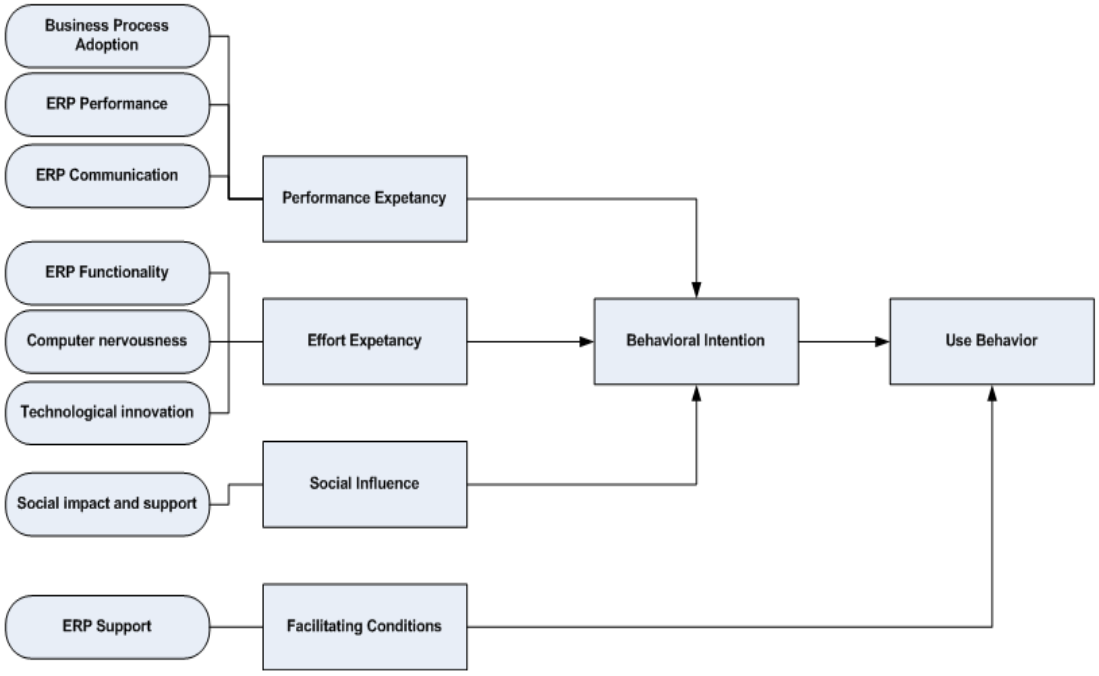

Figure 4. ERP user acceptance model [Chen & Zeng, 2012]

- **Performance Expectancy**
  a. Business process adoption
  The system can full-fill user's working needs as well as his or her organization needs, well adopted between business process and users opinions. With construct items as listed below:
  - The ERP system adapts well with my positions' business requirement.
  - The ERP system adapts well with my departments' business requirement.
  - All part of the ERP system is acceptable in fulfilling my requirement.

  b. ERP performance
  ERP performance is the extent to which a person believes that a system is consistent and the entire related tasks are well performed. With construct items as listed below:

- ERP system makes it faster to search data.
- ERP system makes it faster to retrieve data.
- ERP system improves my job efficiency.
- ERP system makes my job easier.

c. ERP communication

Lack of communication when there are changes in different department regarding the ERP system. With construct items as listed below:

- I have always been informed about the status of the ERP project in my company.
- I am aware of the changes that will happen in my position brought by the ERP project.
- I am aware of the changes that will happen in my department brought by the ERP project.

- **Effort Expectancy**

a. ERP functionality

System functions are flexible and stable, can response to rapid changes. With construct items as listed below:

- I think the ERP system in our company is functionally well and stable.
- ERP system in my company can generate a rapid response if there is a change in business process.
- I think ERP system is easy to use and its functions are flexible.

b. Computer Nervousness

The experience of using computer will influence the acceptance of information system. With construct items as listed below:

- I am nervous when I working with computer.
- I feel comfortable to work with computer.

c. Technological innovation

Stands for to what extant a person is willing to try new Information Technology. With construct items as listed below:

- If I hear about a new appeared IT, I will strive to try it in different ways.
- Among my working companions, I am always the first to try out new IT.
- I always like to try the new appeared IT.

- **Social Influence**

a. Social impact and support

Including social factors and subjective norms. With construct items as listed below:

- I have support from my manager on the use of ERP system for my job.
- People who influence my behavior think that I should use ERP system.
- Generally, my company supports the use of ERP system.

- **Facilitating Conditions**

a. ERP support

ERP support is the extent to which an individual receives enough support from IT department. With construct items as listed below:

- IT staff will help when I met system problems.
- Those kind of urgent situations (computer virus, data losing) are always priority to IT sup-port department.

- **Behavioral intention to use the system**

With construct items as listed below:

- I plan to use ERP system in the future

- **User behavior**

With construct items as listed below:

- After company introduces ERP system, I always want to use this system.

3. Research Method

3.1 Literature Review

To buttress our understanding about the research field we search several previous works from many academic journal and business related fields. As mentioned by Hart (1998) “the use of ideas in the literature to justify the particular approach to the topic, the selection of methods, and demonstration that

this research contributes something new". There are three steps to do literature review process as seen in Figure 5.

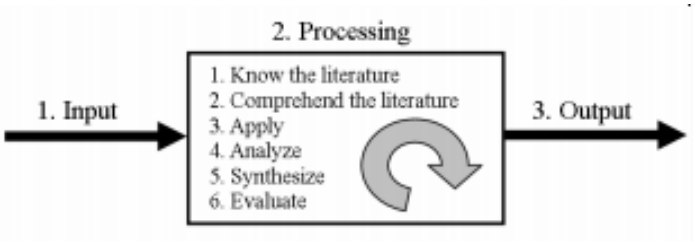

Figure 5. The three stages of effective literature review process [Levy, 2006]

By accomplishing those three steps researches hopefully will [Levy, 2006]:1. Helping the researcher understand the existing body of knowledge including where excess research exists (i.e. what is already know?) and where new research is needed (i.e. what is needed to be known?) 2. Providing a solid theoretical foundation for the proposed study (related to "what is already known?") 3. Substantiating the presence of the research problem (related to "what is needed to be known?") 4. Justifying the proposed study as one that contributes something new to the Body of Knowledge 5. Framing the valid research methodologies, approach, goals, and research questions for the proposed study

3.2 Case Study

To know that some methodology and theoretical foundation applicable in the real business life we select a single case that we assume it related to the field that being researched. This approach helps us to reveal a phenomenon within its context as mentioned by Baxter (2008).

4. Findings

As we want to find out the correlation of Human Resource study to the Information System research field first will find the equality of meaning of each literature in Employee Effectiveness to UTAUT model.

4.1. Performance Expectancy

In UTAUT model we found similar meaning with Employee Effectiveness literature that included in Performance Expectancy group.

UTAUT	Employee Effectiveness
1. I would find the system useful in my job [Venkatesh et al, 2003]. The system can full-fill user's working needs as well as his or her organization needs, well adopted between business process and users opinions [Chen & Zeng, 2012]. 2. Using the system enables me to accomplish tasks more quickly [Venkatesh et al, 2003]. ERP performance is the extent to which a person believes that a system is consistent and the entire related tasks are well performed [Chen & Zeng, 2012]. 3. Using the system increases my productivity [Venkatesh et al, 2003]. 4. If I use the system, I will increase my chances of getting a rise [Venkatesh et al, 2003].	1. **Work Structure & Process** 2. **Performance Management** 3. **Authority &Empowerment** 4. **Respect & Recognition** 5. **Development Opportunities** 6. **Pay & Benefits**

5. I am aware of the changes that will happen in my position brought by the ERP project [Chen & Zeng, 2012].	

4.2. Effort Expectancy

In UTAUT model we found similar meaning with Employee Effectiveness literature that included in Effort Expectancy group.

UTAUT	Employee Effectiveness
1. The system is easy to operate, clear and understandable [Venkatesh et al, 2003]. 2. System functions are flexible and stable, can response to rapid changes [Chen & Zeng, 2012]. 3. The experience of using computer will influence the acceptance of information system [Chen & Zeng, 2012]. 4. Stands for to what extant a person is willing to try new Information Technology [Chen & Zeng, 2012].	1. **Training** 2. **Quality & Customer Focus**

4.3. Social Influence

In UTAUT model we found similar meaning with Employee Effectiveness literature that included in Social Influence group.

UTAUT	Employee Effectiveness
1. People who influenced my behavior, important to me, my senior manager and my organization think I should use and support to use the system[Venkatesh et al, 2003]. It similar with Social Influence that described in Chen & Zeng (2012).	1. **Confidence in Leaders** 2. **Collaboration**

4.4. Facilitating Condition

In UTAUT model we found similar meaning with Employee Effectiveness literature that included in Facilitating Condition group.

UTAUT	Employee Effectiveness
1. I have the resources necessary and Knowledge to use the system [Venkatesh et al, 2003]. 2ERP support is the extent to which an individual receives enough support from IT department [Chen & Zeng, 2012].	1. **Resources**

5. Conclusion

Based on our finding in section 4. We develop proposed conceptual framework as seen in Figure 6.

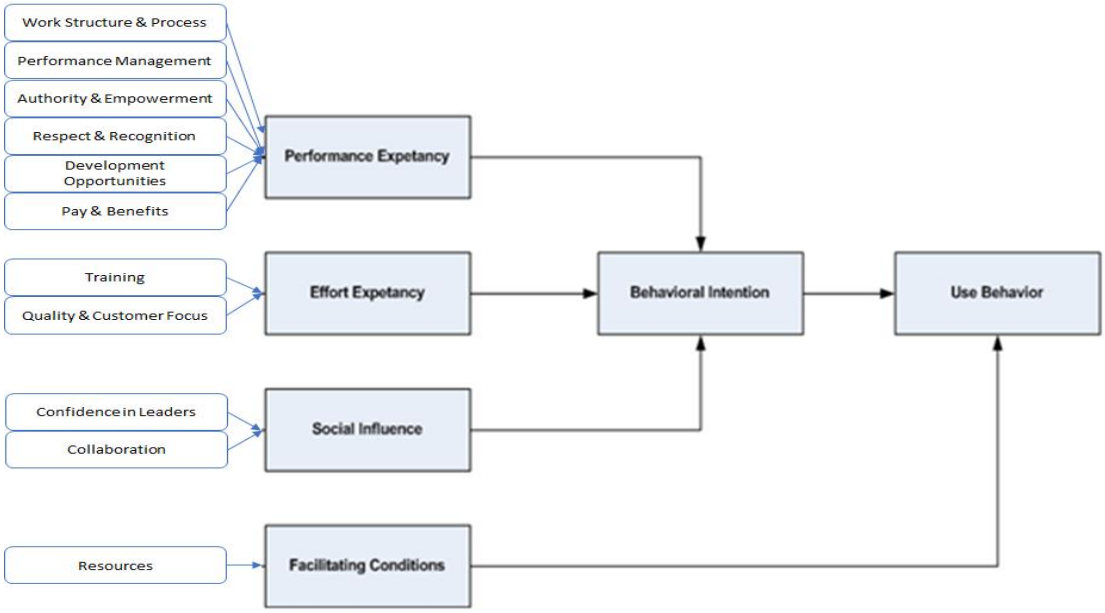

Figure 6. Conceptual framework correlation between Technology Usage Behavior& Employee Affectivity

This conceptual framework theoretically proved to us that the study in Human Resource field can be correlated with Information System field. Thus, we can find a way how to do change management when implementing new technology in a company more effective and efficient by understanding the people needs and perceived that lead to their affectivity when doing their daily task. Of course this conceptual framework still need to be evaluated by quantitative approach to make sure that this theoretically model could be applied in real situation. We left that work for future study.

