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I hope this letter finds you in good health and high spirits. It is my distinct pleasure to address you as the Editor-in-Chief of Integrative Omics and Applied Biotechnology (IIOAB) Journal, a multidisciplinary scientific journal that has always placed a profound emphasis on nurturing the involvement of young scientists and championing the significance of an interdisciplinary approach.

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Our journal continues to serve as a hub for knowledge exchange, providing a platform for researchers from various fields to come together and share their insights, experiences, and research outcomes. The collaborative spirit within our community is truly inspiring, and I am immensely proud of the role that IIOAB journal plays in fostering such partnerships.

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Thank you for being a part of our journey, and for your commitment to advancing science through the pages of IIOAB Journal.



Yours sincerely,

*Vasco Azevedo*

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ARTICLE

# SETTLEMENT DETERMINATION OF SOILS BY SHEAR WAVE VELOCITY PROFILES

Bukhari R\*, Khairul Anuar MN, Anuar K, Siti Aminah O

*Civil and Structural Engineering Department, Universiti Kebangsaan Malaysia, Bangi, MALAYSIA*

## ABSTRACT

**Background** In geotechnical engineer settlement is among the most significant aspects to in designing stable and reliable foundation. Several approaches are used to estimate settlement of soil, of which most important are Plate Load Test and "Spectral Analysis of Surface Waves method. **Methods** this test is conducted on the raw data of time series. This is converted into the frequency domain. The dispersion curves used to generate shear wave velocity profile. Spectral Analysis of Surface Waves Method (SASW) is applied to obtained Shear waves velocity. This method involves two (2) receiver attached to the ground with a power source located near to the first receiver. The shear wave velocity profile is an output of SASW method and it is applied to predict settlement of soils. **Results** Shear wave velocity profile for both sites is used as input in the simulation to predict settlement caused by the same load subjected as PLT. A good agreement is achieved between settlement measured by PLT and simulation. **Conclusion** empirical correlation between the shear-wave velocity and Spectral Analysis of Surface Waves was found. SASW method is a comparatively fresh seismic practice and has to go through continuous improvement. The method escapes the difficulties allied with traditional approaches. In our present study, the shear wave velocity has the increasing probability to estimate settlement of soil, by comparing to Conventional methods however statistically insufficient. Settlement of soils differs on behalf of changes in site/area.

## INTRODUCTION

**KEY WORDS**  
Plate load test, shear-wave velocity, Spectral Analysis of Surface Waves Method

The Settlement is there liable foundation and most important aspect designed to geoengineering. There are several types of methods are used to predict settlement and widely used is one plate Load test. The plates may vary from 760 mm to 150 mm. PLT is very useful since it can offer evidence of tough soils due to unfeasibility of sampling, however the method only trustworthy on the soil to a depth almost two times diameter of the plate [1] In late 1970's, With the arrival of spectral analysis and portable computers the outdated surface wave technique has transformed to the Spectral-Analysis-of-Surface-Waves (SASW) method. Over the last few decades, the SASW technique has fascinated many engineers and has been employed in different applications. These presentation zones include classification of foundation non-destructive estimation and description of concrete systems, evaluation of concrete structures and in situ determination of ground stiffness [10].

The shear-wave velocity (VS) is one of the most important parameters for determining dynamic soil properties and groundresponse analyses. The association among shear wave velocity and standard penetration test blow counts (SPT-N) is inspected. The main focus of the study is an association of SPT-N and shear wave velocity for various soil sorts: all soils, sand, silt and clay-type soils. The new and earlier recommended approaches showing links between uncorrected SPT-N and shear wave velocity are compared and evaluated. The uncorrected blow calculations are used for the better associations in the estimation of the shear wave. [2]

Prediction of Ground shaking soil response requires knowledge of soil, expressed in terms of shear wave Velocity. Although it is best that this vibrant land ownership in measured quantities, which is often not economical at all locations. Shear wave correlations between Velocity and penetration resistance in this study have been assessed and compared with values based SPT received geoseismic collected from geotechnical and first-degree earthquake region of Turkey data correlations. The results obtained are incensus studies that exploded in these correlations significant amounts while not support the findings that have an important influence on the territory. The regression equation developed in this study to exhibit the best performance compared with previous projections and good equations. It is the best correlations used for situations when a hand-blow account. [3]

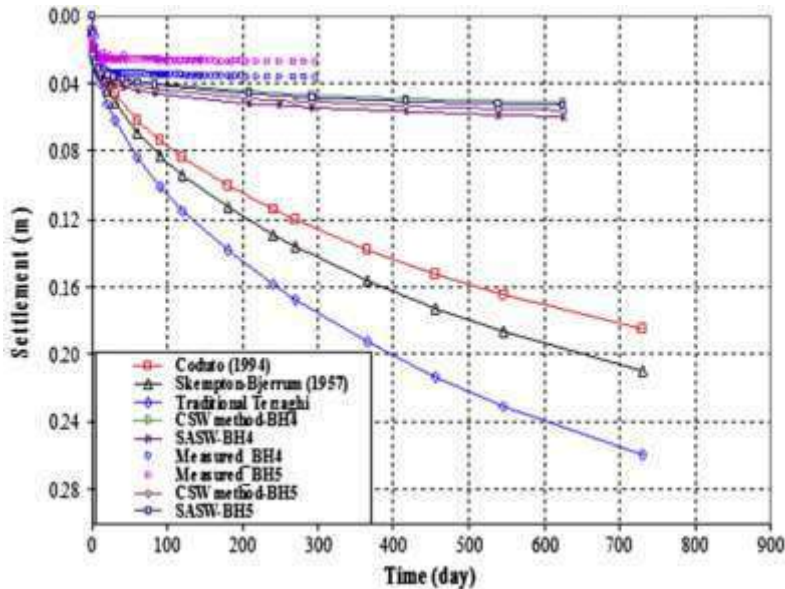
In the present, a method based on seismic and non-caustic were used to provide as input in numerical analysis to predict settlement.

The seismic surface wave method (MASW) is the effective method of calculating the S velocity in the field. The Dynamic Probing Heavy (DPH) test used for earth strength and its deformation properties. Correlations in the shear-wave velocity and the soil penetration resistance NDPH were estimated. Two different approaches (low vs. high strain) were compared, and the results were found to be in a good settlement when the comparative alteration between the pacesis small and smooth. Dynamic probing tests are worthy of learning a distinct point of concern in a huge field area based on preliminary seismic tests. [4]

\*Corresponding Author  
Email:  
bramli99soa@gmail.com  
Tel.: + 60-1123118199  
Fax: + 60 389118344

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Continues examination for the settlement of landfill grounded on shear wave velocity and damping measurement. Seismic measurements and theoretical analysis have been linked to estimate settlement in a non-linear material. The nonlinear characteristics described in terms of strain which then called characteristic strain. Landfill immediate settlement is measured by two loaded skips tests. For the authentication of the proposed method in terms of the settlement, a finite element software or nonlinear numerical method is utilized and good agreement is achieved between observation and the proposed method. Applies the same parameter of which is shear wave velocity and damping to investigate long-term settlement on soft clay and the result compared with various settlement prediction methods as shown [Fig 1] .[5]



**Fig. 1.** Comparison of the settlement of soft clay between various prediction methods. (Mohamad Nor Omar et.al 2011).

Long term settlement of soft clay is predicted by applying a viscoelastic formula. Shear wave velocity of the seismic tests of (SASW) spectral analysis of surface wave and (CSW) continuous surface wave tests provide the elastic shear modulus (G) value. Damping at equivalent elastic strain was calculated from the hysteresis of PLT by using damping – Strain-Formula. The generalized viscoelastic formula calculates long-term settlement by applying damping and elastic settlement. Results of the viscoelastic formula are better than the observed methods. Adjustment of the settlement formula has enhanced the settlement precision to 10%.The comparison between various settlement prediction methods showed that seismic methods are the closest approximation to the actual observation of the settlement marked by Measured BH4 and BH5.[6]

## METHOD

The selection of testing techniques for the measurement of dynamic soil properties requires a careful consideration and understanding of the specific problem [7]. Spectral Analysis of Surface Waves Method (SASW) is applied to obtained Shear waves velocity.This method involves two (2) receiver attached on the ground with a power source located near to the first receiver. The configuration of Spectral Analysis of Surface Waves method can be illustrated in [Fig 2].

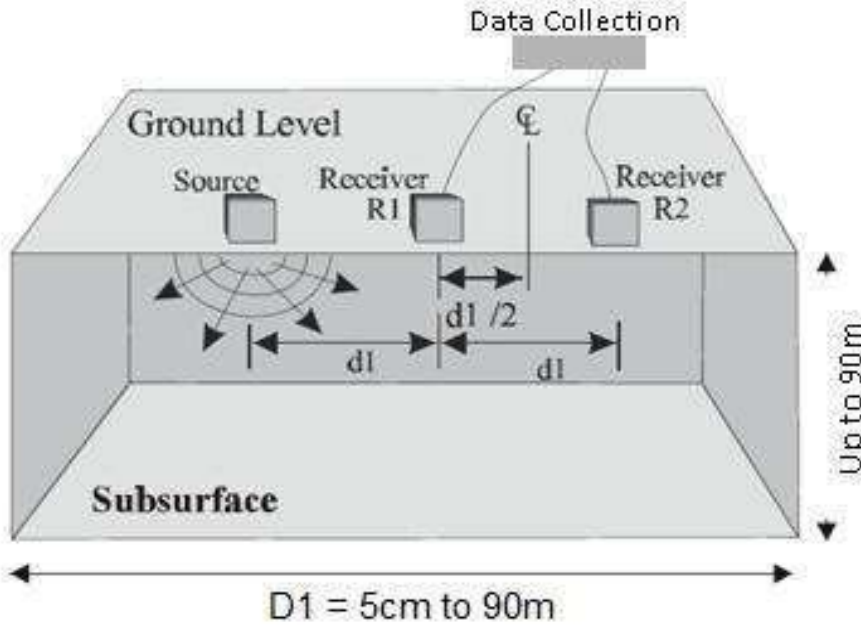


Fig.2: Illustration of SASW configuration.

This test is conducted on the raw data of time series. Which is converted into the frequency domain. Therefore angle difference of receivers is calculated by frequency Response Phase graph. A dedicated software developed by Joh(1992) is applied to advance analysis. This full-bodied software is applied in all the process to collect raw data, performing phase covering, creating dispersion curves and turning data into shear wave velocity profile. Wrong interpretation of curve may cause to misleading dispersion curve. Finally, the dispersion curves used to generate shear wave velocity profile. The shear wave velocity profile is an output of SASW method and it is applied to predict settlement of soils.

The input is used to calculate the settlement by means of simulation. Settlement from the simulation then can be compared to conventional test such as Plate Load Test (PLT). PLT is used through additional pre. In this paper, PLT and SASW method were conducted in two different sites around, in ALABAMA, USA

### RESULT AND DISCUSSION

To determine the ultimate posture capability of soil and disbursement of foundation under the loads for mud and filthy soils plate load test is done.

[Fig.3] show the both conventional PLT (Plate load test) and SASW (Spectral Analysis of Surface Waves) test conducted at site 1. [Fig. 4B] shows shear wave velocity profile obtained from SASW test. The site condition site reported to be quite saturated since the water trapped around and excavation are still not completed by the contractor. This can be seen by the shear wave velocity profile that it is lower at 0 to 0.2 meter compare to a deeper depth.



Fig.3a. Test locations of PLT and SASW method [8].

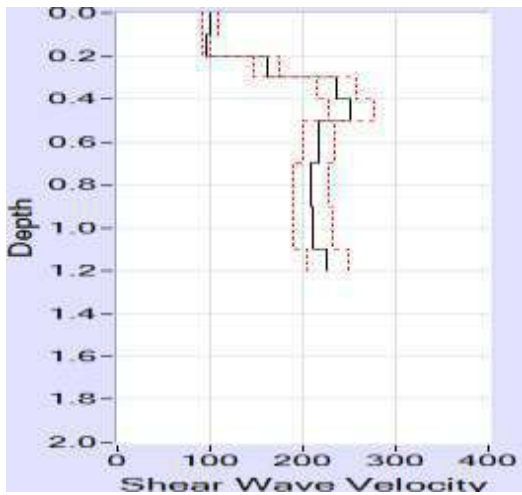


Fig.3b. Shear wave velocity profile [9].