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Implementation of Ranko Tracker Data Collection for Oil Palm Productivity Census

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Abstract

Current data collection for census in oil palm plantation produces only plantation data and block data. Lower level data, tree level data is not available. Tree level data needed for particularistic purpose, such as deep observation on a low yield block for production intensification purpose and higher accuracy in production projection. This research aim to produce digital spatial data to enable efficient productivity analysis by collecting a full population production census using Ranko Tracker method of data collection. Sets of color coding map successfully produced with this method, accurately locating specific area requires immediate action plan within efficient and effective manner.

Keywords: oil palm, intensification, spatial data, color coding map, census, mobile application, decision support system

1. Background

"Palm oil is the most widely used vegetable oil in the world – it's used for cooking, as a source of energy, and can be found in half the products on supermarket shelves. Palm oil is an edible vegetable oil derived from the fruit of the oil palm tree (Elaeis guineensis). Oil palm trees are planted and harvested on more than 15 million hectares of tropical area around the world – mostly in Indonesia and Malaysia where 86% of all palm oil is produced, but increasingly in South and Central America, Africa, as well as other parts of Asia [1]

Oil palm is grown by both smallholders and on large plantations. Trees begin bearing fruit after three years and have a productive life of up to 25 years [2]. Trees produce continuously and fruit bunches are harvested every few weeks. Fresh fruit bunches (FFB) are then taken to a mill, where the oil is extracted with pressure and steam from both the fruit itself (which yields crude palm oil, or CPO) and the kernel or seed (which yields palm kernel oil, or PKO). Indonesia is the biggest producer of CPO, contributing 53% of world production and the largest exporting countries with 44% shares of world market [3].

2. Statement of the Problem

When extension of plantation by enlarging the area (deforestation) is not an option, plantation management must come with intensification alternatives. Among many alternatives, is to focus on recovering lower yielding blocks to improve their harvest yield to meet the average plantation standard and even higher. Treatment of unhealthy trees can be costly because it means extra fertilizer, extra nutrient and more resources. Management need to evaluate in a lower yielding blocks, which trees or group of trees that are sick or need special treatment but the fact is management can't determine precisely which trees or group of trees in a certain low yield block, requires special treatment to improve its productivity.

There are three problems we identified after rounds of interview with our industry collaborator:

- No accurate tree identification scheme; there is no convenient method to uniquely identify
- Manually recording the census data; recording process is usually done manually and record them in a log book. This method is prone to human error and is also very labor intensive specially on the reconciliation data
- Inaccurate analyzed data; achieving accurate analyzed productivity information for the whole plantation is difficult as it requires manual sorting through the whole manual records.

2.1 Objective of the Research

- To propose new data collection method on production census to identify high-low yield trees in low yielding blocks that is significantly more accurate for better decision making
- Analyze data produced from proposed data collection method.

2.2 Hypothesis

The proposed method of data collection able to provide management with data to identify condition and more accurate and efficient production projection

3. Research Methodology

3.1 Primary Data

Data is a critical component in any research has been gathered through various resources. The researcher is using primary data for this research. Primary Data are being collected using mobile application as data collection tool.

3.2 Data Collection Flow

Figure 1. Data Collection Flow Technology and Architecture

3.3 Application Flow Chart

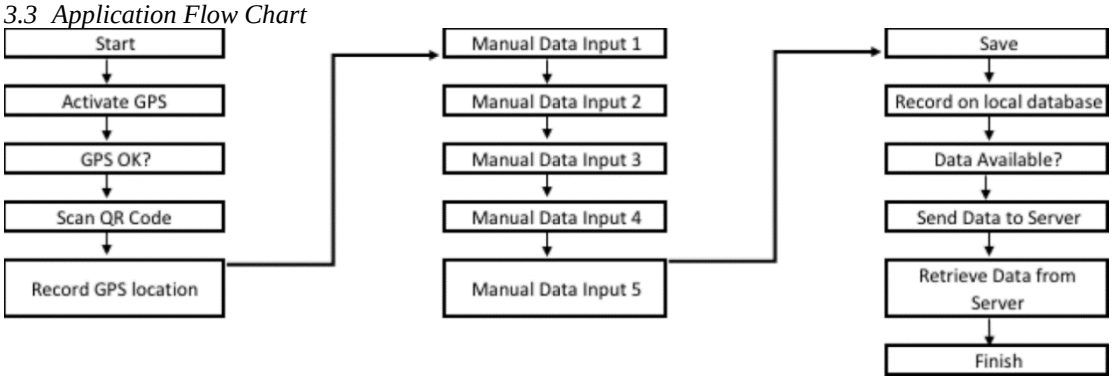

Figure 2. Application Flow Chart

3.4 Ranko Tracker Mobile Application

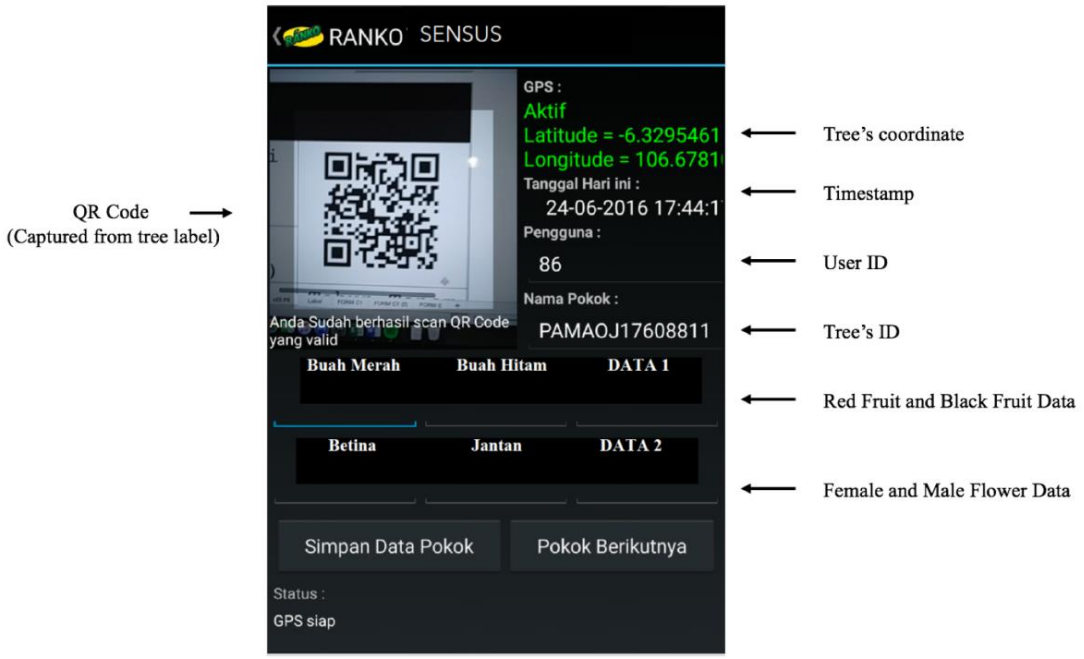

Figure 3. Ranko Tracker Interface

3.5 Data Collection and Management

Data collected from apps and send to the server with the following data table:

tanggal	waktu	latitude	longitude	qrcode	Buah_Merah	Buah_Hitam	DATA1	Betina	Jantan	DATA2
9/28/16	10:51:58	-0.1655295	99.9257615	PAMAOJ12609031	0	7	0	3	0	0
9/28/16	15:05:52	-0.2444724	99.9305131	PAMAOJ12009123	1	3	0	6	0	0
9/28/16	10:32:19	-0.2575424	99.9384897	PAMAOJ12009117	4	8	0	2	2	0
9/28/16	10:47:51	-0.2488291	99.933172	PAMAOJ12009103	2	7	0	8	3	0
9/28/16	14:32:50	-0.2575424	99.9384897	PAMAOJ12209716	3	2	0	5	3	0
9/28/16	11:09:06	-0.2444724	99.9305131	PAMAOJ12209830	5	1	0	2	0	0
9/28/16	11:03:04	-0.2575424	99.9384897	PAMAOJ12009305	0	6	0	2	3	0
9/28/16	14:55:49	-0.2444724	99.9305131	PAMAOJ12209736	4	3	0	2	3	0
9/28/16	14:34:49	-0.2575424	99.9384897	PAMAOJ12209725	5	0	0	7	1	0
9/28/16	13:48:37	-0.2575424	99.9384897	PAMAOJ12209703	5	6	0	5	2	0
9/28/16	13:26:08	-0.2575424	99.9384897	PAMAOJ12608934	1	2	0	8	0	0
9/28/16	13:54:37	-0.2510074	99.9345014	PAMAOJ12608919	0	8	0	0	2	0
9/28/16	14:56:52	-0.2510074	99.9345014	PAMAOJ12009104	2	4	0	8	3	0
9/28/16	15:12:03	-0.2575424	99.9384897	PAMAOJ12209712	2	1	0	0	2	0
9/28/16	15:54:12	-0.2575424	99.9384897	PAMAOJ12009307	1	8	0	8	2	0
9/28/16	14:42:30	-0.2575424	99.9384897	PAMAOJ12209734	2	1	0	1	0	0
9/28/16	11:42:05	-0.2510074	99.9345014	PAMAOJ12209732	0	6	0	2	1	0
9/28/16	11:28:26	-0.1041875	99.9172761	PAMAOJ12209720	4	0	0	0	2	0
9/28/16	11:38:02	-0.2575424	99.9384897	PAMAOJ12608933	3	3	0	7	3	0
9/28/16	11:29:03	-0.1041875	99.9172761	PAMAOJ12608909	0	1	0	6	3	0

Table 1. Census Data Table from Ranko Tracker

Census data retrieved from the server are analyse using Microsoft Excel to determine:

- Number of female and male flowers, red fruits and black fruits
- Determine the sex ratio using formula:

$$\text{Sex Ratio} = \frac{\text{(red fruit + black fruit + female flowers)}}{\text{(Red fruit + black fruit + female flowers + male flowers)}}$$

- Categories tree based on the number of bunch
- Distribution of the group in the trial block
- Colour coding of the group

4. Research Limitation

This research has limitations on the area of the research is one block of 28 hectares, located in Kabupaten Agam, Sumatera Barat, elevation of 11 meters, histosols land and we choose to conduct the research on September until December 2016 according to the period given by our industry collaborator. The trees are 8 years old, using Bina Sarana Makmur seed with are 6,384 mm of rainfall. Research conducted during rainy season.

5. Analysis and Findings

5.1 Current Data Collection

Production census normally held every 4 (four) months to obtain data for production projection for the next upcoming 4 months, collecting information on:

- Quantity of male and female flowers
- Quantity of red and black fruits

Although it's called a census, the activity is a sampling. Best practice for the sampling is 10 – 15% of total plantation area. All blocks are visited but the in each block data collection is maximum 15%

5.2 Sex Ratio Analysis

Ranko is 100% tree census; we can identify accurately condition of each tree in trial block. One is the sex ratio of each tree. This block was chosen for the research based on industry collaborator yield data as this block's yield is lower than the average in Juliet afdeling. Based on that information, common assumption when yield is low, sex ratio is bad.

We use industry collaborator criteria of sex ratio where 75% -100% is good, 50% - 74% is average/medium and 1% - 49% is consider bad/low; male only are good with range of maximum 2% per hectare and resting tree 3% are consider normal.

From Table 2, we conclude in term of sex ratio, trial block falls in category of good with 90.56% are in the range of healthy sex ratio. This is an indication the production potential in trial block is high. The male flower only trees are also enough, especially looking at the distribution. Per hectare male flower only is 2 – 3 trees considered good. The resting trees are high, plantation need to observe more on the physical condition of those resting trees and the soil and surrounding conditions.

Sex Ratio Range	Quantity	%
75% - 100%	3743	90.56%
50% - 74%	134	3.24%
1% - 49%	15	0.36%
Male Only	32	0.77%
Resting Tree (-1)	209	5.06%
Total	4133	

Table 2. Sex Ratio

5.3 Color Coding Analysis

The main benefit of having data down to the level of trees is we can have a very detail analysis and exercise variations of output and reporting. We highlight the analysis that can only be executed with tree level data. Color coding reporting and analysis can be done conveniently with existing Ranko Tracker data.

5.4 Sex Ratio Color Coding Analysis

We extract data on trial block and the color coding present in Figure 4. We examine conveniently and easily on the positions and coordinate of the categories we want to observe.

We use industry collaborator criteria to group the categories of sex ratio for Q4 2016 in this block as shown in Table 3.

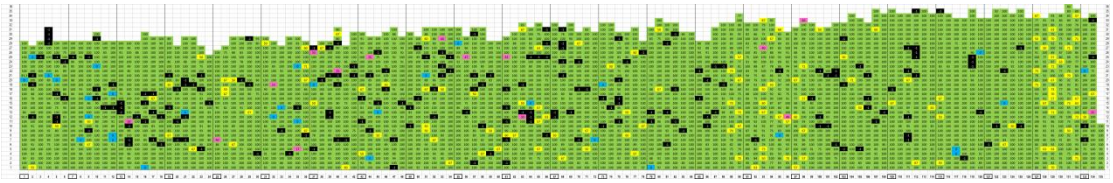

Figure 4. Sex Ratio Color Coding

Sex Ratio Range	Quantity	%	Criteria
75% - 100%	3743	90.56%	Good
50% - 74%	134	3.24%	Average
1% - 49%	15	0.36%	Bad
Male Only	32	0.77%	-
Resting Tree (-1)	209	5.06%	-
Total	4133		

Table 3. Sex Ratio Legend and Criteria

5.5 Production Census Color Coding

Having census on 100% of population of the blocks, we discover detail and interesting data on the trial block, which by our industry collaborator was labeled as a low yielding block and refer as 'patience block.' We can collect data that shows on Figure5 that based on industry collaborator site specific criteria, the trees that are consider good scattered majority in that block consisting of 53.16% of population and 26.64% are average. The number of bad trees which only has 1 – 2 bunches/tree is only 11.61%. As a normal cycle, we also have 7.79% resting tree and we have 33 missing data (0.8%).

We determine by these figures in Q4 2016, in terms of bunch quantity and female flower, majority population of this block falls in the category of 'good.'

Figure 5. Production Census

Bunch Quantity	Quantity	Percentage	Criteria
6 - 12	2197	53.16%	Good
3 - 5	1101	26.64%	Average
1-2	480	11.61%	Bad
0	322	7.79%	Resting Tree
-	33	0.80%	No Data
Total	4133		

Table 4. Production Census Legend and Criteria

5.6 Intermediate Analysis – Moving Average

Having spatial data on trees with color coding in the block helps industry collaborator identify efficiently and accurately on which precise trees or a group of trees are achieving high, moderate or low yield. Projections of production based on census are also more accurate with the total population being census. Having large plantation to be review, we see this first level data analysis can be improve to make it easier for management to identify with more focus on what is the main issue in certain block.

Based on this consideration, we extend further our analysis with deeper and more focus analysis using existing data. We conduct second level of data analysis using 28 days moving average. We use 28 days instead of 7 days moving average referring to the pattern of harvest interval in plantation where each tree is harvested average of once a month and maximum twice a month due to the morphology of oil palm tree maximum number of bunch harvested in a year is 18-24 bunches [2].

5.7 Sex Ratio – Moving Average

Result of moving average analysis on sex ratio in Figure 6 is very promising. Colour coding identifies line no 5 on trees number 11 to 25 shows as the ‘bad ‘or worse sex ratio in trial block. This will make the plantation management can work efficiently and accurately in identifying the group of trees that needs focus and immediate actions. These will safe many budget, time and resources in plantation. Faster and accurate input will trigger a faster and precise action plans for the management to increase the plantation yield productivity.

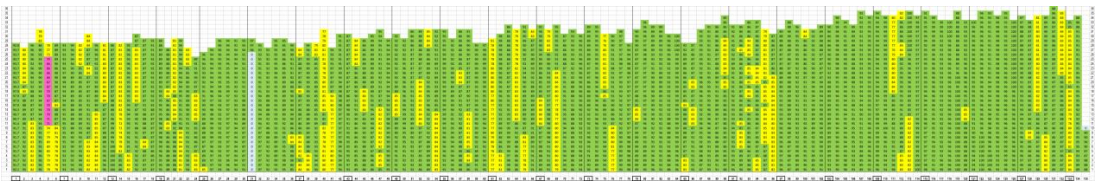

Figure 6. Sex Ratio with Moving Average

We validate our valuable data by having field staff visit trial block, line no 5, trees no 11-25. We ask our staff for physical observations on those trees and took pictures. We validate our moving average data with evidence of potassium deficiencies on majority of trees. Symptoms shown to be associated with potassium deficiency were given various names, particularly ‘confluent orange spotting’ [3]. This consisted of pale green spots that became more coloured through yellow to orange and that expanded both across and between veins, with fusion into larger irregular areas. Necrotic spots then appeared also, with possible fungus invasion. We also found symptoms of algae attack as indicates by the black dots on the leaves [2].

Below in Figure 7 are pictures taken by field staff to validate the findings in the sex ratio moving average.

Unhealthy Tree with Potassium deficiency & Algae Disease

Healthy Tree

Figure 7. Comparison of Tree with Potassium Deficiency and Algae attack with Healthy Tree

5.8 Production Census – Moving Average

Moving average in production census shows we can zoom in to group of trees that has the lowest bunch quantity efficiently. From total 135 tree lines, we can identify accurately in only 9 lines which contains significant number of trees that fits in the criteria of 'bad' trees. We can save many resources using this analysis.

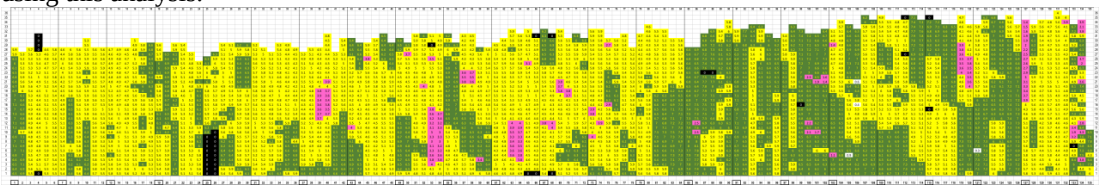

Figure 8. Production Census Moving Average

6. Conclusions

Current data collection has its limitation on zooming in, in the scale of per tree yields. This implicate in limitations of analysis. Ranko Tracker data collections prove it ability to explore more on block condition until the lowest tree analysis. These make it more accurate and produce more valuable data analysis and detail action plan. Ranko Tracker method enables an accurate way of monitoring the Fresh Fruit Bunch productivity.

Color coding analysis for production census shows its accuracy. It is higher due to 100% population census. It can create efficiency and possibility of combining annual tree census with production census held every 4-6 months and monthly census for early warning system.

Intermediate moving average analysis, this is the main achievement of this research, as a tool for Decision Support System (DSS). It pins point's exact and accurate location using spatial data where to go in response to identifying issues in production projection. This analysis wills safe budget, time and resources in plantation. Faster and accurate input will trigger a faster and precise action plans for the management to increase the plantation yield productivity. In the end this method will make plantation management works more effectively and efficiently.

7. Suggestions

We recommend Ranko Tracker data collection for production census on a larger scale, 30 blocks with a two years' research to obtain an appropriate sampling amount and going through the full cycle of oil palm morphology of 20-22 months[2]. This long period of research is needed to ensure suitability of this method in a production/large scale plantation. This method can be assessed for smallholders using less costly devices and simplified method.

Color coding analysis, we recommend plantation to use this to monitor and analyze production projection in line with their plan to increase plantation productivity.

Intermediate moving average analysis, we recommend this analysis on a much larger area for higher accuracy in discovering issues in production effectively and efficiently.

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Transactions on the smartphone as a driving factor to Indonesian Cashless Transaction

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Abstract

Less Cash Society - is societies which in financial transactions no longer rely on cash. All transactions particularly retail which is done by electronic. The success of cashless society, in addition to requiring the technology readiness also requires the mental readiness of the society, which is expected to protect them from crime mode, especially cybercrime. Currently, a transaction in Indonesia is still dominated by cash. Bank Indonesia hope that in the future every Domestic Transactions must be electronics. The Government encourages the public to use a prepaid card or electronic money to reduce the use of cash transactions, particularly in socializing " Gerakan Nasional Non Tunai" which in turn is expected to impact positively to the Indonesian economy, to the era of Less Cash Society. In line with this, it should also be noted the level of satisfaction of the users of electronic money in Indonesia, namely to the comfort and safety of products existing eMoney.

Keyword: Less cash society, electronic Money, ServQual,

1. Introduction

The rapid advancement of technology in the mobile device is already changing people's behavior and lifestyle including financial transactions. For example in the banking sector, the public has been introduced with ease via e-Money transactions simply by using a mobile phone.

Although in Banking sector at first a bit of difficulty when to start implementing and receiving of smart phones-based e-Money, because transactions using the electronic is considered may trigger criminal action, but the collaborate and synergize with Telco Provider finally a non-cash transactions can be enjoyed in Indonesia.

Bank Indonesia (BI) has officially launched the National Movement of Non Cash (GNNT). Pencanangkan movement aims BI Governor Agus DW Martowardojo in Mangga Dua Mall, Jakarta. He said "Sebagai bentuk komitmen atas perluasan instrumen non tunai, kami akan menjadikan GNNT sebagai gerakan tahunan yang di dukung dengan berbagai kegiatan untuk mendorong meningkatkan pemahaman masyarakat akan penggunaan instrumen non tunai dalam melakukan transaksi pembayaran," in Mal Mangga Dua, Kamis (14/8/2014).

In the near future people, who initially prefer to use cash, will automatically switch to the transaction of Electronic Money, because transactions using e-Money will facilitate routine transactions of their daily, saving time, safer, and more practical because it does not need to carry cash. Using our mobile phone, all transaction can be done

2. Literatur Review

2.1 Electronic Money

Electronic money (digital cash) is the currency used in Internet transactions by electronic means. In general features of e -money has same characteristics as follows:

- Electronic money has a stored value or prepaid where the amount of the value of money stored in an electronic medium that is owned by someone.
- The Value of money listed has been recorded in the instrument of e-money, or often called stored value, will be immediately reduced when consumers use it to conduct payment transactions.
- Funds recorded in e-money completely in the possession of consumers.
- At the time of the transaction, electronic transfer of funds in the form of e-money
- Value of its customers to the merchant terminal can be done offline. In this

2.2 Service Quality.

Service Quality is a comparison of expectation (hope) with Performance, Citing Lewis and Booms, 1983, they stated: Service quality is a measure of how well a service encounter compatibility with customer expectations. The implementation of quality of service means making compromises with the customer expectations consistently.

When we compare between expectation and performance then this will create a "gap" related to service quality issues, in general, we know there are 5 gaps are

- Gap 1: The gap between customer expectations and perceptions (performance) management, where such expectations will have an impact on customer service quality assessment.
- Gap 2: Gap between management perception about customer expectations and service quality specifications, this will impact on the quality of service from the customer's perspective.
- Gap 3: The gap between service quality specifications and actual service delivery, this will impact on the quality of service from the customer's perspective.
- Gap 4: Gap between actual service delivery and external communications about the service, which will have an impact on the quality of service from the customer's perspective.
- Gap 5: The gap between the quality of service that customers expect (Expected Service) and services Received (Perceived Service).