The floor of a building under construction was selected for PLT and SASW (VSpectral Analysis of Surface Waves) test at Site 2 as in [Fig. 4a and 4b] . Since the floor is to be used for developing emergency staircase, it was compacted regularly. This can be illustrated in [Fig. 4c] where the ground has higher shear wave velocity than site 1 and is regularly stiffer along the deeper depth.



a)

b)



c)

Fig.4. VSpectral Analysis of Surface Waves].

#### Illustration of Comparison of Settlement from both Conventional PLT and SASW

The results show the Shear wave velocity with high likelihood to estimate the settlement of narrow groundwork by relating to conventional test even though statistically insufficient. The percentage different of settlement from both sites are 9.44 and 0.55 percent. This study can be applied to another conventional test which provides settlement as output so that it can be useful to industry.

#### CONCLUSION

In the present paper, we present empirical correlations between the shear-wave velocity and Spectral Analysis of Surface Waves. SASW method is a comparatively fresh seismic practice and has to go through continuous improvement during the last few decades, particularly in the inversion of the data analysis. The



method escapes the difficulties allied with traditional approaches. The non-damaging and noninvasive property of Spectral Analysis of Surface Waves method avoids sampling disturbance and unreliable sampling. In our present study, the shear wave velocity has the increasing probability to estimate settlement of soil, by comparing to Conventional methods however statistically insufficient. Settlement of soils differs on behalf of changes in site/area.

### CONFLICT OF INTEREST

All the authors declare no conflict of interest with in this research.

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ARTICLE

# THE RELATIONSHIP BETWEEN INTERNAL CHARACTERISTICS OF FIRMS AND MACROECONOMICS ON THE RETAIL AND WHOLE SALE SECTORS IN INDONESIA

Yudhia Mulya<sup>1\*</sup>, Edhi Asmirantho<sup>2</sup>

<sup>1</sup>Lecturer, Faculty of Economics, Universitas Pakuan, Bogor, INDONESIA

<sup>2</sup>Senior Lecturer, Faculty of Economics, Universitas Pakuan, Bogor, INDONESIA

## ABSTRACT

The role of this research paper is to explore and highlight how internal aspects of firms and the external environment in economics affect the retail and whole sale sectors in the country. To effectively do this, specific internal economics characteristics have been used including financial performance and risk indicators. On the other hand, the macroeconomic aspect is variables to stock returns; this is in consideration of all the retail and whole sale firms that were listed in the stock exchange between the years 2008 and 2015. The panel regression is used and comprises two models regarding the internal and macroeconomics aspects utilizing the Chow Test and Hausman Test. The application of panel regression leads to the results which imply that there is a significant relationship between the returns in firms and price to sales ratio, debt ratio, return on assets, firm size, beta, and rate of exchange in the stock market. These results are based on tabular comparison of the aspects in terms of their statistical values of coefficients, t-Statistics and probability values in the panel regression. The discussion further asserts the existence of strong relationship identified in the results and further proves a negligible relationship between the internal and macro-economic aspects in the context of their environments. The conclusion finally sums all the findings suggesting that the financial well being of retail and wholesale firms in Indonesia rely heavily on the identified aspects.

## INTRODUCTION

The economics of retail and wholesale firms is critical in the evaluation of the financial performance; employing the internal and external environments in this evaluation is a sure way to determine where the financial success of the firms depends heavily on. Most of these environments rely on tabular or statistical values which show the exact relationship between the return of assets or stock and the environments. Additionally, the financial statements help in arriving at the statistics by proving the data necessary for the computation of financial ratios including debt ratio and price to sales ratio. By arriving at the various findings, stakeholders such as investors have the reliance on the accurate decision as whether or not to invest in the firms as well as knowing which aspects of the internal and external environments to focus more.

Financial performance is the overall health of a firm in terms of the returns gained from sales and investment as well as other financial activities [1]. As such, it is related to the return on assets, the exchange rates for the case of stock market firms, the beta ratio and the price to sales ratio. Return on assets is the revenue that assets give back to the firm for example through leasing a retail building, using private transportation for delivery of products and amassing of shareholder value in the stock market [2]. This element represents the most popular way of determining the profitability of a whole sale or retail firm by comparing the total firm assets and the revenue generated.

Exchange rates determine the value which a retail or wholesale firm get through trading in the stock market for example through the buying and selling of shares. In the Capital Asset Pricing Model (CAPM), the beta ratio represents the systematic risk which retail or wholesale firms are exposed to in the specific market [3]. Systemic risks on a large extent affect the well being and financial performance of a firm; this is because a systemic risk might cause the whole sale or retail firm close and this will completely shut the income generation means for the good performance of the firm. The financial performance is largely dependent on the size of the firm and this means that the beta ratio is varied on both whole sale and retail firms. The size of a firm means that operations are done depending on the financial capacity, the shareholders' equity and capital size of the firm. These elements of internal and external economic aspects in retail and whole sale firms comprise the structure that determines performance [4].

## MATERIALS AND METHODS

At the center of this research is to find out returns on an asset in both the internal and macro-economic levels; any performance measures are therefore used to calculate how the specific aspect under investigation affects the return. The following formula is used to compute the return on asset for both the retail and whole sale firms' scenario [5].

$$r_t = \frac{r_t - r_{t-1} + \beta(r_t - r_{t-1})}{r_{t-1}}$$

### KEY WORDS

Financial performance, return on assets, beta, firm size, exchange rate

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### \*Corresponding Author

Email: mulyayudhia@yahoo.com  
Phone No: +62 89614621458  
Fax no: +62 251356927

Using the prefix  $t$  to represent time, the variable  $r_t$  represents the returns on an asset while  $p_t$  is the market price for an asset. On the other hand,  $p_{t-1}$  is the market price of the asset after a period of  $(t-1)$  while  $Div_t$  is the dividend per one share of the retail or wholesale firm. Time  $t$  was normally applied over a period of one year in the research and the same done repeatedly for the value of the years between 2008 and 2015.

The various financial performance data were calculated from the financial statements of the used firms and in particular the balance sheet and income statements. The financial performance categorized under return on assets and debt ratio, market financial performance and the risk of the selected firms. Under the financial market performance, the price to sales ratio was used as the performance measure, while the risk factors was determined using the beta ratio and the firm's size [6].

Calculating the debt ratio was done on the basis that the ratio is given by the formula [7].

$$\text{Debt ratio} = \text{overall debts} / \text{over all assets}$$

To calculate the price to sales ratio, the price per share was divided with the sales per share [8].

$$\text{Price to sales ratio} = \text{Price per share} / \text{sales per share}$$

From the market value of shareholders' equity, the natural logarithm was applied to arrive at the size of the firm [9]. Lastly, the beta value was obtained by regression of the Jakarta Composite Index (JCI) with the original market price.

The models used in the regression panel were the internal and external environmental aspects including debt ratio, price to sales ratio, size of the firm, and beta. Additionally, the Chow test was used to compare the similarity between the internal environmental aspects of firms' financial performance and the external or macroeconomic aspect of the exchange rate [10]. On the other hand, the Hausman test was applied to determine the consistency of the statistical data in order to arrive at accurate findings.

## RESULTS

The table below represents general results of the debt ratio, return on assets, price to sales ratio, and the firm size for the Indonesian firms between 2008 and 2015.

**Table 1:** Statistics of internal and external environmental aspects

	RETURN	DR	ROA	LNME	PS	BETA	EXCHRATE	INF	INT
Mean	0.039722	0.214028	0.117917	29.96444	0.629861	0.693832	10494.42	0.060000	0.081667
Median	0.030000	0.230000	0.100000	30.20000	0.475000	0.218857	9915.878	0.055000	0.080000
Maximum	0.200000	0.460000	0.500000	37.23000	2.120000	8.031900	13391.97	0.100000	0.100000
Minimum	-0.080000	0.010000	0.030000	20.37000	0.030000	-3.359332	8779.492	0.040000	0.070000
Std. Dev.	0.052647	0.131670	0.085546	5.329530	0.506878	1.822053	1669.002	0.017442	0.009038
Skewness	0.780870	0.033629	2.867108	-0.472324	0.968789	1.788729	0.649868	1.299038	1.050139
Kurtosis	4.380147	1.873041	12.49547	2.100909	3.208651	9.325409	1.950266	3.833333	3.378121

These results indicate a general positive relationship between the internal and external environmental aspects of the financial performance; the return on assets (ROA) is particularly positive all through as compared with some negative elements in the actual return and the beta value [11]. These results specifically confirm at a general point with the hypothesis that the internal aspects such as the beta ratio and micro-economic aspect of exchange rate a direct and positive effect on the overall financial performance of the whole sale and retail firms in Indonesia.

[Table 2] presents the regression panel where the internal and macro-economic aspects have been demonstrated in two models in consideration of the Chow and Hausman Tests [12].

**Table 2:** Statistical relationships between the internal and macro-economic aspects on the financial performance

Specifications Test	Model 1 (Firms Characteristics)	Model 2 (Firms Characteristics and Macro Variables)
Chow Test		
Statistic	2,8702	2,7227
Prob	0,0048	0,0075
Selection	Fixed Effect Model	Fixed Effect Model
Hausman Test		
Statistic	11,8756	6,4048
Prob	0,0365	0,6020
Selection	Fixed Effect Model	Random Effect Model

These results are generalized and need to therefore be broken down to the particular aspects in regard with the two models. The internal environmental aspects are represented by the firms' characteristics while the external environment comprises the macro-economic aspect of exchange rate.

**Table 3:** Specific relationships between the internal and external environmental aspects

Variables	Model 1			Model 2		
	Coefficient	t-Statistic	Prob.	Coefficient	t-Statistic	Prob.
Constant	0.648854	2.675296	0.0098	0.113077	1.254486	0.2143
Actual Returns	-0.182341	-2.669733	0.0100	-0.033970	-0.501845	0.6175
ROA	0.137413	2.415626	0.0191	0.012366	0.163780	0.8704
Price to Sales Ratio	0.087838	6.641842	0.0000	0.049866	2.893864	0.0052
Beta	-0.003739	-2.799987	0.0070	-0.007054	-1.891758	0.0631
Size (LnME)	-0.021327	-2.663567	0.0101	-0.000144	-0.076587	0.9392
Exchange Rate				-1.40E-05	-4.282088	0.0001

## DISCUSSION

This part can be broken down into the two models of internal and external environments. For the first model (internal environment of the firm characteristics), the return on assets has the highest effect on the characteristics of the firms. The highest probability is 0.0191 which is under the ROA. This is followed by the size of the firm (0.0101). Other relationships of the characteristics and the performance of the firm are the beta value (0.0070) and the price to sales ratio. As such, these aspects contribute therefore to the finding that the internal environment or the characteristics of the firm comprising the beta, the return on assets, and the size of the firm have a strong relationship with the overall financial performance of the whole sale or retail firm [13]. In short, the sizes of the firm, the return on assets, beta and price to sale ratios determine to a large extent the internal structure of firms.

The second part has the external environment or the macro-economic aspect; the exchange rate for this model has the highest effect on the original price of assets. This can be interpreted as a proportionality between existing market prices at the stock market and the relationships between one asset and another for example between the Indonesian Rupiah and the United States Dollar. The probability and t-statistics have negatives signs in the macro-economic model which helps to prove the existence of the relationship between the exchange rate and the financial performance of the particular firms [14].

There is however a very minimal relationship between the two environments as compared with between the individual environments and the financial performance [15]. Taking an example of the probabilities for the various aspects, there is a significant difference; the internal environment has very low probabilities with the highest in the ROA (0.0191). On the other hand, the highest probability in the macro-economic environment is exhibited by the size of the firm (0.9392). This difference implies that there is negligible existence of interactions between these two aspects in the context of their broad environments.

## CONCLUSION

The results from this research show a direct and strong relationship between the financial performance of the whole sale and retail firms in Indonesia. Different aspects of internal environments (firms 'characteristics) and the external environment (macro-economic) contribute to the overall financial well being of the firm. Internal aspects include the price to sales ratio, the beta ratio, return on assets, and the size of the firm while the macro-economic aspect is the exchange rates and applies to firms which are listed in the stock exchange. There is however little relation between these two environments in a general perspective. This research therefore concludes by confirming that the aspects discussed form the central point in the well being of Indonesian retail and wholes sale firms.

### CONFLICT OF INTEREST

Authors declare no conflict of interest with in this research.