3. Methodology & Discussion :

To get an idea of how the level of satisfaction of users of electronic money apps that circulated in Indonesia, we took samples from a survey of electronic services from three large banks such as Bank Mandiri, Bank Central Asia, Bank Niaga, and 2 Telco providers Telkomsel and Indosat which have been available in the Market from the Play Store of Android devices.

This analysis is limited to only using android device user data; because it is based on the table below shows Android dominated the market with an 87.6% share in 2016Q2.

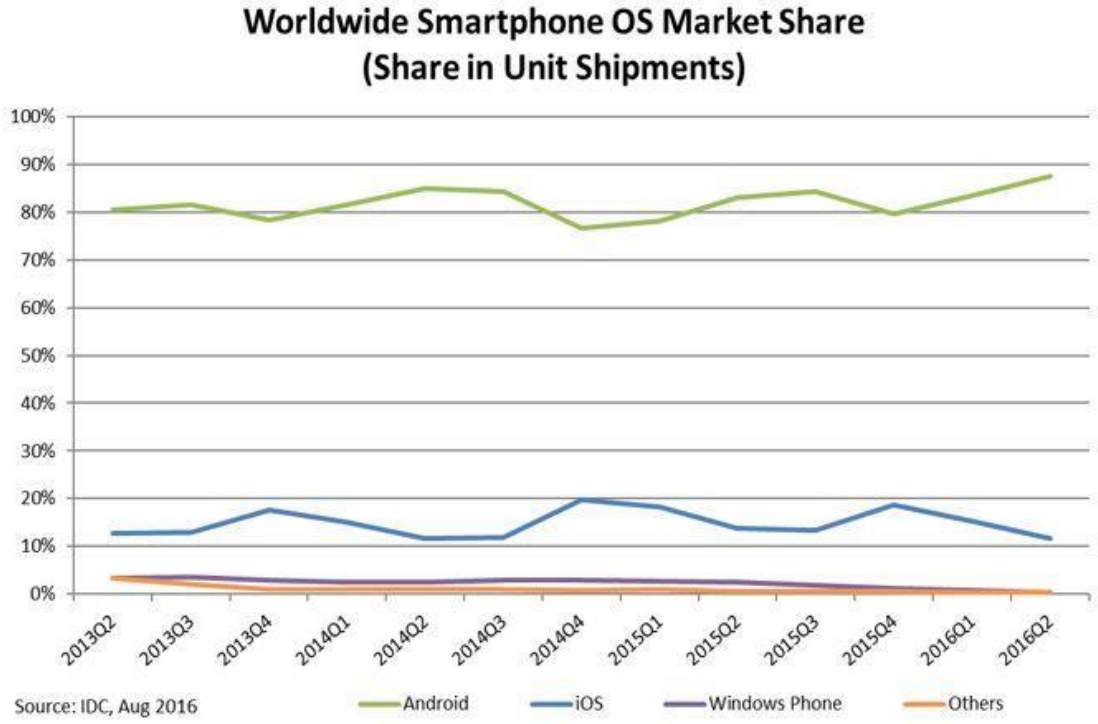
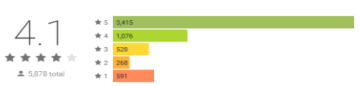
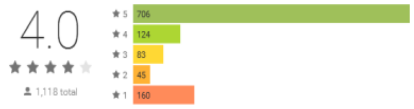
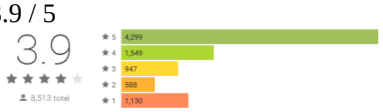


Figure 2 : Smartphone OS Market Share, 2016 Q2

Period	Android	iOS	Windows Phone	Others
2015Q3	84.3%	13.4%	1.8%	0.5%
2015Q4	79.6%	18.6%	1.2%	0.5%
2016Q1	83.4%	15.4%	0.8%	0.4%
2016Q2	87.6%	11.7%	0.4%	0.3%

Analysis of Quality of Service or Service Quality (acronym: SERVQUAL) is a descriptive method to describe the level of customer satisfaction. **This method was developed in 1985 by A. Parasuraman, Valarie A. Zeithaml, and Leonard L. Berry through their article in the Journal of Marketing**. The method in the journal and then revised by them through the article "SERVQUAL: A Multiple-Item Scale for Measuring Consumer Perceptions of Service Quality."

PRODUCTS ELECTRONIC MONEY	PRODUCT FACTS	SURVEY RESULTS ANDROID DEVICE
Mandiri e-Cash	Digital Financial Services-based server that allows mobile phone owners to have an e-wallet. Can be accessed through a native app on Android, iOS, Windows Phone and Blackberry. As well as the featured phone access through USSD * 141 * 6 #	4.1 / 5  58% said very satisfied, 18.3% of fasting, 8.9% fairly satisfied, 4.6% dissatisfied and only 6.7% said very dissatisfied; thus concluded that the majority **(76.3%) of "*e-cash*" users were satisfied (satisfaction level of 4.1 out of 5)**.
BCA Sakuku	Digital Financial Services-based server that allows mobile phone owners to have an e-wallet. Only accessible via the native app on Android and iOS	4 / 5  63% said very satisfied, 11% satisfied, fairly satisfied 7.4%, 4% were not satisfied and only 14.3% said very dissatisfied; thus concluded that the vast majority **(74%) of the "*Sakuku*" are satisfied (satisfaction level of 4.0 out of 5)**.
CIMB Niaga Rekening Hape	Mobile accounts enable users to refill, payment and withdrawal of money from ATMs using any type of mobile phone. For a native app using mobile banking applications Go Mobile.	3.9 / 5  50.5% said very satisfied, 18% satisfied, 11.1% fairly satisfied, 7% dissatisfied and only 13.3% said very dissatisfied; thus concluded that the majority **(68.5%) of the users "*Rekening Hape*" satisfied (satisfaction level of 3.9 out of 5)**.

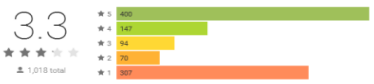
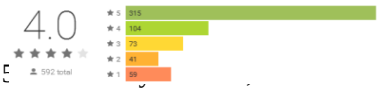
Telkomsel T-Cash	TCASH is electronic money service from Telkomsel. In contrast to the pulse, the funds loaded in TCASH can be used to pay merchants, online shopping, send money, pay bills, fill pulse, and others	3.3 / 5  39.3% said very satisfied, 14.4% satisfied, 9% are quite satisfied, 6.9% dissatisfied and 30.1% said very dissatisfied; thus concluded that the majority **(53.7%) of users "*Tcash*" satisfied (satisfaction level of 3.3 out of 5)**.
Indosat Dompetku	Indosat digital wallet is a financial service of Indosat. E-wallet now has more than 800,000 registered users and can be used to pay bills, cable TV, and gaming vouchers.	4 / 5  fied, 12% fairly satisfied, 7% dissatisfied and 10% said very dissatisfied; thus concluded that the majority **(70.6%) of the "*Dompetku*" are satisfied (satisfaction level of 4.0 out of 5)**.

Figure 2: comparison 5 product

To measure the level of customer satisfaction, this survey makes a range of satisfaction levels ranging from 1 to 5, with the following caption:

- 1: very dissatisfied
- 2: unsatisfied
- 3: fairly satisfied
- 4: Satisfied
- 5: Very Satisfied

From the results of calculations performed by the provider of electronic money applications in Android devices, the conclusion: that the users of eletronic money expressed as satisfied, if they choose a minimum level of customer satisfaction above (*3), we assume as 3, 5 and above.

4. Formulas Customer Satisfaction

Based on the proposition of the 8th and the research they do for Framework ServQual; Parasuraman, Zeithaml, and Berry compose Customer Satisfaction formula as follows:

Q = P – E

Where: Q = Quality Customer Service
E = Expectations Customers on Quality of Service (Expected Service)
P = the actual service received (Perceived Service)
If Q>0 then the EP; customers are less satisfied with the services received;
If Q=0 then E = P; the customer is satisfied with the services received;
If Q<0 then E<P; customers are more than satisfied with the service received or have ideal conditions.

Based on the assumption of the formula above, given that the expectation level of customer satisfaction is above 3 is assumed to be 3.5 (more than enough) in order to obtain results:

Q1 (eCash) : E(3,5) – P(4,1) = - 0,6
Q2 (Sakuku) : E(3,5) – P(4,0) = - 0,5
Q3 (Rekening Hape) : E(3,5) – P(3,9) = - 0,4
Q4 (TCash) : E(3,5) – P(3,3) = 0,2
Q5 (Dompetku) : E(3,5) – P(4,0)= - 0,5

From the calculation using the formula above were obtained the following results:

- Product Mandiri eCash
- BCA Sakuku
- CIMB Niaga
- And, Dompetku have demonstrated ideal condition, a condition in which the customer is satisfied exceeds the ideal conditions.

Here there is only one product of a Telco provider that the application of its electronic money felt less satisfying its customers (the service is below expectations), TCash.

Based on the theory Framework ServQual, we know that there has been a condition of Gap 5, ie the gap between the quality of service that customers expect (Expected Service) and services Received (Perceived Service), which need to be improved on the Application TCash, so the level of customer satisfaction that is a minimum score of 3.5 or more can be achieved.

Attract users, especially among the age range between 20-45 years as a productive circles with a high level of consumerism in which there are young people who are very concerned with lifestyle trends, gadgets, convenience, practicality, reliability and accuracy; to satisfy and meets the expectations of the majority of this age group will make electronic money products more easily accepted.

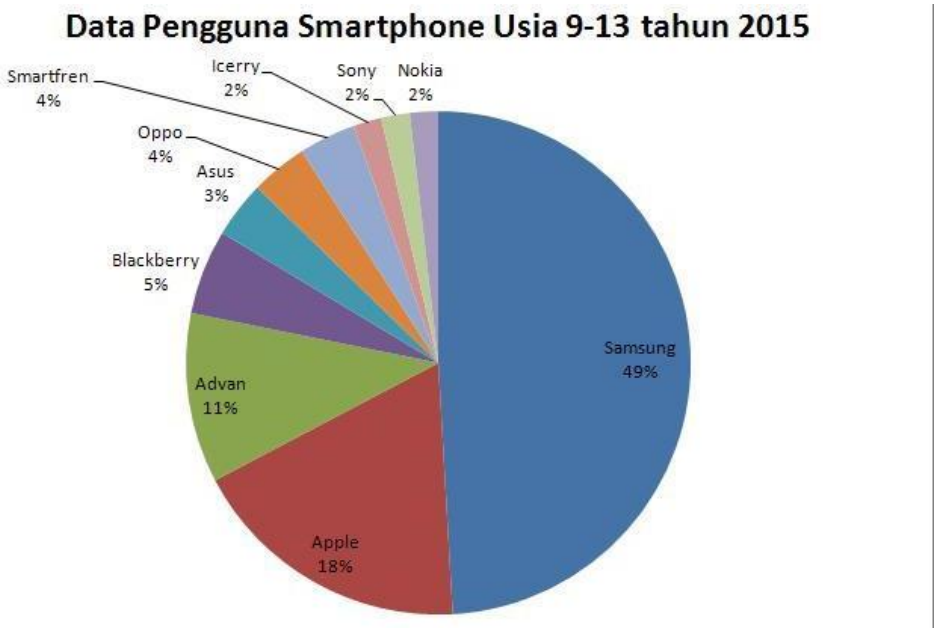


Figure 3 : smartphone user data in the age 13-19

5. Conclusion:

- IDC survey results in August 2016 concluded that the majority of Indonesian people prefer to use Android Device.
- SevQual of the analysis of the 3 Bank and 2 Telco company, it can be concluded that the majority of Indonesian people are satisfied conduct transactions using electronic Money. Expected future, the Indonesian people will sooner or later be able to leave the cash and start doing transactions using electronic money, it supports the program less cash society.
- user data from individual survey and social media in their teens menunjukkna type android 49%

The authors concluded that the trend of technology in the future is Android-based Smartphone and Cash Less Transactions will develop in mobile banking applications

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Literature review on "Industry Needs for Information Technology competence, Information Technology competence/skill program study and certification of Information Technology competence"

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Abstract

Information Technology as a new Technology has been used in businesses from small company until multinational company in almost all industries. IT role as an enabler and differentiation factor separating success company from average company. IT need people to build, operate, maintain and support the systems, hence expect the new hire to immediately contribute from the first day they join the company. The industry define the needs for Information Technology competence and expect Education Institution as one of IT resource work hard to design their program study to fulfill the needs for Information Technology graduates, yet the industry still struggle to succeed in hiring fresh graduate to fill the IT position. Information Technology Training Institution can be an alternative to improve the education result. Also certification on Information Technology competence from third party or independent body might be used as a standard for both Industry and Education. This paper will report literature review several previous paper about all of the above.

Keywords: Competence, Information Technology program study

1. Introduction

Industry scope in this research as a primary source for data collection on the requirement of IT graduates and the problems need to solve.

University scope as the place were student learn about IT and how they manage their Information Technology study program to be in line with Industry need and provide student need to be employability when they graduates.

Starting year 2005 the government creates new institution named BNSP (Badan Nasional Sertifikasi Profesi) with main duty doing certification of competence to help improve the quality and readiness of job seeker. In 2015 the KEMKOMINFO has issued a degree about which covers. SKKNI (Standard Kompetensi Kerja Nasional Indonesia), involving business and industry association in developing new SKKNI and developing job seeker in training and certification.

2. Literature Review

In current digital era where the use of information technology is almost exist in every part of human life. Information Technology still young technology with a characteristic of short life cycle compare to other technology like in manufacturing, automotive. Person involved in this field have to keep their knowledge and skill updated and keep at the speed of the change itself. In the business and Industry Information Technology hold an important role in their operation, as almost all function in the operation are depend on the Information Technology. Globalizations also drive the need of using Information Technology for the success of the business. Business still facing a shortage of Information Technology graduates to be hired to fulfill their requirement.

Several researches have been conducted to identify and analyze the competencies required for the position/position of labour in the field of information technology. Another research conducted on relation and implication of the competency and program of education information technology curriculum.

2.1 Business/Industry Requirement of Information Technology job

In general Business/Industry requirement of Information Technology job are for:
Data base administration, Network administration, Infrastructure support, IT Consultant, IT Manager, Help Desk support, Software Engineer, Application development, Application system design and Web Development. The job function in the IT depend on how the IT organization structure to support enterprise objectives, see below example from IT organization structure best practice.

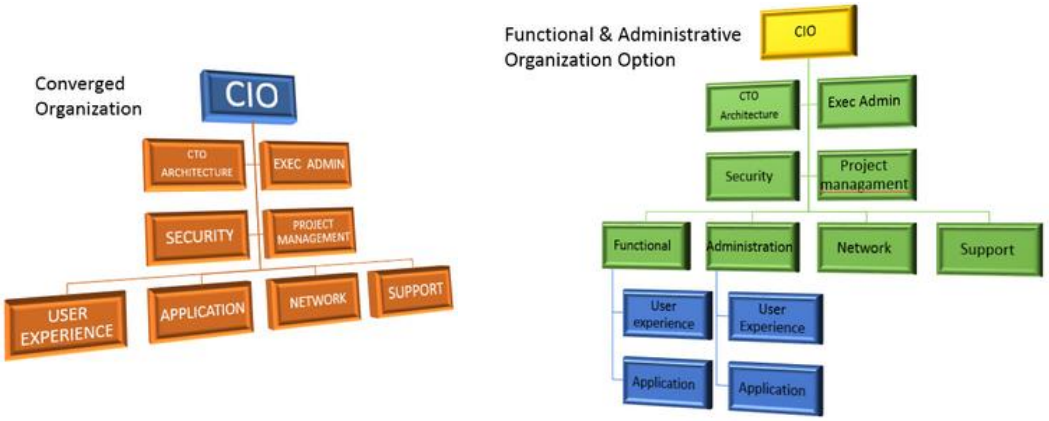

Figure 01 : Sampe IT Organization Source: UniComm Consulting LLC

The organization is not static, it will change and adapted to the enterprise need, while the IT skill and knowledge also needs to keep up to date.

2.2 Information Technology curriculum

As most university offering Information Technology in their program is teach the following; Software development (System Analyst and Design, Software Development life Cycle, Web Design); Data analysis (Data base administration, Big data Analysis, Decision making System); Software Engineering (Operating Systems, Network Administration, Security); Application development (Programming, Web development, Mobile Application) ; IT Management (IT service management, IT Risk, IT Governance, IT Audit, IT Essential).

3. Previous research

3.1 Summary of previous research paper about what employers want from Information Technology

Graduates, Information Technology graduates competence. Common objectives of previous

Papers presenting in this paper are:

- Collect *information on Industry needs for IT competence*
- Identify the most important IT competence needs by Industry
- Identify the most IT competence according to Industry still cannot be delivered by the student from the university in Indonesia
- Industry/Employer satisfaction analysis from IT graduates as their employee
- The Objectives of the paper is to identify what IT skill is needed by the candidate for the IT job vacancies. Then it compare with the skills thought in the university
- To identify Industry needs for Information Technology competence and the implication to Information Technology curriculum.
- To show the needs of robust Information Technology skill and competence to be able to compete with foreign talent in fulfill Industry needs for Information Technology resources

4. Method

*4.1**"**Information Technology competence needs in Industry labor market in Indonesia 2007 vs. 2012".***

Distribute questionnaire using Google docs to 1092 respondent with 8.6% response out of 100 target response. Questionnaire distributed to almost all companies in Indonesia with priority located in Jakarta, Bandung, Surabaya, Medan, Makassar, Palembang, and Pontianak and addressed to HR Manager, IT manager and analysis only for IT employees.

4.2"Record of Technology Information need in South Sumatera",

Data collection from news paper in South Sumatera Province (Sriwijaya Pos, Palembang Pos, berita pagi) and comparing with Information Technology program study in STMIK MDP (Sekolah Tinggi Manajemen Informatika dan Komputer Multi data Palembang).

4.3"Information Technology competence need and the implication to curriculum"

Collect information to identify what industry needs from job vacation in the newspaper and on line advertisement between April 2007 to June 2007, email communication to 800 respondent, telephone and face to face interview to 10 respondent, also send purposive sampling for questionaire

4.4 Challenge and Opportunity for Information Technology graduates in Indonesia

4.5 Actual training participant from one of IT Training Institution

4.6 Actual certification participant from one of LSP (LembagaSertifikasiProfesi) Institution

5. Result and Discussion

Various research results written on the paper are as follows:

5.1"Kebutuhan kompetensi tenaga kerja teknologi informasi dan implikasinya terhadap kurikulum, Survey dan analisis perkembangan (trend) kebutuhan kompetensi tenaga kerja teknologi informasi di pasar kerja industry Indonesia.

5.2 Kebutuhan Kompetensi Kerja Teknologi Informasi di Indonesia 2007 vs 2012,

- Respondent demography :
  a. Industry location
     Table 01 shows summary of 93 respondent based on city and province. Majority respondent from West Java (49.5%) where 46% from Bandung and DKI Jakarta (37.6%) – 27.6% from Jakarta

Tabel 1. Lokasi Kota dan Propinsi Responden

Kota	n	%	Propinsi	n
Bandung	43	46.2%	Jawa Barat	46
Jakarta	35	37.6%	DKI Jakarta	35
Denpasar	2	2.2%	Jawa Timur	4
Pekanbaru	2	2.2%	Kalimantan Barat	2
Bekasi	1	1.1%	Bali	2
Bogor	1	1.1%	Riau	2
Cirebon	1	1.1%	Jawa Tengah	1
Gresik	1	1.1%	Sumatera Barat	1
Madiun	1	1.1%	Total	93
Malang	1	1.1%		
Padang	1	1.1%		
Palangkaraya	1	1.1%		
Pontianak	1	1.1%		
Semarang	1	1.1%		
Surabaya	1	1.1%		
Total	93	100%		

- Industry type
  Table 02 shows summary majority respondent from IT Consultant (28%, 26 person) and Bank/ finance (17.2%, 16 person)

Tabel 2. Bidang Usaha Perusahaan Responden

Bidang Usaha	n	%
Konsultan IT	26	28.0%
Bank/Finance	16	17.2%
Pendidikan/Training	8	8.6%
Medis	7	7.5%
Konsultan IT, Bank/Finance	3	3.2%
Konsultan IT, Pendidikan/Training	3	3.2%
Tekstil	2	2.2%
Graphic Design	1	1.1%
Graphic Design, Konsultan IT, Pendidikan/Training	1	1.1%
Konsultan Manajemen, Konsultan IT	1	1.1%
Konsultan Manajemen, Konsultan IT, Pendidikan/Training	1	1.1%
Lain-lain	24	25.8%
Total	93	100.0%

- Number of IT employees in the company
  - There are 80 respondent (86.0%) work in IT department as separate department, while 14% of respondent do not have separate IT department.
  - Table 03 shows number of IT employees in the company, 36.6% have 6 – 15 IT employees, 25,8% have 1 – 5 IT employee and there is 10.8% company have more than 100 IT employees

Tabel 4.Jumlah Karyawan IT di Perusahaan

Karyawan IT	n	%
1 - 5 orang	24	25.8%
6 - 15 orang	34	36.6%
16 - 50 orang	21	22.6%
50 - 100 orang	4	4.3%
Lebih dari 100 orang	10	10.8%
Total	93	100.0%

- University recruited
  Table 04 shows the University the company recruited their IT employees. 45.2% employees study at Universitas Kristen Maranatha, 39.8 % from Bina Nusantara Jakarta, 36.6% from Universitas Padjajaran Bandung, 16.1% from Universitas Parahyangan Bandung, 14% from Universitas Indonesia and 11.8% from Institute Teknologi Telkom

Tabel 5.Asal Universitas Lulusan

Asal Universitas Lulusan yang Telah Dipekerjakan	n	%
UK. Maranatha Bandung	42	45.2%
Bina Nusantara Jakarta	37	39.8%
Universitas Padjajaran Bandung	34	36.6%
Universitas Parahyangan Bandung	15	16.1%
Universitas Gajah Mada Yogyakarta	14	15.1%
Universitas Indonesia	13	14.0%
Institut Teknologi Telkom	11	11.8%
Universitas Atmajaya Yogyakarta	8	8.6%
Universitas Guna Dharma Jakarta	8	8.6%
Universitas Atmajaya Jakarta	7	7.5%
Institut Teknologi Harapan Bangsa	7	7.5%
LPKIA	6	6.5%
Poltek Pos	6	6.5%
STMIK Bandung	5	5.4%
Unikom	4	4.3%
ITS Surabaya	3	3.2%
Lain-Lain	41	44.1%
Total	93	100.0%

Tabel05: Number of response by position title

Tabel 6.Jumlah Respon Per Kelompok Jabatan

Kelompok Jabatan	Jumlah Respon yang Didapatkan
Administrasi *Database*	2
Administrasi Jaringan	4
Consultant	4
IT *Manager*	13
Software Engineer	32
System Analyst	7
Technical support	17
Web Developer	5
Lain-lain	10
TOTAL	94

Table 05 shows number of respondent based on Information Technology position title