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## ARTICLE

# THE ROLE OF MEDICAL-LEGAL ETHICS IN MIDWIFERY PRACTICE- A STUDY CONDUCTED IN PEMATANGSIANTAR CITY OF NORTH SUMATRA- INDONESIA

Tengku Sri Wahyuni<sup>1\*</sup>, Juliani Purba<sup>2</sup>, Ardiana Batubara<sup>3</sup>

<sup>1</sup>Head of Midwifery Study Program, Pematangsiantar Poltekkes Kemenkes Medan, INDONESIA

<sup>2</sup>Senior Lecturer at Midwifery Study Program, Pematangsiantar Poltekkes Kemenkes Medan, INDONESIA

<sup>3</sup>Lecturer at department of Midwifery Study Program, Pematangsiantar Poltekkes Kemenkes Medan, INDONESIA

## ABSTRACT

The core of operation of any profession is its ability to have standards and regulations that govern its practice. Ethics is one way in which professionalism can be exercised in a profession especially a medical profession in which errors can lead to disastrous. This study was conducted among the midwives in Indonesia to identify the role of medical legal and ethics in practice of midwifery. Also the level of understanding of legal and malpractice issues was ascertained using questionnaires. Results showed that the level of knowledge of midwives concerning medical legal issues and ethics was poor especially in the rural setting. Therefore, action needs to be taken to increase awareness on malpractice and importance of having medical legal understanding of the practice. Midwives are the main providers of health services to the community in a health facility and thus form a bigger portion of the health workforce. Since the midwives are the cornerstone in the provision of services, they have to operate in a professional way and comply with the rules and regulation given by the medical practice. The midwives and the nurses provide unique services to patients and thus require knowledge and skills to identify complications early and act accordingly. However, their decision making in clinical practice has to abide by the rights and code of conduct aimed at proper ethics in the hospital.

## INTRODUCTION

Ethics is defined as the study of philosophy that deals with human behavior and their ability to distinguish right from wrong, good from bad as the individuals relate with one another. Midwives are required to protect, promote, and optimize health service through prevention of injury to the patient [1]. Also, they alleviate suffering by identifying and treating disease and promoting care in the community. Therefore, nurses and midwives should not only understand the ethics but also display them in their practice [2].

Midwives provide most of the emergency services required in a hospital and thus have a difficult task to engage in and with the shortage of midwives and adverse working conditions; there has been an increase in lawsuits as delivery of services has been compromised. Increased workload and shortage of workers are the main factors for the increase in unethical practices as the midwives have a low morale and provide substandard service to patients. The quality of care and services provided by the midwives is highly dependent on the sound decisions made by the midwives in a daily routine [3].

Therefore, this study was conducted to determine the role of ethics in preventing malpractice and promoting better service provision to patients. Also, the study was conducted to identify the best practices and ethics in the profession. Moreover, the study identified ongoing strategies to reduce the level of malpractice in midwives. The midwives play an integral part of health care in Indonesia as studies show that most patients seek medical care from midwives compared to other practitioners in the country [4].

## MATERIALS AND METHODS

The study conducted was conducted using questionnaires structured to assess the degree of awareness among the midwives of Indonesia. A study sample was selected at random from the hospitals in Pematangsiantar city of North Sumatera, Indonesia. Those with special skill in the field such as medical personnel and trained nurses were excluded from the study. The midwives were guided in detail the ethical principles and view of the study and their informed consent obtained.

To determine the level and role of legal awareness as understood by the midwives, a cross-sectional study was carried out. Also, the midwives were asked whether they had any training in the legal aspects and ethical issues involved in the midwifery practice considering the high levels of malpractice and lawsuits. The midwives were also assessed to identify if they had any information about legal complaints leveled against the midwives and any action taken against them. After the interaction, a discussion was conducted to ascertain if knowledge on medico-legal ethics was paramount to the practice of midwifery and the role of medical-legal ethics in midwifery [5].

### KEY WORDS

Ethics, medico-legal, lawsuit informed consent, obstetric care, postpartum

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### \*Corresponding Author

Email: wahyuniakhyar@gmail.com  
Tel.: +62-081376480111  
Fax: +62-49-883 44567 774

RESULTS

The results obtained were analyzed, and statistics obtained showed that the level of awareness and knowledge of various medical-legal ethics was poor. Analysis of the results based on the time in the midwifery and level knowledge in legal practices showed that midwives with more than ten years in the field understood the role of medical-legal ethics in practice. When age was used as a factor, the level of knowledge increased with an increase in age of the midwives. When the midwives were asked whether they had any training on legal issues and midwifery practice, the majority of the response was that they had no legal training in midwife practice. From the study, the major factors contributing to the low levels of legal ethics were ignorance, lack of time and lack of technological skills

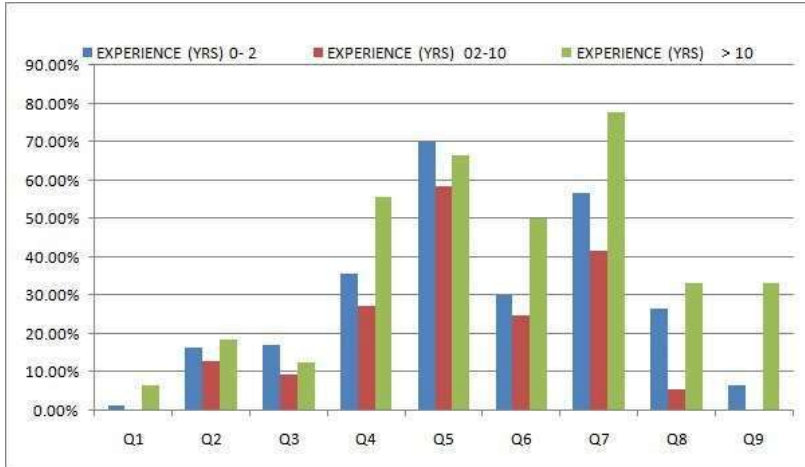


Fig. 1: Level of experience of midwives and awareness of medical legal issues and ethics.

Q1 to Q9 represent the different hospitals that we conducted our research and their corresponding responses, with those in the rural setting having a higher percentage.

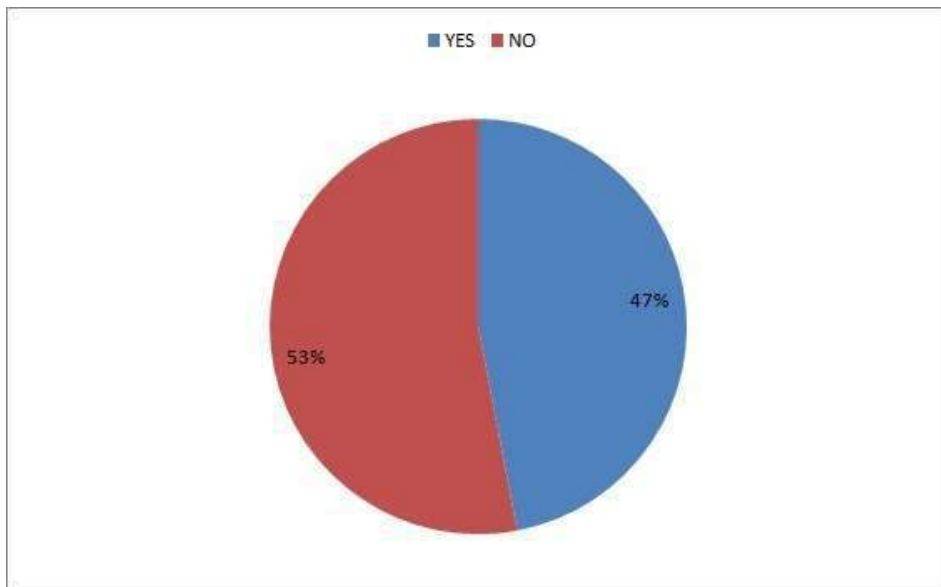


Fig. 2 : Level of awareness of about complaints in hospitals made against midwives.

DISCUSSION

Midwives are the largest group of health care providers forming the health care contributing to more than 50% of the deliveries done in Indonesia [6]. They play an important role, and due to ignorance of the patients they are in large part safe from law suits, but this would not be available for a long duration of time as the patients are getting informed [7]. Our study revealed that most of the midwives had information mainly obtained from training in ethics and legal affairs. The results showed that most of the

medical-legal issues arose due to negligence and lack of skills and knowledge in the practice of midwifery [8].

All midwives should be well aware of the laws and ethics involved in the practice of midwifery. For instance, midwives are required to obtain informed consent from the patients before any procedures are done to the patient in writing and signature, failure to which they would be accountable in case of any damages or injury to the patient [9]. Also, it is a responsibility of midwife to ensure that documentation of the details of the patient is done correctly including vitals, bio data, and medication to avoid random errors and avoidable mistakes [10].

It is the duty of a midwife to ensure that all patients have a right to privacy of all medical records and personal information [11]. The legal responsibility of midwives is to provide help in conducting normal deliveries and provision of advice to pregnant women and women in the post-partum period. Midwives are therefore not allowed to conduct caesarean sections and complicated deliveries [12].

## CONCLUSION

Analysis of the results led to the realization that a lot of issues have to be addressed regarding medico-legal and ethical issues involved in midwifery practice. The increasing role of a midwife means that the midwife should be provided with the necessary skills and training to ensure that the level of malpractice due to negligence is reduced [13]. Having identified the level of legal knowledge of the midwives, it is prudent to say that legal knowledge is beneficial in midwifery practice [14]. The study has corroborated with the fact that midwives need to be equipped with necessary legal and ethical knowledge to guide their practice as lawsuits are rising steadily [15].

### CONFLICT OF INTEREST

All the authors declare no conflict of interest.

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### FINANCIAL DISCLOSURE

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ARTICLE

# MEASURING THE AMOUNT OF TRANS TRANS-MUCONIC ACID (TTMA) IN CORRELATION WITH THE CD4+ AND CD8+ LYMPHOCYTES AND THEIR RATIOS CAUSED BY BENZENE EXPOSURE, AND ASSOCIATED OCCUPATIONAL HEALTH HAZARDS

Sukaisi<sup>1\*</sup>, Urip Harahap<sup>2</sup>, Erman Munir<sup>3</sup>

<sup>1</sup>Staf Program Studi Kebidanan Pematangsiantar, Poltekkes Kementerian Kesehatan Medan, INDONESIA

<sup>2</sup>Departemen Farmakologi Fakultas, Parmasi Universitas Sumatera Utara Medan, INDONESIA

<sup>3</sup>Departemen Biologi Fakultas Matematika & Ilmu Pengetahuan, Alam Universitas Sumatera Utara Medan, INDONESIA

## ABSTRACT

Workers working in a benzene filling station face a risk of benzene exposure. Benzene is a chemical which its exposure has been proven to have adverse effects to the bone marrow which is an organ responsible for the production of blood components. Testing for the exposure workers in this case study was done through the measurement of the amount of trans-trans-muconic acid in correlation with the CD4+ and the CD8+ lymphocyte cells in the body. Six stations around the Medan City were chosen for analysis. Urine samples were collected for testing after the work shifts of the workers and analyzed at the Medan Sumatra Hospital. The collected data was analyzed using SPSS. A total of 43 participants were included in the study, they constituted both males and females of whom 79% were below the age of 20 and 30. The level of ttMA, lymphocytes, CD4+ cells and CD8+ cells were 21,37,2 and 23 respectively. The correlation of the ttMA and the lymphocytes, CD4+ cells and the CD8+ cells showed that there was a high probability that Benzene was the major cause of all the irregularities of the ratios of these components of blood. Therefore, the study concludes that the exposure of workers at the benzene filling stations to benzene may be the leading cause of the health risks hazards that they may face during the course of duty.

## INTRODUCTION

Working in Benzene filling station comes with a fair share of its health risks. Benzene has been long recognized a carcinogen and its exposure to individuals even at low concentrations may lead to leukemia (Duarte-Davidson *et al* 2001). The WHO and the ILO are working in collaboration to identify and eliminate the workplace hazards that may affect the health of the workers which includes benzene ("WHO | Occupational health", 2017;"International Labour Standards on Occupational Safety and Health", 2017). Exposure of workers to Benzene may lead to adverse long term health effects especially on the blood and organs that manufacture blood. When these organs are affected, there may be a decrease in the formation of red blood cells that may lead to anemia or even cause leukemia. However, it is important to note that, these health effects greatly depend on the amount and period of exposure to Benzene ("CDC | Facts About Benzene", 2017). There are three small cohort studies that give a close relationship between benzene and Leukemia and the dose-response relationship (Wong, 1987; Bond, 1986; Rinsky, 1987). These studies have shown that workers that are exposed to high levels of benzene have an equally high chance of getting leukemia. This gives proof of a relationship between benzene exposure and leukemia. In the body, benzene undergoes a chain of complex biotransformation that lead to the formation of toxic and carcinogenic end products(Snyder & Hedli ,1996). The common biomarker that is normally used for ascertaining the presence of benzene in the body is the trans, trans-muconic acid (ttMA). The analysis of ttMA is done using urine samples from individuals (Zhang *et al*, 2011; Wiwanikit *et al* 2001). Testing of lymphocytes for the presence of Benzene is carried out through the examination of the CD4+ and the CD8+ T cells. Normally, after an exposure of an individual to high levels of Benzene, a decrease in count of the CD4+ and the CD8+ T cells is expected since Benzene affect the production of blood components(Lan *et al*, 2004; Li & Yin, 2006).

This research paper seeks to find the occupational hazards that the workers in a Benzene filling station by measuring the amount of ttMA in their urine as well as the amount of the CD4+ and the CD8+ T cells in the blood and find their ratios.

## MATERIALS AND METHODS

Urine samples of the employees were taken at the end of shift and taken to the laboratory for analysis of the benzene metabolite; ttMA. Inspection of lymphocytes on the other hand, involved taking of the blood samples of the participants and examination of them at the Medan Sumatra University Hospital. The examination of CD4 + and CD8 + T cells was done on the blood samples obtained at the Prodia Jakarta laboratory.

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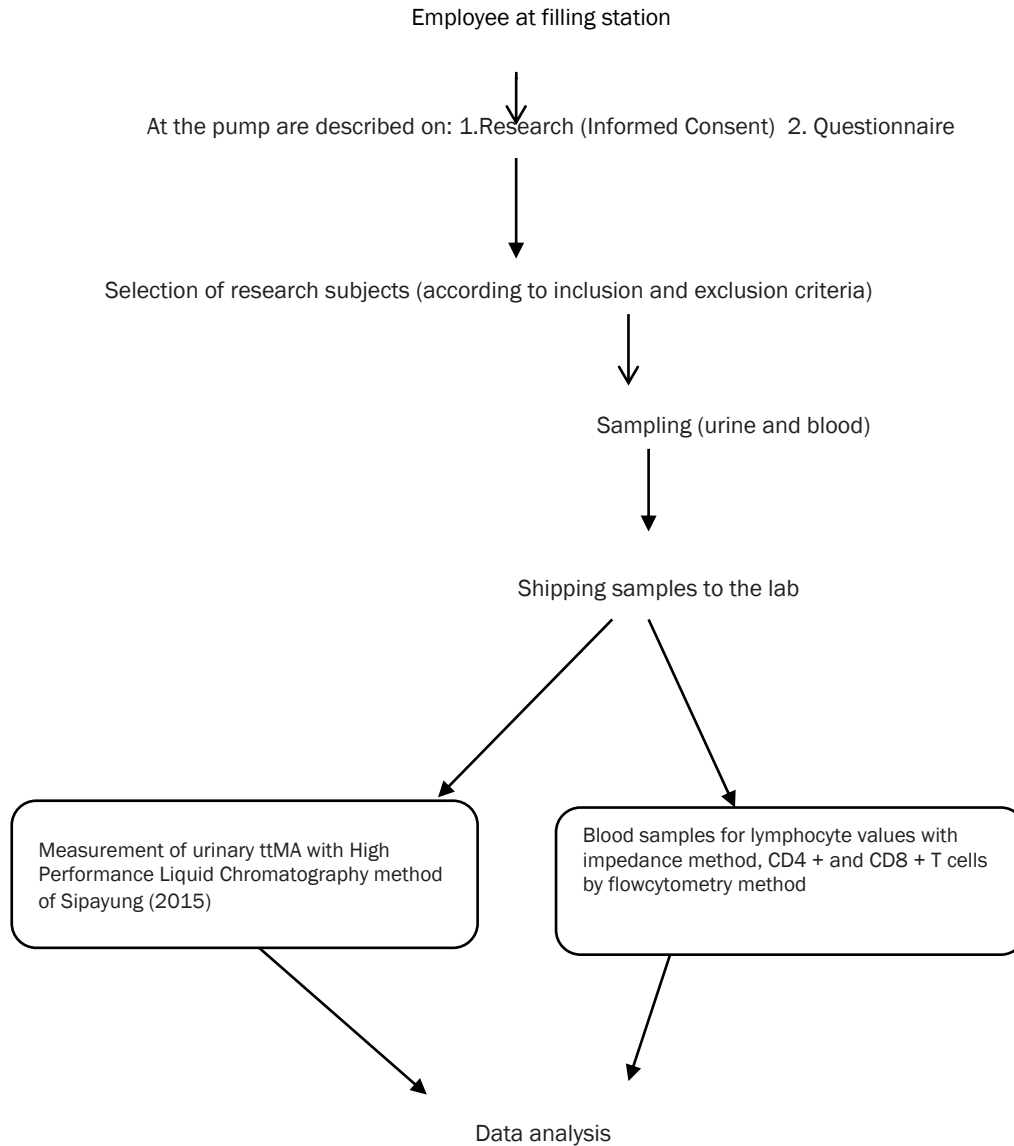
### KEY WORDS

Benzene, occupational hazards, exposure, health risk

### \*Corresponding Author

Email: sukaisi2017@gmail.com  
Tel: + 62 87869098400  
Fax: +62 62222968

**Research Schematic framework of the implementation of the research**



**RESULTS**

Six stations in Medan city were selected for the study. Questionnaires were given to those who met the inclusion criteria and their results obtained.

**Data research**

The data analysis of the study included both univariate and bivariate analysis.

**Univariate analysis**

Univariate analysis involved giving an overview of the character of the participants, value ttMA, lymphocytes, CD4 + T cells, CD8 + T cells, the ratio of CD4 / CD8 T cells obtained.

**Character Research Subjects**

Characters include the age, sex, duration of work, smoking status, and job roles. Data that was obtained is shown below [Table 1];

**Table 1:** Characteristics of subjects

Attribute	CHARACTER	RESULT	
		N	%
Age	< 20 YEAR	5	11,6
	20 – 30 YEAR	34	79
	≥ 30 YEAR	4	9,4
Gender	Man	25	58,2
	Women	18	41,8
Employment duration	≤ 1 year	13	30
	> 1 year	30	70
Smoking status	Smoker	11	25,5
	Non smoker	32	74,5
Job role	Administration	8	18,6
	Petrol filling operator	35	81,4

**Table 2:** statistical picture laboratory measurements, which includes the value ttMA,

Measurement	Mean	Median	SD	Lowest average	Highest average
ttMA (µg/gCr)	587	75	1326,5	32	6825
Lymphocyte (10 <sup>3</sup> /mm <sup>3</sup> )	3,1	3,1	0,6	2,1	4,4
CD4 <sup>+</sup> (cell/uL)	899	894	245	454	1654
CD8 <sup>+</sup> (cell/uL)	917	838	309	401	1748
CD4/CD8 Ratio	1,1	0,93	0,4	0,57	1,94

lymphocytes, CD4 + T cells, CD8 + T cells, CD4 / CD8 ratio of T cells at the gas station employee. Source: ttMA reference value of Sipayung (2016); Lymphocytes, CD4 +, CD8 +, and the ratio of CD4 / CD8 of laboratory measurements in 2015, n = 43 subjects.

**Table 3:** Picture of normality laboratory measurements on the employees of gas stations in medan city

MEASUREMENT	Normal Value		Above normal		Below normal	
	n	%	N	%	n	%
ttMA (µg/gCr)	34	79	9	21	-	-
Lymphocyte (10 <sup>3</sup> /mm <sup>3</sup> )	27	63	16	37	-	-
CD4 <sup>+</sup> (cell/uL)	42	98	1	2	-	-
CD8 <sup>+</sup> (cell/uL)	33	77	10	23	-	-
Ratio CD4/CD8	40	93	-	-	3	7

Source: Value ttMA referral of Sipayung (2016)

**Bivariate analysis**

This type of analysis is used to show the correlation between different sets of data. The Table-4 shows the correlation of benzene exposure through the measurement of the value ttMA lymphocytes, CD4 + and CD8 + T cells, and the ratio of CD4 / CD8 T cells at the gas station.

Table 4: correlation of benzene exposure

Correlation with ttMA	N	R	p-value
Lymphocytes	43	0,133	0,219
CD4*	43	0,183	0,086
CD8*	43	0,223	0,036
Ratio CD4/CD8	43	-0,138	0,198

## CONCLUSION

Based on the above findings, it can be concluded that exposure to benzene is associated with varying levels of lymphocytes, CD4 and CD8 cells together with alteration in their ratio. Most of these parameters are above normal in the blood samples obtained from the participants and thus points towards the deregulation in the hematopoietic system and thus we can make a conclusion that indeed high levels of benzene in the body are associated with harmful health risk such as lymphocytic leukemia, myeloid leukemia among others.

## RECOMMENDATIONS

Employees working in benzene producing industries or gas filling stations should be routinely rotated to different department and regularly monitored to prevent the buildup of benzene to more harmful levels. Companies also ought to put in measure that will prevent emission of benzene into the environment. Governments have a role to play by coming up with legislations that will curb these emissions.

### CONFLICT OF INTEREST

All authors declare no conflict of interest in the current research.

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## ARTICLE

# AN ANALYSIS OF EMOTIONAL INTELLIGENCE IN THE USE OF INFORMATION COMMUNICATION TECHNOLOGY IN EDUCATION

Iskandar

*Faculty of Educational Sciences and Teachers, Universities Islam Negeri STS, Jambi, INDONESIA*

### ABSTRACT

The study was conducted to analyze emotional intelligence in the use of information communication and technology in education. Various scholarly research studies related to the topic were reviewed. The data obtained from the research studies indicate that in deed the application of the information and communication technologies in the education sector has a profound impact on emotional intelligence. The paper concludes that educators need to embrace these new technologies and explore for ways through which the technologies can propel learning towards communicative competence that is cognizant of people's emotions while emphasizing on flexibility and transformation.

### INTRODUCTION

The twenty first century is often referred to as the information age due to the advances of information and communication technology. The education sector has benefited from these advances by making education accessible regardless of geographic and time differences [1]. This study aimed at investigating the impact of information communication technology in the education sector on emotional intelligence. Nelson Mandela once said that education is the most influential weapon one can use to change the world [2]. As such, many students, parents and key stakeholders in the education sector have put in measures aimed at enhancing access to quality and affordable education. With the advent of the information and communication technology, the education sector has undergone transformation. Students increasingly use technologies such as calculators, notebooks and computers, mobile phones as well as the internet to advance their knowledge.

#### Emotional intelligence

Emotional intelligence denotes one's ability, skill or capacity to perceive, evaluate, and deal with the feelings of self and of others [3]. Emotional intelligence encompasses four main domains namely: social awareness, relationship management, self-management and self-awareness [4]. Social awareness entails being empathetic to other's concerns and emotions as well as reading undercurrents of political realities and emotions of a group. Self awareness entails identifying one's feelings and how they affect their performance as well as recognizing one's weaknesses and strengths yet remaining self-confident. Self-management entails exercising control over one's stress and anger; being trustworthy, conscientious and able to adapt to situations as they arise. The relationship management domain entails developing others' abilities, communicate openly and effectively, ability to work as a team and build bonds while solving conflicts that may arise. Emotional intelligence contributes a great deal to one's success at school, work and home. A high emotional intelligence enables individuals to know and deal with emotions, to solve private and interpersonal problems as well as cope with pressure, challenges and difficulties of daily living. [5] highlighted the importance of learning and making feelings work to improve self and others.

#### Information and communication technologies (ICT)

According to [6], the phrase information and communication technology denotes the entirety of electronic gadgets, software and hardware that are use to gather, store and process as well as disseminate information to an audience. As such, ICT comprises of mobile phones, computers, internet service provisions inter alia. The history of ICT dates back to 1956 following the installation of the first digital computer in Kolkata [7]. Since then, ICT has been incorporated in various sectors from the health, industries, and government offices [8]. His has made life easier as people can get access to government agencies from the comfort of their houses by clicking a computer button. [9] posit that ICT promotes societal change by encouraging the formation of social movements such as the Arab Spring.

ICT has increasingly been integrated into learning environments through the introduction of computers, online libraries and use of projectors in classrooms. Students can also study from the comfort of their homes or offices due to the introduction of online courses and teleconferencing. As [10] posit, ICT has much to offer for the education sector in future. With increased internet access, students have acquired more ways of searching, gathering and sharing information. Bax further argues that information and communication technologies have impacted on the learning environment, types of learning materials, classroom practices as well as the role of teachers.