Table 06 :Hardskill and soft skill needs from various IT designation

		Description	Dbase	Network	Consultant	IT manager	Sw Engineer	Syst Analyst	Tech Support	Web Dev
1	Operating System	Windows		1st					2nd	
2		Linux					1st		3rd	2nd
3		Mac OS		2nd						1st
4		Unix		1st						
5	Pemrograman	Cobol					1st			
6		pascal					2nd		1st	
7		assembler							1st	
8		C					1st	2nd	3rd	
9		C++				3rd	1st	2nd	4th	
10		Java					2nd		1st	
11		J2Ee				3rd	1st	2nd	4th	
12		J2Me				3rd	1st	2nd	4th	
13		VB	1st						2nd	
14		Delphi					4th	3rd	1st	2nd
15		.NET			1st					
16		PHP		1st						2nd
17	Multimedia	Flash		2nd						1st
18		Adobe		2nd						1st
19		Corel							2nd	1st
		Description	Dbase	Network	Consultant	IT manager	Sw Engineer	Syst Analyst	Tech Support	Web Dev
20	Database	SQL				1st		2nd	3rd	
21		MY SQL	1st		2nd					3rd
22		Oracle			1st			3rd	2nd	
23	Applikasi	ERP SAP	1st			3rd				2nd
24		ERP JD Edward	1st			3rd				2nd
25		ERP Oracle	2nd	3rd	1st					
26		Microsoft	2nd		1st	4th		3rd		
27	Others	Administrasi Database	2nd	3rd	1st					
28		Perancangan Database	2nd		1st			3rd		
29		Perancangan Jaringan Komputer		1st		2nd				3rd
30		SetUP dan Instalasi Jaringan Komputer	1st					2nd		
31		Administrasi Jaringan Komputer		2nd	1st					
32		Keamanan Jaringan Komputer	1st					2nd		
33		Perancangan sistem informasi	2nd		1st					
34		Dokumentasi Sistem Informasi	2nd		1st					
35		Manajemen Dasar	2nd		1st			3rd		
36		Manajemen Proyek			1st			2nd		
37		Troubleshooting jaringan Komputer		1st		2nd				
38		Troubleshooting hardware		1st						
39		Perbaikan hardware	1st						3rd	2nd
40		Penguasaan Algoritma			1st		3rd	2nd		
41		Design Interface			2nd					1st

Table 06 is a summary of top 3 most needed hard skill and soft kill competence for various Information Technology position title

		Description	Dbase	Network	Consultant	IT manager	Sw Engineer	Syst Analyst	Tech Support	Web Dev
42	Soft Skill	Komunikasi Verbal								
43		Komunikasi tertulis								
44		Memimpin tim			2nd	1st		3rd		
45		Bekerja sama dalam tim								
46		Publick Speaking								
47		Presentasi								
48		Berpikir secara logis dan analistis								
49	Attitude and Behaviour	Adaptability								
50		Creativity			1st					
51		Integritas	1st							
52		Emotion control	1st							
53		Work under pressure						1st		
54		extrovert								
55		Assertive	1st							
56		Decisive	1st							
57		Self Confidence		1st						
58		independent	1st							
59		Dicipline							1st	
60		Hight initiative								
61		hardwork	1st							
62		Motivated								
63		Proactive								
64		Diligent								1st

5.3 From "Record of Information Technology needs in South Sumatera" paper,

The higher need is windows server, sql server, lan, wan, foxpro and hardware support, hard skill needed, novel networking, VB, java , c++ programming, SQL, my SQL, Ms access, Db2, oracle data base management, Windows – Linux, unixsolaris operating systems, Microsoft application hardware support, multimedia design (Corel draw, Photoshop) University curriculum cannot fulfill the need of Industry for Information Technology competence

5.4 The need of Information Technology competence and its implication to curriculum

The implications of competence need by industry for IT graduates to the curriculum are:

- The curriculum need to in line with competence needs by Industry
- Follow ACM (2008) in creating the program study having a basic competence for IT then provide optional specific competence needs by the Industry
- Unready IT graduates to contribute except some graduates with additional certification. Its advice able the university considering the focus competence they plan for their graduate student
- Content materi adjusting to technology development and use active learning method
- Include soft skill in the program study e.g. verbal communication especially in English

5.5 Challenge and Opportunity for Information Technology graduates In Indonesia

Qualities of Education on Information Technology still need improvement, and standard certification is helping to improve the quality. There are International certifications from Microsoft, Cisco for networking.

5.6 Training Institution

Data collected from one of Training Institution deliver Information Technology material, shows variety of topics that has been delivered to average more than 4000 participant a year. Company experience that they need to train the new hire to keep up with the technology they are using and future technology they plan to implement. IT job function will continuously change to cope with enterprise

objectives and constant change of the technology. Most IT training institution provide a service the company needs i.e.

Table 1. Topic and Training participant at INIXINDO Training Centre average per year between year 2014 – June 2017

SKILL	TOPICS	Average Participant
1. Technical Skill	Programming, network administration, data base administration, IT security	1.092
2. Application Development	Web development, Systems Analyst and Design	1.400
3. IT Management	IT Service Management, IT Governance, IT Risk, Project Management, IT Enterprise Architecture, IT Audit	1.445
4. Data Centre	Cloud, Data Centre management	157
5. New Technology	Virtualization, Cloud, Mobile Application, Internet of Thing, Big Data Analysis	95
GRAND TOTAL		**4.189**

5.7 Certification of IT Competence Institution (LSP = Lembaga Sertifikasi Profesi)

Since 2005 Government initiate a standard competence Reason to have certification in information technology are :

- To get a level as expected in the Information Technology job need an expertise
- Acknowledgement from independent institution that certified the individual have the expertise according to the scheme.

Unlike the Training Partner that concentrates on the technical skill and in some cases link to product of Information Technology, The certification of competence was expected to fill the gap between education and business expectation from IT graduate. The certification are based on competency and offering several scheme i.e.: ICT literacy, ICT audit, ICT project management, Analysis of Cloud Computing, Administration data base, Administration Networking, IT service management, administration data centre, programming, Mobile application development, office application literacy.

LSP LPK Inixindo has done certification for 822 participant for the period of Apr 2016 until June 2017 for some scheme e.g.; programmer (208), Mobile Application (25), Administration data base 9138), Network security (119), Information security (84), IT service (184), Data centre (44), Cloud (11), Infrastructure e-goverent (99).

6. Conclusion and Action Plan

The research conclude there are eight Information Technology needs by Industry which are: Data base administration, Network Administration, Consultancy, IT manager, Software Engineer, System Analyst, Technical Support and Web Developer.

- Industry competence needs for Information Technology graduates only covers partial field of IT in the organization ,as the study carried out in 2012, its should add new technology i.e. Mobile application and development, cloud, virtualization, big data and Information Technology security
- The competence required for each job title are as follows :

Job title	Required Competence
Data base administration	Fundamental to advance database
Network administration	Operating systems, networking
Consultant	Project Management, Database, Information System design
IT manager	Operating system, Programming, database, IT infrastructure
Software engineer	Programming, algorithm
System Analyst	Data base design, programming, project management
Technical Support	Network administration, hardware trouble shoot, Operating systems, Systems information
Web Developer	Web programming

- Lack of soft skill of IT graduates especially working under pressure, self confidence, adjustment to new environment, team work, endurance, creativity and verbal ability
- Respondent suggestion to have longer internship period to give more working experience to the student.
- Increasing number participant for certification of competence based on SKKNI (Standard Kompetensi Kerja Nasional Indonesia)

Whether there is a match skills required by employers and those of job applicants, is the opportunity for further research. An effort has to be made to minimize the gap if any. The information presented here should help to identify what need to be done. There is also opportunity to see the relation between Information Technology program study, Training Topic for Information Technology, Certification scheme of Information Technology competence and Industry needs for Information Technology competence. Future research on a model to bridge the gap between curriculum and Industry needs for Information Technology Graduates as below picture is recommended.

Figure 02 : Theoretically bridging between industry – university

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Characteristics of Slider Crank Mechanism Using Modeling Simulations

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Abstract

This document will analyze the different effects of the length and the angular velocity affecting the performance of the slider crank system. The performance of the slider crank system is simulated and shown using MATLAB with reference of the model represented by a mathematical formula. The result of the simulation is represented by several graphs, showing the relation of the length and angular velocity of the rotary motion of the slider crank mechanism and the angle generated by the translational motion of the slider.

Keywords: Slider Crank; Derivative; Pivot; Angular velocity, Linear Velocity; Angular Acceleration; Linear Acceleration

1. Introduction

1.1 Background

Slider crank systems are commonly used today by different automobile industries and also machines which involves both rotary and translational motion of the components. Known to be commonly applied in engine pistons, the components of the slider crank systems are responsible to attain different results of oscillatory motions, rotation and translation. The performance of the slider crank mechanism relates to the speed output of the rotary motion of the rotating component and also the translational movement of the slider. Thus altering the values of the components will critically affect the oscillatory motion of the slider crank mechanism. According to the study of Akbari, lowering the speeds of the slider crank mechanism can be proven to decrease rate of oscillation of the system [1] because by decreasing the speed, the resulting slider will move slower resulting in lower rates of oscillation. In a larger aspect of application, this factor is crucial in order to attain the needed speed of oscillatory motion of the slider which is relevant to the required system. Thus, this paper will investigate the performance of the slider crank mechanism, when subjected to different variance of the components, mainly the effects of different lengths of the crank pivot bar and the different inputs of angular velocity, by showing graphical representation of the simulations done in the MATLAB program representing the running system.

2. Theory

2.2 Components of a Slider Crank System

The slider crank system consists of 3 main components which are the Crank Pivot, Connecting Bar and the Slider. Similar to the research done by Murk as' team, the slider crank can be viewed as a joint component, each component having individual distinct fields of motion [2], thus obeying the simple physical mechanics in approach of analyzing the different effects.

The crank pivot is responsible for the rotary motion of the mechanism [3]. Assuming that the rotary motion of the crank pivot always rotates on the positive axis of rotation, the connecting bar attached to the crank pivot will result in an opposite rotary direction with respect to the crank pivot. The resulting slider component will reciprocate the polar axis of the rotary crank pivot. Thus if the crank pivot rotates in the positive axis of rotation, the resulting slider will translate in the positive polar axis.

2.3 General Model of a Slider Crank System

A general slider cranks mechanism diagram shows as follows:

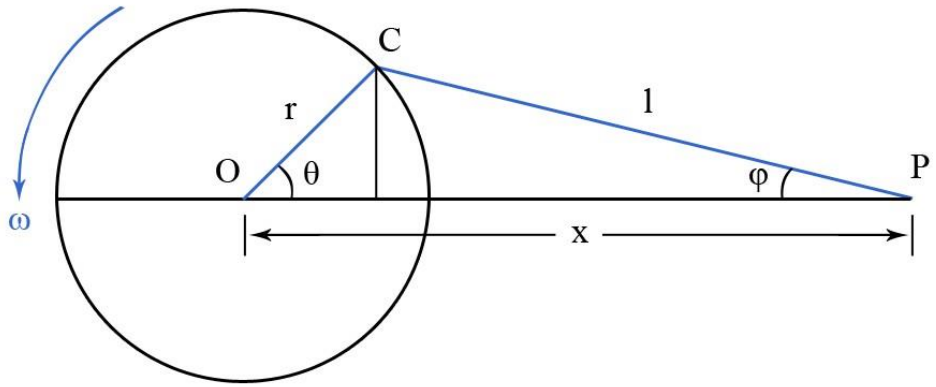

Fig 1. General model of Slider Crank Mechanism.

According to Fig 1, the blue section of the graph shows the components of the slider crank mechanism which is subjected to motion. The followings shows the representation of the physical components of the mechanism:

- **O- Crank Pivot**
- **OC- Crank Pivot Bar**
- **CP- Connecting Bar**
- **P- Slider**

ω Pertains to the angular velocity of the rotating pivot bar OC. As the bat OC rotates, the corresponding bar which is connected to OC; the connecting bar CP will move in a linear translation motion, and also generates an angle of the resulting translation motion of φ. The length of OC relates to the radius of the circular path in which the crank pivot bar moves. With the physical relation known

$\omega = \frac{v^2}{r}$ the angular of the velocity of the rotational motion is dependent upon the radius of the circular

path, in this case of Fig 1, the length of the bar OC. the resulting translational motion is that the length between the centre O and point P will fluctuate according to the axis rotation direction of the crank pivot bar OC. Note that the angles of θ and φ are all in the units of Radians.