The application of ICT has been increasingly advocated for by international organizations such as the United Nations which organized a World Summit on the Information Society to talk about the challenges

**KEY WORDS**  
Information technology,  
communication, learning,  
intelligence, educator

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\*Corresponding Author  
Iskandar2017@gmail.com  
Phone : + 62-82122722131  
Fax: + 62 741 584118

and opportunities facing the modern-day's information society. The Millennium Development Goals (MDGs) that transpired in 2015 and the Education For All (EFA) also called for implementation of ICT across the globe. Consequently, governments are increasingly funding the installation of computers in classrooms. [11] noted that service delivery in the education sector has become more about learning (through individualized abilities in research and self-tutoring) and less about teaching; less dependent upon classrooms or nation; and more flexible to learner's choice of time and curricula.

### Theories of ICT adoption

[11] Posit that there are various theories that expound on ICT adoption. Technology acceptance model expounds on how technology users come to adopt or accept and use a given technological infrastructure [12]. Individuals are often influenced by a number of factors such as its professed efficacy and ease of application. The diffusion of innovation theory posits the process through which a given innovation is communicated over time using certain channels amongst a social system's members. The theory posits that interpersonal contacts and media provide information about the information that influences a person's judgment and opinion [13]. The domestication process theory postulates the process in which a technological innovation becomes an essential part of people's daily habits [14].

## METHODS

Noteworthy research resources related to the research topic (emotional intelligence in the use of ICT in education) were retrieved from search engines such as Google Scholar and later reviewed for the analysis. A total of fifteen resource materials running from 2000 to the present day were reviewed in the course of carrying out the research.

To ensure that significant resources were not left out during the study, the search terms used included: effects of the ICT in emotional intelligence, influence of ICT in education. As such, materials and studies eligible for review in the paper focused on the search terms (which served as the variable of the review) that were used. The section following describes the exclusion and inclusion used to settle on the appropriate and non-eligible sources.

**Inclusion criteria.** All the documents relevant to the emotional intelligence in the use of ICT in education were included. In addition, sources highlighting on the theories of ICT application were also included in the study.

**Exclusion criteria.** All sources that were not conducted in English were excluded. Web sources and those that lacked credible sources were also excluded from the study.

Once the relevant sources were identified and retrieved, they were then assorted based on the search criteria. Sources that did not clearly discuss the impacts of ICT adoption in schools on emotional intelligence but highlighted either ICT adoption or emotional intelligence were considered for the study.

## RESULTS AND DISCUSSION

The review of assorted sources established that the use of information and communication technologies in schools impacts on emotional intelligence. The study also established that the adoption of ICT in the education sector was no longer a first world countries affair but a global phenomenon that aided in making education equitably accessed.

The study noted that one way of analyzing emotional intelligence in the application of ICT in education is looking at communication. Effective communication is closely linked to possessing emotional control. [15] argue that understanding and controlling one's emotions when communicating with others while understanding those of the recipients is crucial in delivering the intended message successfully. For [16], communication is crucial in our lives as it ensures individual survival and stability. The world has increasingly adopted communication technologies over the years. Electronic communication tools provide new opportunities for communication that are faster in terms of sending the message and feedback devoid of spatial and time limitations.

In the education sector, technologies have allowed learners to interact with other learners and teachers across location and time differences. These technologies have also provided opportunities for self instruction through various ways. First of all, it draws the interest of learners; encourages new and wider scopes of learning through internet based research. As such, the adoption of new technologies in schools serves three main functions namely: informative, motivating and informative roles. The adoption of new technologies in schools has crucial effects on their communication skills and emotional control. Education providers are increasingly focusing more on imparting computer skills on their students at the expense of other skills such as interpersonal skills. [17] Noted that there is a significant relationship between learners' attitudes towards information communication technologies in learning English as a language and their emotional intelligence. He further argues technology and emotional intelligence plays significant roles in learning foreign languages. Findings of his research showed that learners who were likely to embrace information and communication technologies when learning English as a foreign language were also likely to distinguish both their emotions and those of others. This was due to the fact that learning a foreign

language often encompasses intrapersonal and interpersonal interaction and communication, which are key components of emotional intelligence. Similarly, information communication technologies have become viable means of communication thus harnessing a positive relationship between individual emotional intelligence and their attitude towards the technologies.

Emotional intelligence is closely related to social adaptability meaning that these technologies play a crucial role in improving communicative competence. Learning of languages obliges one to know his/her personal emotions, manage them appropriately while at the same time recognizing the emotions of others. They further argue that technological devices, online education and ICT are often regarded too mechanical. As such, people regard them to be full or reason but devoid of emotions. People's interactions with these technologies are therefore regarded as insensitive, unemotional and impersonal. This brings us to question how people can communicate their emotions and feelings using these technologies. With increased online courses, human interaction occurs in a text-based platform provided by these technologies. The virtual expression of emotions is becoming possible by taking new shape and form.

The use of information and communication technologies also promotes emotional intelligence by allowing new forms of interactions that lead to new emotional experiences. For instance, interactive video classes allow teachers and students to hear and listen to each other across long distances and in real time unlike classroom teaching. They also argue that an individual's social presence in cyberspace is crucial to understanding individual emotions and other online relationships. The cross-cultural interaction accorded by these technologies in the education sector allows learners to share amongst themselves their individual ideas and feelings on any subject. Learners are increasingly able to look at issues with an open mind that respects other cultures. For instance, an online school exchange program allows students to respect other cultures while remaining cognizant of their cultural differences and evaluating their messages and ideas before posting them.

Application of ICT has also had adverse effects on individual emotional intelligence. New technologies such as internet and smart phones pose several risks to individuals. For instance, it may result in the loss of normal relations, violence, breakdown of group identity and suicide [17]. For instance, teenagers have increasingly been driven to depression and committing suicide due to cyber bullying. An unsuspecting learner who innocently logs in to several media sites and search engines such as Google may suffer from cyber bullying

## RECOMMENDATION

As the world continues to welcome new innovations in the ICT industry and use them in almost all sectors day by day, it is pertinent that more research studies are carried out to analyze the impact of such advancing technologies. For instance, a research study could be conducted to assess the emotional intelligence in the use of ICT amongst relevant stakeholders such as school administrators. It is also vital that similar studies are conducted to analyze their impact on the emotional intelligence of its users across gender, age and racial groups.

While it is important to encourage the development and application of latest technologies in the education sector, key stakeholders ought to put in measures that will protect learners from its adverse effects. There is great need to impart in children and learners for this matter critical emotional literacy. Learners ought to develop knowledge and skills for analyzing how the internet and other information and communication technologies teach individuals to perceive the world in partisan lenses. Educators need to embrace these new technologies and explore for ways through which the technologies can propel learning towards communicative competence that is cognizant of people's emotions while emphasizing on flexibility and transformation.

## CONCLUSION

As the world continues to welcome new innovations in the ICT industry and use them in almost all sectors day by day, it is pertinent that more research studies are carried out to analyze the impact of such advancing technologies. For instance, a research study could be conducted to assess the emotional intelligence in the use of ICT amongst relevant stakeholders such as school administrators. The advent of information and communication technologies has transformed the global society in various ways. The world has become a global village so much that despite geographical location and time differences, people are increasingly staying connected. Social media sites such as Whatsapp, Facebook and Twitter are used as entertainment and informative platforms. The application of ICT in the education sector has transformed service delivery by creating new learning environments. In addition, it continues to contribute to universal access to education, education equity, more efficient management of education, and improved professional development of teachers as well as the delivery of quality teaching and learning.

From the above discussion, it is evident that information and communication technologies will continue to dominate all aspects of human life. While it is important to encourage the development and application of latest technologies in the education sector, key stakeholders ought to put in measures that will protect



learners from its adverse effects. There is great need to impart in children and learners for this matter critical emotional literacy. Learners ought to develop knowledge and skills for analyzing how the internet and other information and communication technologies teach individuals to perceive the world in partisan lenses. Educators need to embrace these new technologies and explore for ways through which the technologies can propel learning towards communicative competence that is cognizant of people's emotions while emphasizing on flexibility and transformation.

### CONFLICT OF INTEREST

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## ARTICLE

# INVESTIGATION OF THE SHEAR WAVE VELOCITY AND DAMPING MEASUREMENTS, TO BE CONDUCTED (*IN SITU*) ON SOFT CLAY, TO TEST ITS SHEAR STRENGTH

Bukhari R<sup>1\*</sup>, Khairul Anuar M. N<sup>2</sup>, Anuar K<sup>3</sup>, Roszilah H<sup>4</sup>, Kowstuba R<sup>5</sup>, Colin Peter A<sup>6</sup>,  
Mohamad Noh O<sup>7</sup>

<sup>1,2,3,4,5</sup> Civil and Structural Engineering Department, Universiti Kebangsaan Malaysia, Bangi, MALAYSIA

<sup>6</sup> Former Senior Research Officer, Building Research Establishment, Watford, UNITED KINGDOM

<sup>7</sup> Director, Road Engineering & Geotechnical Works Division, Public Works Department, MALAYSIA

## ABSTRACT

This is an efficient conventional Engineering seismic test that is carried out on soft soil samples. It is widely preferred due to reduction in disturbances on samples; non-destructive method, physical mitigation of the problem of stress relief, accurate- inherent errors are minimal, compared to results from other tests. The known values to the equation are the shear wave velocity and the strain. These values are calculated after conducting the Plate Load Test; damping is done at a strain level which is determined during the test. The proposed equation will produce a stress-strain (shear) relationship which will enable the plotting to failure point; the failure strain level of 4% indicating the maximum possible shear strength. The Plate Load Test strain data is the basis for the equation. This equation over-estimates the shear strength values, by a margin of about 32 and 1.3 % at depths of 2.0 and 5.0 m respectively. However, its results are more accurate than those of the Geonor Vane test; measurements of un-drained shear strength and sensitivity of soft clays, *in situ*.

## INTRODUCTION

**KEY WORDS**  
Shear strength, shear velocity, Plate Load Test, Damping

Shear strength of clay can be scientifically defined as the maximum resistance of a soil, just near shear failure- due to structural loads subjected to the soil [1]. Clays can be subjected to either field, *in situ*, tests or laboratory tests [2]. Common laboratory tests are:

The Unconsolidated Undrained Triaxial Test (UU Triaxial Test),

- The Isotropically-Consolidated Undrained Triaxial Test (CIU Triaxial Test),
- The Unconfined Compression Test (UCS Test),
- The Shear Box Test.

Common *In situ* tests include:

- Vane Shear Test,
- Piezometer Cone Penetration Test (CPTU),
- Geonor Vane Test,
- Acker Vane Test.

All these methods have their limitations.

In the research, the UU Triaxial Test, CIU Triaxial Test, Piezometer Cone Penetration Test, Geonor Vane Test and Acker Vane Test were considered.

The **Unconsolidated Undrained Triaxial Test (UU Triaxial Test)** measures the shear strength of a soil by not consolidating the specimen [3], thus drainage is not permitted either during application of cell pressure or at the point of shearing [4].

The **Isotropically-Consolidated Undrained Triaxial Test (CIU Triaxial Test)** involves three stages [5]. These are:

- saturation stage- application of a back-pressure (undrained condition),
- consolidation stage- the specimen is brought to the state of effective stress (isotropic),
- Shearing stage- during compression/consolidation, the cell pressure is kept at a constant as the soil sample is sheared at a constant rate of strain.

The **Piezometer Cone Penetration Test (CPTU)** involves the direct penetration of a 60 degrees cone of about 35.8 mm diameter. The equipment is pushed by a hydraulic force. The resistance and pore pressure of a soil are measured [6]. According to Huang [7], advantages of this test are that:

- the soil is displaced without creating any soil cuttings,
- the tools are small, thus minimal intrusion,

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**\*Corresponding Author**  
Email:  
bramli99soa@gmail.com  
Tel.: + 60-1123118199  
Fax: + 60 389118344

- no fluids are required for penetration,
- the equipment measures the equilibrium pore pressure at full PPD,
- The test allows for empirical and theoretical correlation of piezocone measurements to some soil parameters.

The Geonor Vane Test is the most widely used method for measuring the shearing resistance and sensitivity of soft to medium stiff clays in the field. It is conducted at undrained conditions. The test employs the use of various vane sizes. The Geonor H-70 can bore to a depth of 10 metres by hammering, pressing or drilling.

The Acker Vane Test is performed on undisturbed soft soils; thus, no much resistance is required [8]. The vane equipment is usually designed for hand operations. The whole assembly consists of samplers, tubes and earth augers. Fast and accurate readings can be obtained for depths of up to 30.5 metres.