Based on the analysis done by Harihara and Childs, the geometrical model of a slider crank system is shown as follows [4]:

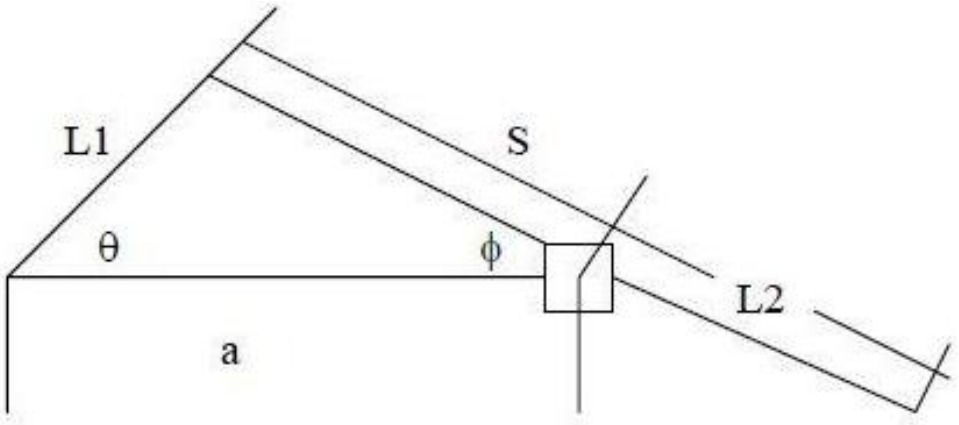

Fig 2. Mathematical model of Slider Crank Mechanism.

2.4 *Geometric relations and physical relations to the model:*

The following shows the representation of the variables:

Variable	**Representation**
L_1	Length of the Crank Pivot Bar
S	Length of the Connecting Bar
$\emptyset$	Angle generated by resultant of translational motion of slider
θ	Angle generated by resultant of rotary motion of the pivot.

Based on trigonometric laws, the general geometric relation can be defined as follows:

$$\mathbf{S\cos\emptyset = a - L_1\cos\theta} \quad \textbf{(1)}$$

$$S\sin\emptyset = L_1\sin\theta \quad (2)$$

According to the team of Hroncova, the diagram shown in Fig 1 can be modeled mathematically through trigonometric principles [5].Where S represents the length of the connecting bar and L_1 is the length of the crank pivot. The equation above represents the displacement of the slider with respect to the datum where the head of the crank pivot connects with the tail of the connecting bar. The angular velocity of the rotating crank pivot will induce a linear velocity on the slider. Given the length of the connecting bar, the angular velocity can be deduced by taking the derivative of equation (1) and (2) with respect to time [6]. The results of the first derivative to obtain the equation of angular velocity are shown as follows:

$$S\cos\emptyset - \sin\emptyset = L1\omega\sin\theta \quad (3)$$
$$S\sin\emptyset + \cos\emptyset = L1\omega\cos\theta \quad (4)$$

Equation (3) and (4) are 2 simultaneous equations which represents the horizontal and vertical components of the motion. Thus, both equations can be written in matrix multiplication form for a much easier conception shown as follows:

$$\begin{matrix}\cos\emptyset & -\sin\emptyset \\ \sin\emptyset & \cos\emptyset\end{matrix}\begin{matrix}\dot{S} \\ \emptyset\end{matrix} = \begin{matrix}L\ \omega\sin\theta \\ \dot{S}\ 1\ \cos\theta\end{matrix} \quad (5)$$

Equations (3) and (4) can further be differentiated to represent the Angular Acceleration of the system. Angular acceleration usually represents a forced response during the running of the mechanical system, thus fluctuates an input resulting in a rotational acceleration of the movement of the crank pivot and also the resulting linear acceleration of the slider. The result of the second – derivative of the initial length is shown as follows:

$$\begin{matrix}\cos\emptyset & \sin\emptyset \\ \sin\emptyset & \cos\emptyset\end{matrix}\begin{matrix}\ddot{S} \\ \ddot{\emptyset}\ \dot{S}\end{matrix} = \begin{matrix}L_1\cos\theta\dot{\theta}^2 + 2\dot{S}\dot{\emptyset}\sin\emptyset + \ddot{S}\cos\emptyset\ \ddot{\emptyset} \\ -L_1\sin\theta\dot{\theta}^2 - 2\dot{S}\dot{\emptyset}\cos\emptyset + \ddot{S}\sin\emptyset\ \ddot{\emptyset}\end{matrix} \quad (6)$$

3. Numerical Analysis

In this section of the paper, the results of the derivation of calculations from equation (1) to (6) are all implemented in to MATLAB. This allows the user to investigate and simulate with aid of graphical representation.

As shown in equation (5) and (6), the different simultaneous equation shows the results of both linear and angular velocity in matrix form. For the example shown in Fig 1, several parameters will be used to investigate the different effects of the length L1 and the angular velocity of the crank pivot. The values which will be inputted are tallied by a table shown as follows:

Table 1. Value Of Input

Variable	Input Values		
ω (rads/s)	3	5	10
$L1$ (m)	0.5	0.7	0.9

The equations shown in (5) and (6) obey the laws of matrices in solving simultaneous equation. To calculate for the unknown, the Inverse is applied. Defined, as a sample matrices multiplication is given by the characteristic equation:

$$AX = B \tag{7}$$

The general equation of the Inverse Matrices Multiplication is shown as follows:

$$X = A^{-1} B \tag{8}$$

As referenced in the theory section, the system will be subjected to many variances such as vibrations, friction, abrasion forces and also change in heat conductivity in the metal material which can affect the overall stability performance of the mechanism. In this analysis section, the factors above are all neglected to ensure simplicity in conception, and also to fully understand the different effects of the altered values.

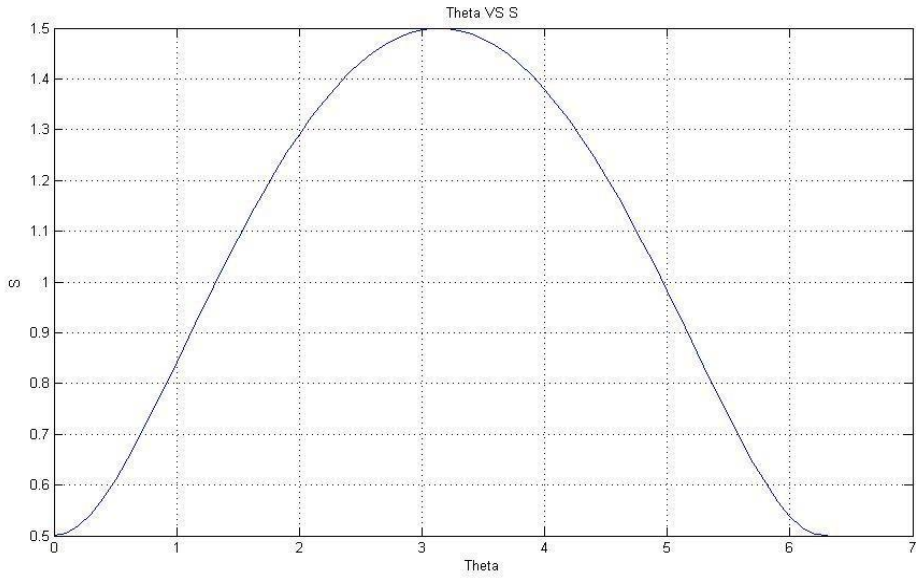

Fig 3. Graph of the performance of a general Slider Crank Mechanism.

With respect to equation (1) and equation (2), the value of S can be deduced shown on the graph above in terms of θ. To obtain the value of , substitute the value of θ which is given in radians to equation (1) and equation (2) . These values are significant to determining the maximum angle of and θ to obtain the optimal performance for the given length of the crank pivot bar.

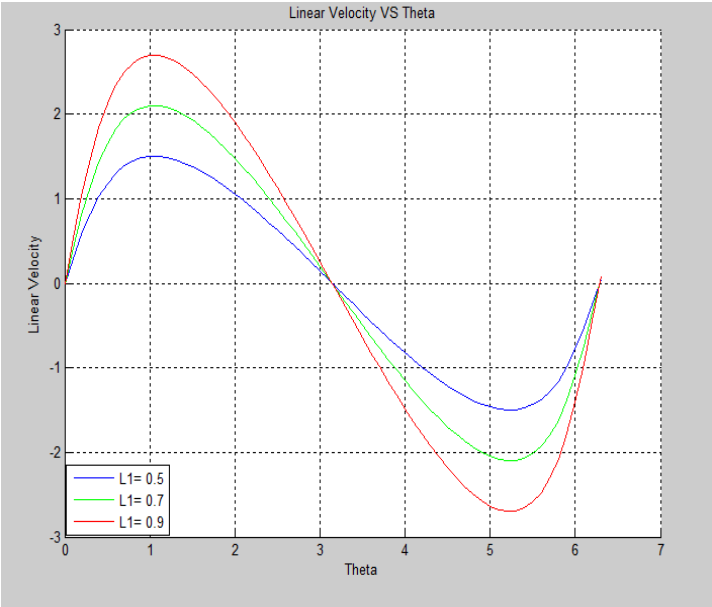

Fig 4. Graph of Linear Velocity VS Theta, Varying values of L_1.

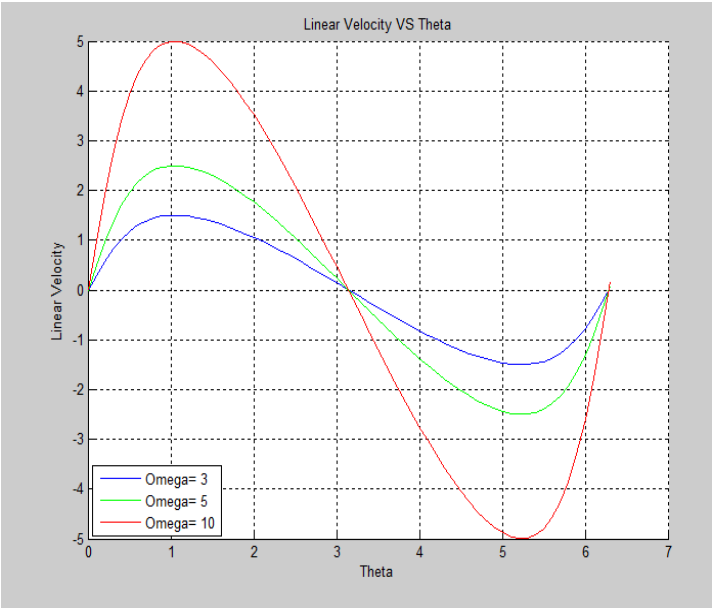

Fig 5. Graph of Linear Velocity VS Theta, Varying values of ω.

As shown in Fig 4 and Fig 5, the graphs show a similar shape of the system pertaining to the linear velocity. Since velocity is a vector quantity, the negative curvature of the graph shows the velocity of translation in the negative polar axis.

When the increasing value of length L_1, the translational motion on the slider increases rapidly over a range of angle which is generated by the crank pivot. This is represented by the graph when the different values have a higher value of linear velocity with respect to the common value of θ. In physical terms, it shows that the length of the crank pivot affects the velocity of the slider.

However, when the constant angular velocity ω is altered, the graph shows no change in the values of the resultant linear velocity.

Thus, to increase the slider translational velocity, given a constant angular velocity does not change the resulting value with respect to a fixed length.