An alternative method was considered in this research; shear wave velocity and damping measurements. The experiment involved comparison of results with the laboratory methods conducted on a soft clay- origin: Klang, Malaysia.

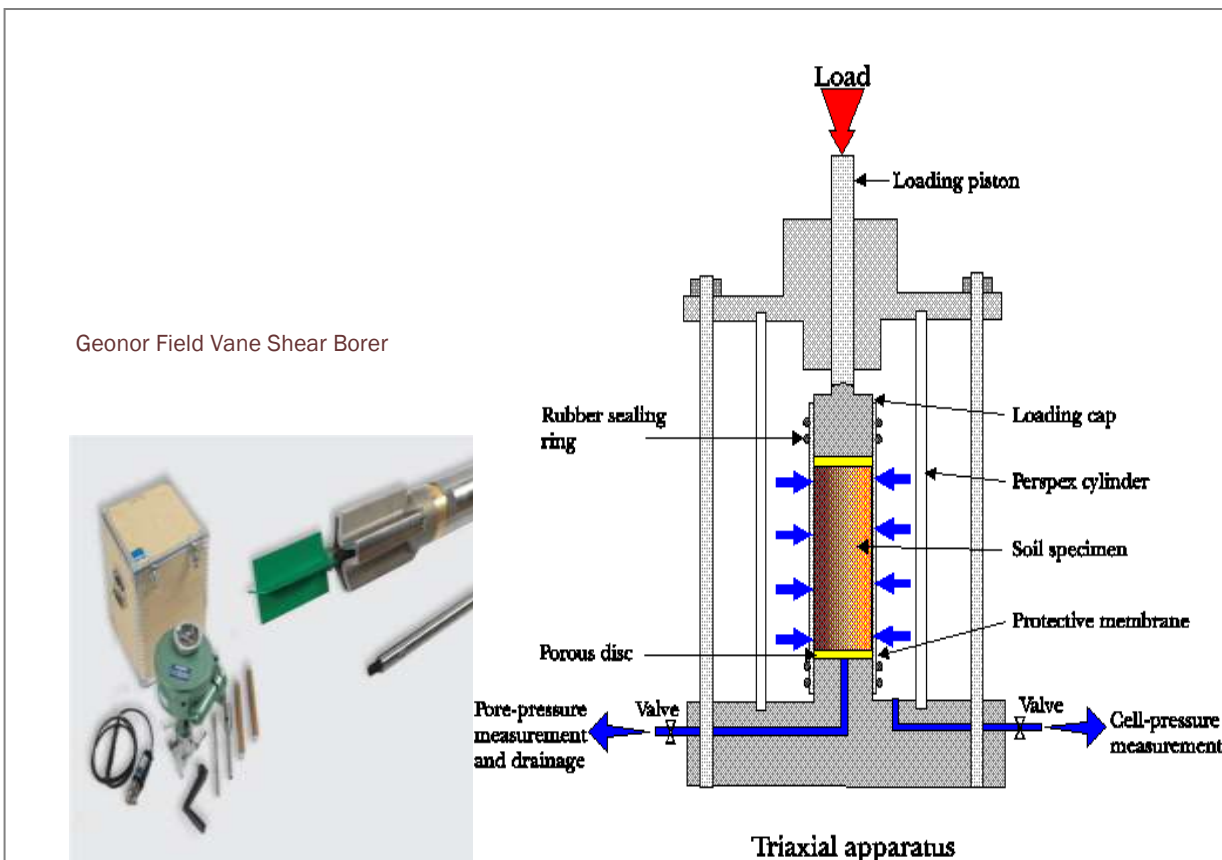


Fig. 1: Geonor Vane Test and Triaxial Tests Apparatus (Courtesy: Google)

**Symbols**

- D Damping
- D<sub>max</sub> Maximum damping, whose value is 33%
- G<sub>0</sub> Shear modulus
- E Energy
- Δ Change in
- E Euler constant
- γ Shear strain
- τ Shear stress
- Δσ<sub>v</sub> Deviator stress
- γ<sub>r</sub> Characteristic shear strain

- $\epsilon$  Strain
- $\tau_f$  Shear strength
- $\nu$  Poisson's ratio

1. The viscoelastic soil model

In this study, the property of viscoelasticity is considered. This is the property of a material exhibiting both elastic and viscous characteristics, during deformation- e.g. at settlement. Viscoelasticity calculations greatly depend on the following variables:

- viscosity/fluidity,
- Temperature.

The value of viscosity or fluidity is a function of the temperature or as a certain value- dashpot [9].

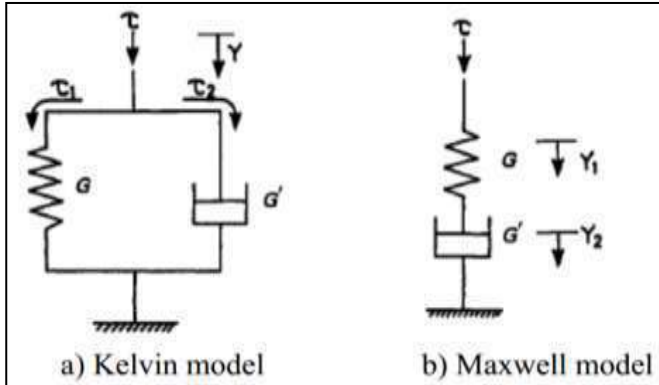


Fig. 1: A typical viscoelastic soil model [9].

Soils exhibit nonlinear stress-strain behavior; which can be represented by models which obey the real stress-strain path during cyclic loading. The shear strength of a soil sample can be accurately represented, and with a pore pressure model, changes in stress (effective) during cyclic loading for un-drained conditions [10]. The following hyperbolic backbone function, Eq. (1), illustrates the performance of nonlinear cyclic models. Three functions are of great importance:

- shear modulus,
- characteristic shear strain,
- Shear stress.

$$\tau = G_0 \gamma / [1 + (\gamma / \gamma_r)] \tag{1}$$

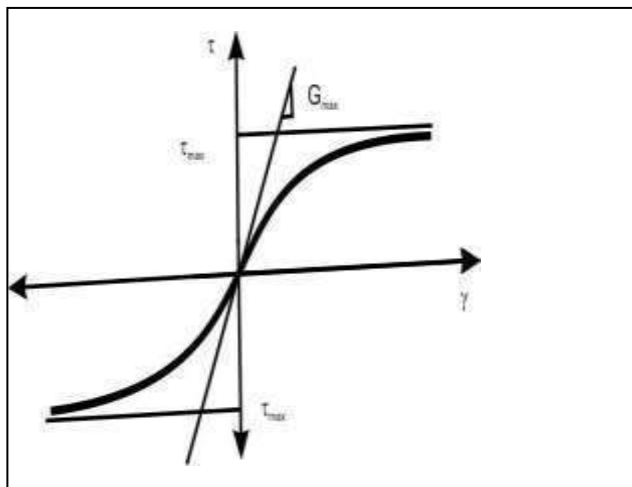


Fig. 2: The hyperbolic backbone curve [5].

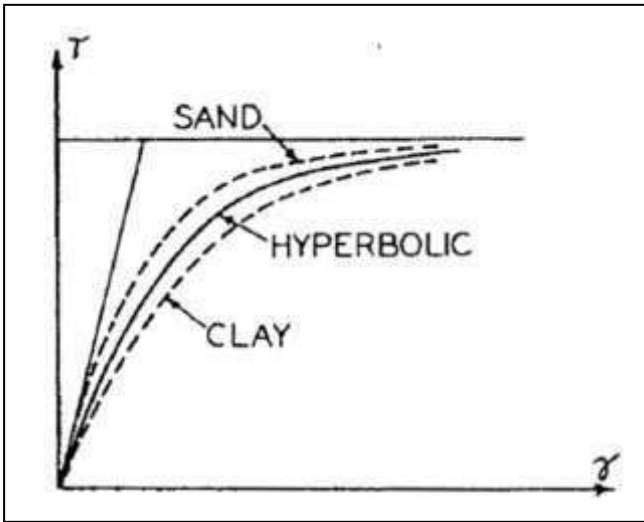


Fig. 3: Hyperbolic stress-strain relation [11].

At maximum shear strain,

$$\tau_{\max} = G_0 \gamma_r \quad (2)$$

A plot of shear stress ( $\tau$ ) versus shear strain ( $\gamma$ ), can be used to determine the unknown parameter ( $\gamma_r$ ) from the relationship of damping and strain [12],

$$D = D_{\max} / (1 + \ln[1 + (e - 1)(\gamma_r / 2\gamma)]) \quad (3)$$

The equivalent shear strain is found from the axial strain. This is represented in the elastic relationship below.

$$\gamma = \varepsilon(1 + \nu) \quad (4)$$

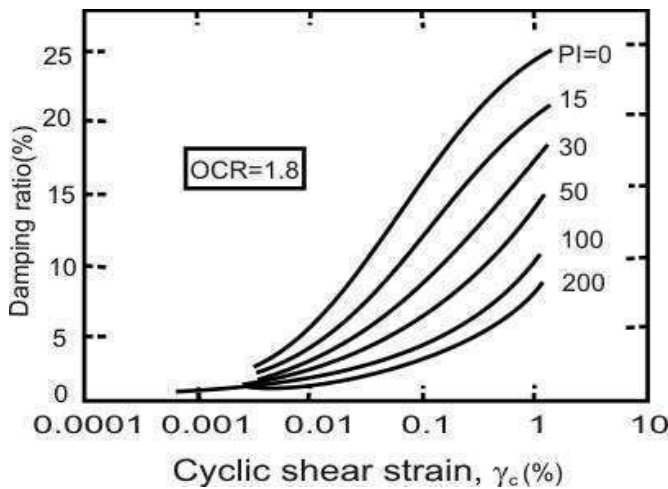


Fig. 4: Variation of damping ratio with cyclic shear strain, for clays [13].

Damping ratios of very soft clays are lower than those of coarse-grained soils, at the same cyclic strain amplitude [14]. Hysteresis loops, in physics, involves energy dissipation, hence vibration damping [15]. The more the hysteresis in the stress-strain curve, the greater the loss of energy, hence the higher the damping ability [16].

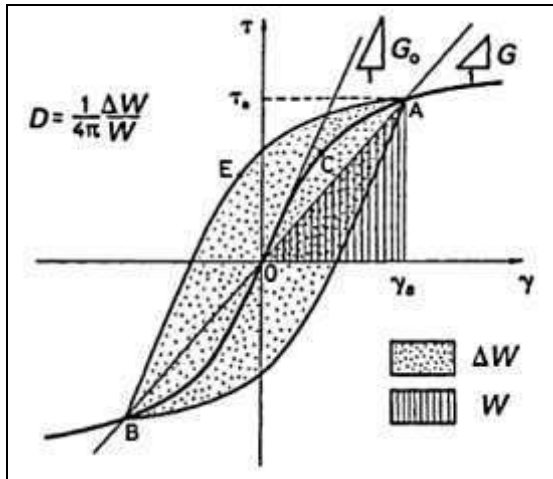


Fig. 5: Damping- hysteresis loop, as a stress-strain curve [16].

Using the hysteresis loops, damping  $D$  is calculated from the energy loss.

$$D = \Delta E / 4\pi E \tag{5}$$

Experimental evidence shows that some energy is lost at low strain levels [17]. Therefore, there is always a value of more than 1, of the damping ratio. The width of the loop exhibited by a soil under cyclic loading conditions increases with increasing amplitude of the cyclic strain [18].

The Isotropically-Consolidated Undrained Triaxial Test can be used to find values of shear stress and shear strain and a plot of these achieved [19]. [20 proposed the reference shear strain  $\gamma_r$ , which has been illustrated below.

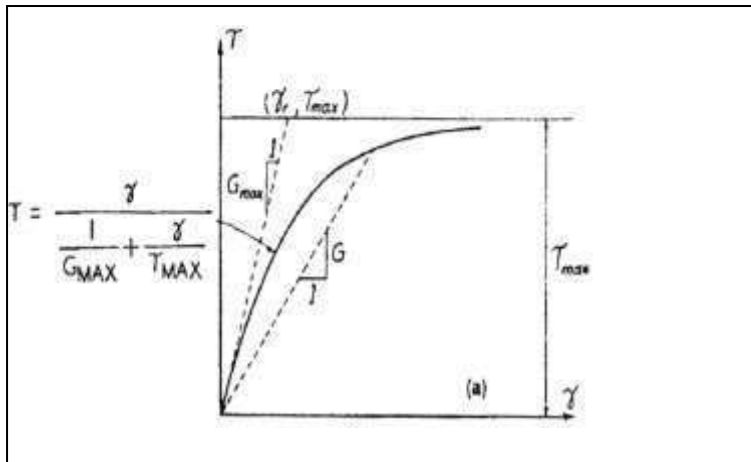


Fig. 6: The Plate Load Test reference strain curve.

## RESULTS

A layout of the geotechnical site investigation tests is presented as shown below, showing the Spectral-Analysis-of-Surface Waves (SASW) and the rest of the test.

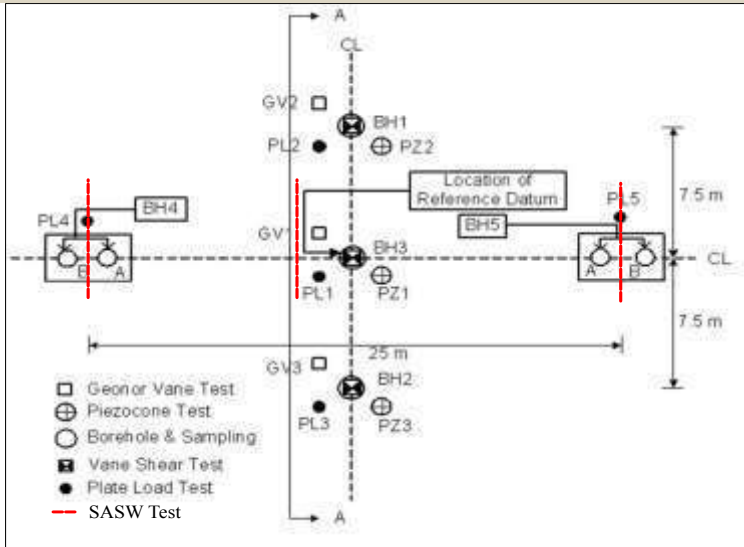


Fig. 7: Layout of the geotechnical site investigation tests.

The SASW test is a seismic technique for obtaining the shear wave velocity profile of soil samples. Advantages of this test are that:

- It is a non-invasive *in situ* technique [21],
- it is faster than other similar methods [8],
- it incur low cost [8],
- it can be used where site subsurface conditions may hinder the use of probes and boreholes [22],
- it can be used to estimate the damping ratio profile of a soil sample [22].

The site's geology has been identified as that of quaternary alluvium, derived from soft marine clay, with some organic materials. Marine clay is usually found in coastal regions [23]. A loose, open structure of clay particles is formed in the process [24]. It is prone to swelling [25] and has the potential to destroy building foundations [26]. The soil profile and its properties are shown in the figure below.

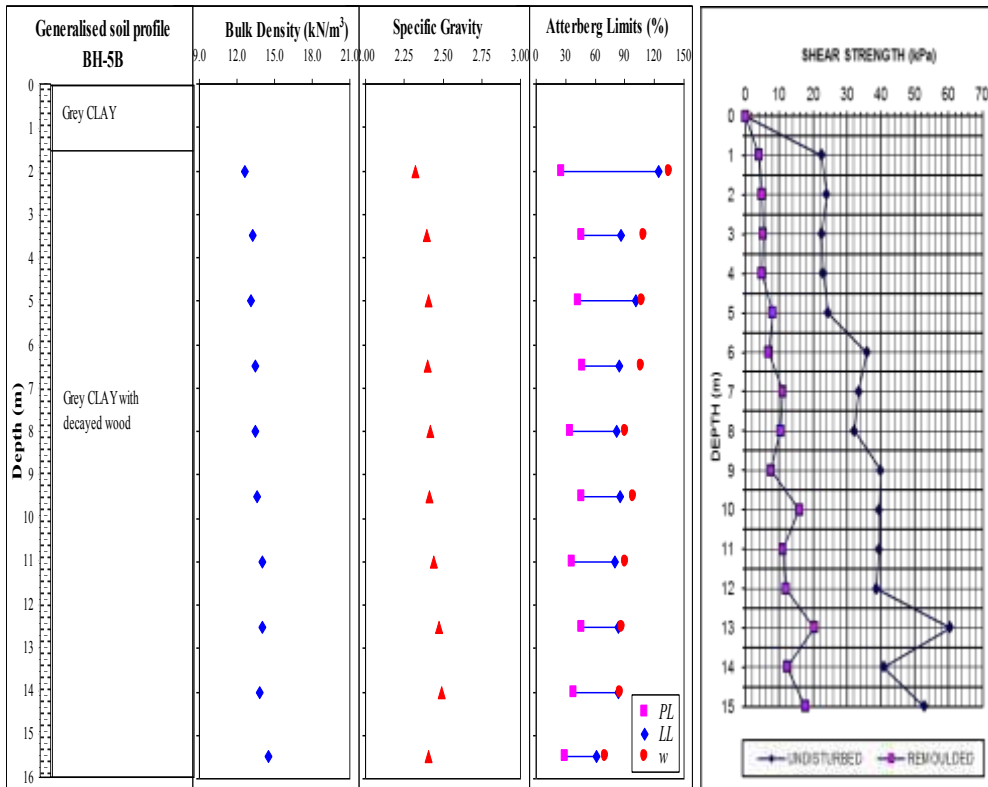


Fig. 8: Profile, basic properties and shear strength of the existing soil, at site.

Eq. (1) was used to find the values of shear stress and shear strain, and show their relationship. This has been illustrated below.

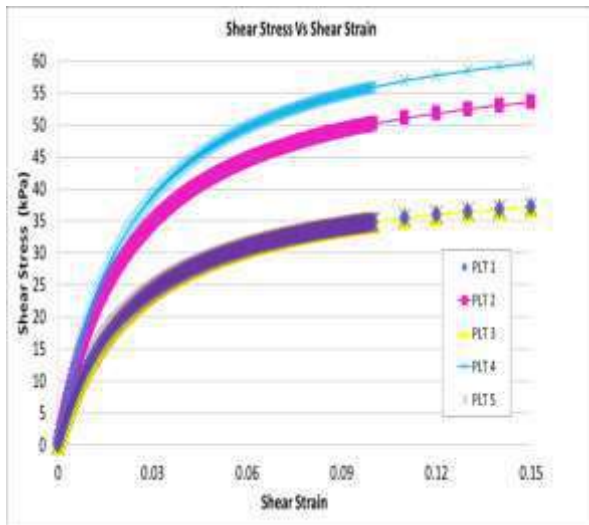


Fig. 9: Shear stress and shear strain relationship. A typical diagram is represented by [27].

Various field and laboratory tests were conducted and their shear strength values compared to the proposed equation at 4% strain, using the Plate Load Test reference strain data.

Table 1: The shear strength of soil samples, evaluated from all conventional methods at a depth of 2.0 m.

	Shear strength (KN/m <sup>2</sup> )					Average (KN/m <sup>2</sup> )	Difference compared with the Geonor Vane Test (%)
Test location	1	2	3	4	5		
Proposed equation at 4% strain, using the PLT reference strain data	27.1	39.0	27.1	43.5	27.1	31.0	32.0
Total Stress (UU Triaxial Test)	-	-	-	-	12.4	12.4	-47.2
Effective stress (CIU Triaxial Test)	-	-	-	-	4.6	4.6	-80.4
The Piezometer Cone Penetration Test (CPTU)	8.3	7.4	8.8	-	-	8.2	-59.8
The Geonor Vane Test	26.0	20.6	24.0	-	-	23.5	-
The Acker Vane Test	-	-	15.2	-	-	-	-35.3

Table 2: The shear strength of soil samples, evaluated from all conventional methods at a depth of 5.0 m.

	Shear strength (KN/m <sup>2</sup> )					Average (KN/m <sup>2</sup> )	Difference compared with the Geonor Vane Test (%)
Test location	1	2	3	4	5		
Proposed equation at	27.1	37.0	27.1	43.5	27.1	32.4	1.3



4% strain, using the PLT reference strain data							
Total Stress (UU Triaxial Test)	-	-	-	-	29.5	29.5	-2.5
Effective stress (CIU Triaxial Test)	-	-	-	-	11.1	11.1	-65.3
The Piezometer Cone Penetration Test (CPTU)	14.1	19.1	20.2	-	-	17.8	-44.4
The Geonor Vane Test	29.0	37.0	30.0	-	-	32.0	-
The Acker Vane Test	-	-	21.0	-	-	-	-34.3

## DISCUSSION

The maximum shear strength corresponds to the estimated value of the maximum shear strain, at the point of failure [28],[29]. The maximum strain is found from the level of strain of the Isotropically-Consolidated Undrained Triaxial Test (CIU Test) of the laboratory samples; the initial strain of the soil samples up to failure being about 4.2%.

Three Geonor Vane tests and Peizocone tests were evaluated. It was observed that all the test values for the other conventional methods were lower than the individual values of the proposed equation. Though there was consistency of obtained values, there are some errors in the experiment. This may include:

- Insufficiency of samples used, thus the average value of the shear strength is not very reliable or accurate. About 25 Cone Penetration Tests (CPTU) need to have been conducted [30],
- the penetration pause effect- on cone tip resistance [30],
- equipment and calibration errors [31],
- human errors such as wrong counting and non-consistent drop height [31],
- computation-spring factor [32],
- clay with organics [32].

In the comparison, the Geonor Vane Test was chosen as the standard test since it was reported as the best method for estimation of the shear strength of soft clay [33]. According [34] the Geonor Field Vane Shear Borer is considered efficient because:

- it is fully protected and pressure push-in,
- there is no friction between the rod and the soil due to its tube protected rods,
- The protection shoe protects the vane and cleans it automatically before each measurement. The shoe is very useful for testing in sites with stratified, sandy, gravelly and marine sediment clays.

Negative values of the percentages indicate an underestimation of the shear strength while positive values of the percentages indicate an overestimation of the shear strength.

At 2.0 m depth, the UU Triaxial Test, CIU Triaxial Test and Acker Vane Test underestimated the shear strength by 47.2 percent, 80.4 percent and 35.3 percent respectively. Shear strength calculated using the equation, at 4.0% strain, and for PLT reference strain data overestimated it by 32 percent. A similar pattern is obtained at the 5.0 m depth and at other subsequent depths. At the 5.0 m depth, the UU Triaxial Test, CIU Triaxial Test and Acker Vane Test underestimated the shear strength by 2.5 percent, 65.3 percent and 34.3 percent respectively. Shear strength calculated using the equation, at 4.0% strain, and for PLT reference strain data overestimated it by 1.3 percent.

Major reasons for underestimation include:

- stress relief,
- Sample disturbances- inevitable damage is caused to the granular microstructure of the 'nominally undisturbed' samples.

The following experiment was subject to differences (overestimation and underestimation) in estimated values due to the nature of both methods. Differences in these methods, according to Powrie [35] are stated below:

- The proposed method applies a seismic method; waves are propagated into the soil (in a cylindrical form); this form is in all the three dimensions. In contrast, the conventional method is conducted in two dimensions,

- Only a test area within a diameter of 50mm or 100mm of the specimen can be represented, using the conventional methods. On the other hand, the seismic method covers a very large area of the site.

## CONCLUSION

In comparison with the Geonor Vane Test, it was found that the proposed equation overestimated the shear strength while the conventional methods underestimated the shear strength, of the specimen. This situation is quite acceptable and reasonable since the seismic method (basis of the proposed equation) is non-destructive while the conventional methods are destructive [36].

## RECOMMENDATION

It is extremely difficult to accurately correlate the two methods due to their inherent nature. Sufficient representative data of the conventional method is thus required, so as to cover an equivalent area of the seismic tests. However, this is considered uneconomical and impractical.

## CONFLICT OF INTEREST

All the authors declare no conflict of interest with in this research.

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ARTICLE

# TOWARDS UTILIZATION OF A LEAN CANVAS IN THE BIOMETRIC SOFTWARE TESTING

Padmaraj Nidagundi<sup>1</sup>, Leonids Novickis<sup>2</sup>

<sup>1</sup>Faculty of Computer Science and Information Technology, Institute of Applied Computer Systems, Riga Technical University, LATVIA

<sup>2</sup>Head of the Division of Software Engineering, Riga Technical University, LATVIA

## ABSTRACT

The growth of technology kept a unique value in the market for the biometrics products and its solutions. Biometrics solutions normally collect the human characteristics related different metrics and main utilization of biometric software solutions is in security. Biometrics solutions are mainly cauterized in two types physiological & behavioral characteristics. Growing digital data and human dependency on software embedded devices created questions on the security of the system and its collected data safety. Another side day to day growing digital security threats and personal data protection forced the human to think and adopt the biometrics solutions for better data security and protection. Some of the research suggests in the year 2015 overall biometric solutions market expected to be worth \$13.8 billion and this information boosted the development of the number of the unique biometric solution with introducing the cutting-edge technologies. Development of biometric software solutions is turned into the new age with the usage of the number tools and technologies for the biometric data collection store and retrieve information for the valid human authentication. In recent years' biometric authentication possible with many types of devices including mobiles. In this case, it is becoming very important test the biometric software performance in more precisely on a number of supporting mobile devices before giving software to end customer. Overall biometric performance testing is key for the biometric software solution make successful with end customers. From many years, the traditionally lean canvas is used for business planning's and strategy building, but considering the lean principles we can generate the more suitable lean canvas for the biometric software test planning and in test strategy building.