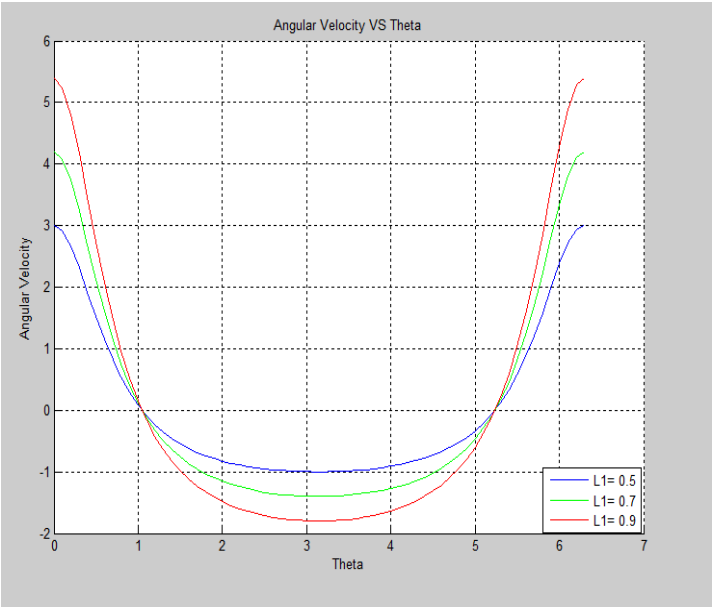

Fig 6. Graph of Angular Velocity VS Theta, Varying values of L_1.

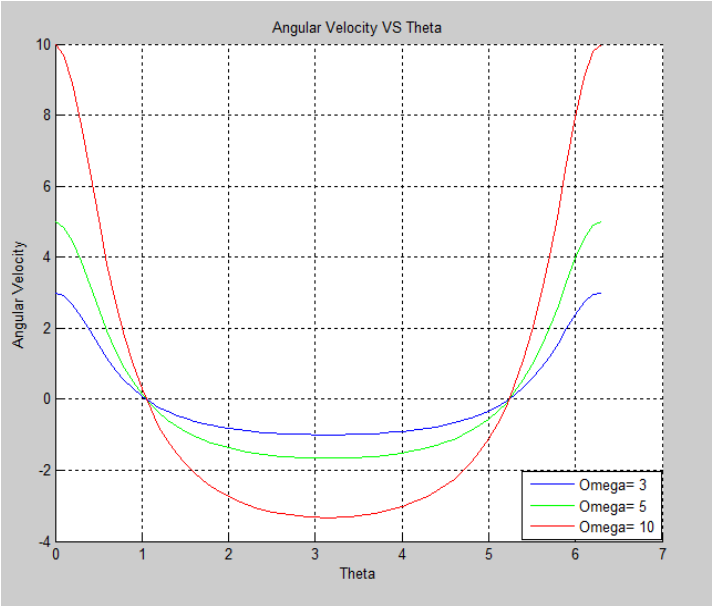

Fig 7. Graph of Angular Velocity VS Theta, Varying values of ω.

As for the angular velocity shown in Fig 6 and Fig 7, the rotational motion of the crank pivot decreases with respect to the increasing angle of rotation given by θ when the value of the length L_1 is increased. This result is caused by the change in length of the crank pivot; as the length increases, the moment and resulting work done required increases due to the higher amount of force generated by a higher induced angular velocity [7]. As it increases, the rotational motion will show a decay towards the datum point of the rotation which is represented by the transition from decay to exponential trend of the graph. The other half of the exponential trend shows the positive axis of rotation when the crank pivot is rotating in the system.

Similarly with the results given in the *Linear Velocity* section, the graph does not show change in the behavior of the resulting system when the constant angular velocity ω is changed.

This shows that regardless of the constant angular velocityω, the results will not show change in the performance of the system, thus changing the length of the crank pivot will induce more work done towards the rotational motion of the crank pivot.

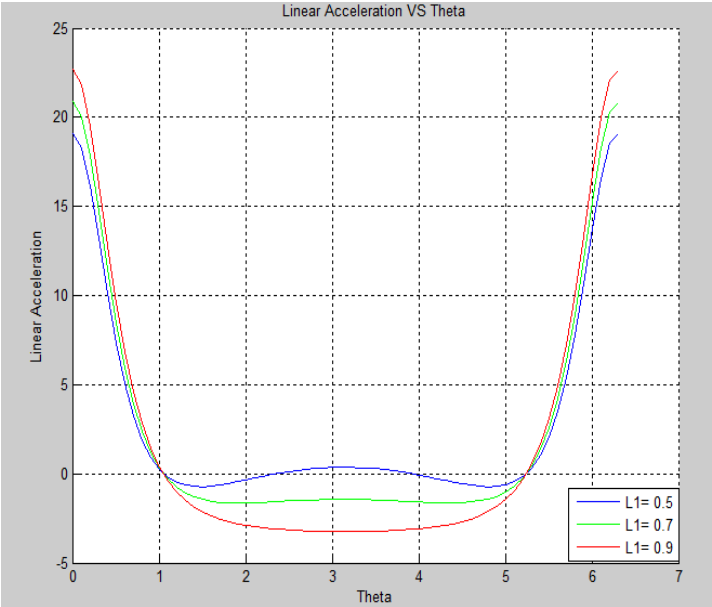

Fig 8. Graph of Linear Acceleration VS Theta, Varying values of L_1

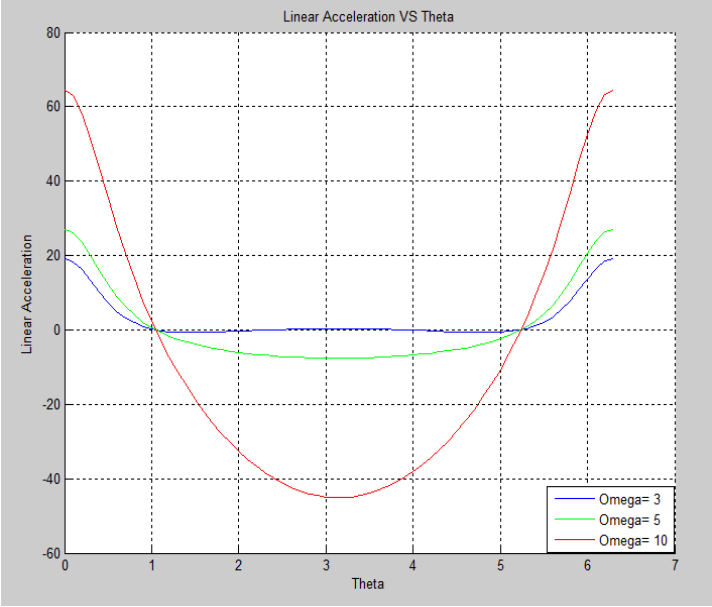

Fig 9. Graph of Linear Acceleration VS Theta, Varying values of ω.

The graphs in Fig 8 and Fig 9 shows the different results of the linear acceleration of the slider when the values of length and constant angular velocity are altered. The result shows a decaying trend in both results of the altered values. This decaying trend represents the negative translational acceleration of the slider.

However, the results shown in Fig 8 represents where the increasing value of the constant angular velocity has a smaller graph span compared to the graphs given with a smaller constant angular velocity. This shows that there is higher change in variable speed which pertains to higher acceleration of the slider when the angular velocity is increased.

Both graph represented a smooth curvature throughout the running of the slider crank system. Based on the study of Chaudhary, when the crank is subjected to a high velocity, the system induce higher forces of abrasion and vector inertia forces which will cause high amounts of vibrations in the testing of the real physical environment[8].

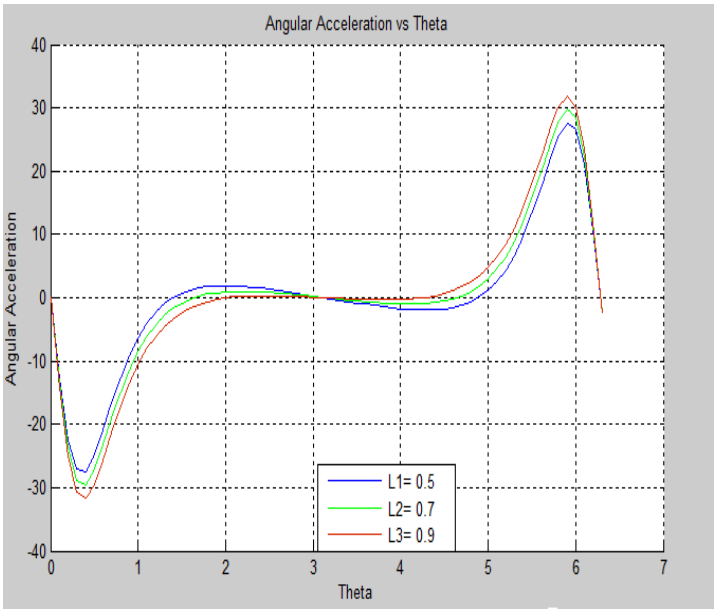

Fig 10. Graph of Angular Acceleration VS Theta, Varying values of L_1

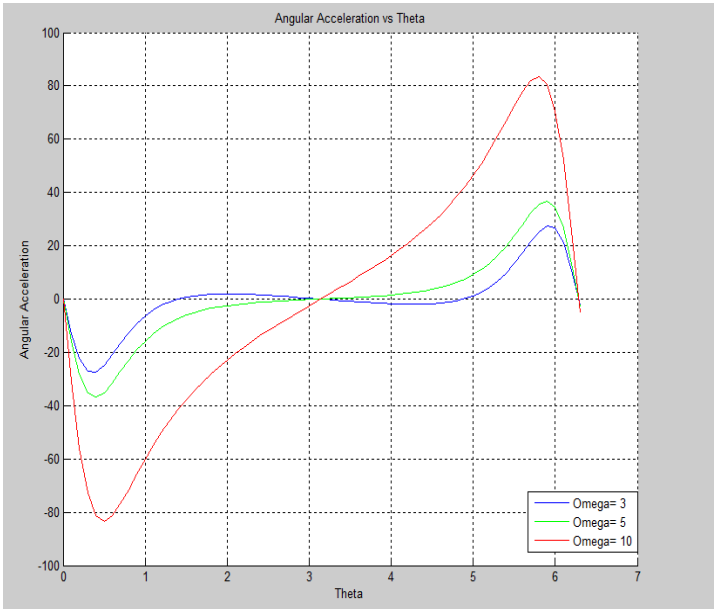

Fig 11. Graph of Angular Acceleration VS Theta, Varying values of ω.

Fig 10 and Fig 11 shows the results of the angular accelerations at the crank pivot. The result shows that when the Angular Velocity is increased, the resulting Angular acceleration will increase for a given angle. The change in length of the crank pivot shows that the rotational acceleration increases within the given angle of θ.

In the physical terms of the system, the longer the crank pivot bar the higher the acceleration will be generated by the crank pivot. There is also less time taken to change the rotational acceleration from the positive acceleration axis to the negative acceleration axis. Thus, by increasing length, more optimum rotational motion can be attained.

The result can also be interpreted by changing the initial constant angular velocityω. As the value of the angular velocity increases, the time span needed to change from the positive rotating axis to the negative rotating axis decreases, thus optimizing the rotational motion.

4. Conclusion

In conclusion, the length of the crank pivot and the initial angular velocity has a significant effect upon the translational motion of the slider crank mechanism. The goal of investigating the different effects of length and also angular velocity was individually represented in the graphs shown. Increasing the Length of the crank pivot bar and increasing the angular velocity can result in a much more stable performance of the slider crank mechanism. In most of the graph, for one cycle of the running mechanism, the values are able to reach the original datum point value of the original input which are being used, being length or angular velocity, thus this shows no spikes or fluctuations on the performance of the running mechanism. Noted that the initial angular velocity is given at a constant value, the physical quantity of acceleration still exist due to the shift in angle of Ø. This document can be further analyzed by altering the values of Ø, showing the different effects of the change in angle of the slider.

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