## KEY WORDS

Biometric, Biometric software testing, Lean canvas, Software testing, Software validation, Software verification, Test process, Test strategy.

## INTRODUCTION

In daily life, digital personal identification, frauds preventing and personal data security becomes more important for securing the user tractions. Biometric is more advantages comparing any other, it uses such technology that checks many human body characteristics such as Deoxyribonucleic acid, iris recognition, eye retina, fingerprint, palm veins, palm, voice, typing rhythm, and gait. These all characteristics are unique with each human being and difficult to create a clone of them. The biometric solutions secured human life with personal identification via token-based technology for the passports, driver license, passwords, etc. In this path, biometric identification software and hardware are playing a key role in securing the data in the more advanced way. Biometric identification now used daily routine life, such as in banks, web login, offices, government office, personal mobile login as well as in the surveillance. The biometric solution created an advanced layer of protection to user data that's not very easy to break for the malicious attackers.

Biometric software success depends on its performance results. It is very important biometric application need to be well tested to get best results. Robust error free software plays a key role in succeeding the biometric software solutions to intended end users. From many years' lean canvas is used only in the business validation, but adoption of the lean principal in the lean canvas development for the biometric software verification, validation process can impact directly on software quality. Lean canvas simplifies the test planning and reduces the cost of software testing itself.

## The problem statement

In biometric software testing process, quality assurance team faces many challenges while creating the test plan and test strategy.

The most common biometric software testing challenges are:

- The performance [1] of the system is key for succeeding biometric software characteristics such as accuracy, speed.etc
- The number of performance objects increases the test complexity (e.g. number of images, multiple fingers).
- Need more effort to collect correct sample test data for the test system.
- Feature extraction capabilities & complexity of merging data from self-developed vs third part algorithms.
- Biometric capture time of human characteristics with the help of hardware [2, 3] (e.g. scanners, mobile, embedded devices).
- Complexity in testing if biometric using multiple human body characteristics performance objects for identification.
- Lack of combination of sample tests data for testing objects.

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\*Corresponding Author  
Email:Padmaraj.nidagundi@gmail.com

- Combination of performance metrics for biometric systems such as FAR = False Accept Rate, FRR = False Reject Rate, ROC = Receiver operating characteristic, EER = Equal error rate, FTE = Failure to enroll rate, FTC = Failure to capture rate, TC = Template capacity.
- Captures image quality factor, improved data quality and dealing with poor quality input data for biometric system affect the performance.
- Single algorithms or combination of algorithms to get more desired results increase the complexity of the system.

Scientific novelty of paper

From many years, lean canvas is used only for the creating and evaluation of business models. The lean canvas is a white board consists of the several segments on it and it shows the overview of the business. It is drawn on a single page which helps to plan the business ideas, prototype, segment the business and validation with help of several segmented blocks. This board can help you to make strategy, planning, decision-making and help the team to build better businesses.

Now considering lean canvas design as a base for biometric solution system software testing to find the optimal test metrics for the test planning and test strategy.

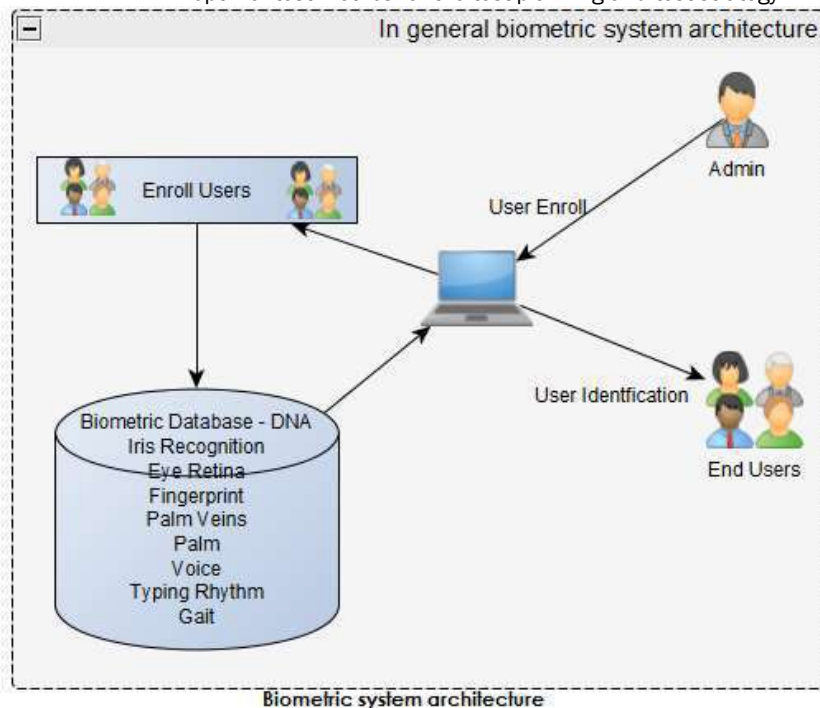


Fig. 1: In general biometric system architecture.

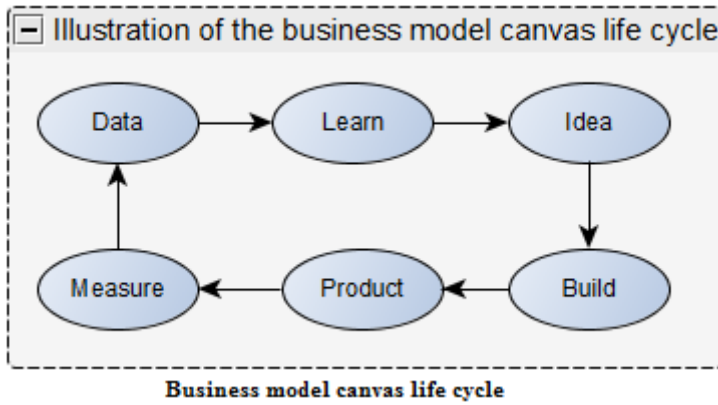
Specifically

- Investigating and building the more sophisticated lean canvas prototype in biometric software testing.
- Developing the biometric test strategy and planning using lean canvas.
- Analyze and simplifying the test planning for the biometric solutions.
- Taking care of lean principles, need to design the biometric testing compatible lean canvas.
- Identifying the most appropriate lean canvas metrics from biometric such as FAR, FRR, ROC etc. those fit in test planning.
- Identifying the biometric system subcomponent, software features to do integration and end to end testing.

Related research

Alex Osterwalder with his co-authors in the year 2000 introduced first-time business model canvas for the business planning and strategic management. The business model canvas acts as a one-page light weight document where the user can visualize possible activities of the business. In the year 2006 business model canvas is named as a lean canvas [4].

The business model canvas life cycle phase start with an idea, build, product, measure, data and learn.



**Fig. 2:** Illustration of the business model canvas life cycle.

Business model canvas fundamentals help to identify the object of the business.

- Start with an idea and loop with learning.
- Remove the unwanted things from the process in life cycle by analyzing.
- Constant feedback in the life cycle.

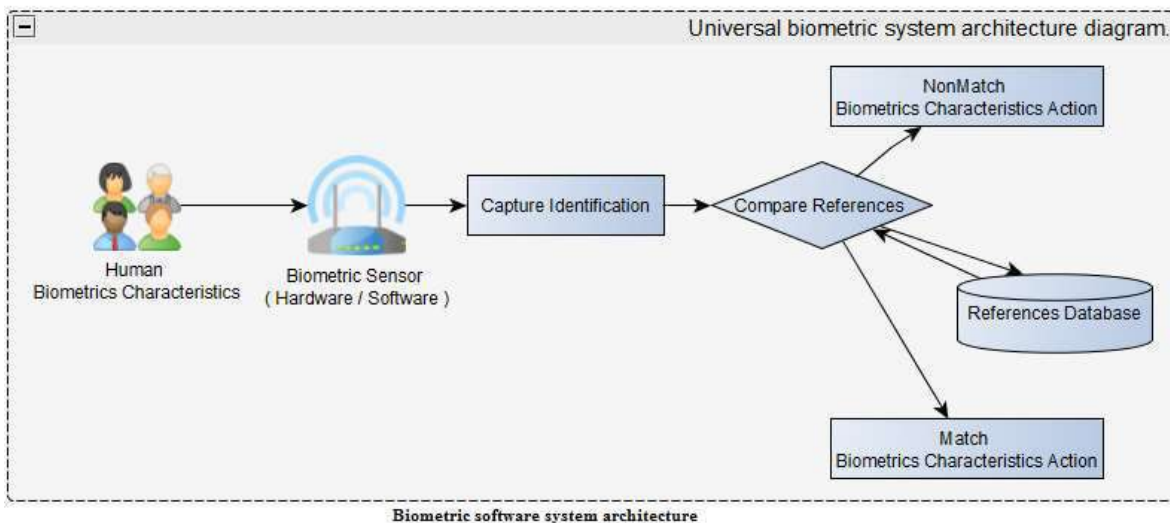
**Biometric testing and Lean canvas life cycle**

From [Fig. 1], In general, biometric system architecture demonstrate the system overview now considering the business model canvas life cycle, we able to identify the similar terms for biometric testing [7].

- Ideas = Biometric solution using DNA, iris recognition, eye retina, fingerprint, palm veins, palm, voice, typing rhythm, and gait or the combination of any of them.
- Build = Biometric capturing hardware and software.
- Product = Biometric as a solution.
- Measure = FAR, FRR, ROC, EER, FTE, FTC, TC
- Data = Stored templates in the database.
- Learn = Performance and logs.

**Biometric system testing process and possible waste identification test metrics using lean principles**

In the general test plan for the biometric system solutions need to rethink because of many reasons, but among important is test engineers are using collected data from various human characteristics and sometimes reusing sample data of different n numbers of users is not show the [4]. Moreover, sample data generated from software not give hundred percent guarantees about data that is matched with real user human characteristics.



**Fig. 3:** Universal biometrics system architecture diagram.

In biometric software development, it is needed to understand the importance of possible waste producing that can directly impact on the software development and testing cost, time as well as on software quality.

In such situation using lean seven principles [5], we can get different test metrics [8] and these can be used for the biometric testing process.

Transport – Sample test data generated from software not guaranteed results with comparing real user data.

Inventory – Without having good compatible hardware and software under investigation not able to test.

Motion – Testing the users in a test environment as well as a real environment bring different results.

Waiting – Identification processing time.

Overproduction – Testing the solution in such environment itself, where it not able to adopt it.

Over processing – Not having the appropriate user database for testing, resulting performance go down.

Defects – Fail to detect early stage bugs due to lack of real environment setup.

### Lean canvas board test metrics for biometric products testing

Now with the help of seven lean principles, we can recognize new possible biometric test metrics. Collected all various metrics can be used to visualize the lean canvas on the white board. Collect test metrics titles may vary and improve the overtime on lean canvas board.

### Lean principles and design lean canvas board

From above chapter, we get to know that there are possibilities we can generate the different basic biometric software test metrics those can be used further for the drawing the lean canvas board. Once we identified the test metrics, then we can create the number of blocks and names on the white board.

## CONCLUSION

The study about biometric test process and test strategy improvement with utilization of lean canvas shows the new possibilities for visualizing the process on the single page. This one-page light weight document can direct impact on the software verification and validation process as well as save money that spent in testing. In next level to create and visualize lean canvas for the biometric testing need to continue the following research activities.

- Identification of lean canvas test metrics needs to be done with real product development environment.
- Need to carry out an experiment that segment testing process into sub-components.
- Lean metrics identification and brief description need to set for them
- Need to develop a prototype that shows the biometric lean canvas visualization.
- Need to develop algorithms that identify and optimize the lean metrics.
- Need to develop software that generates a prototype for biometric software test planning.

Author wish is to ideas discussed in the above research article generate new ideas and new research topics. Also, about how biometric software testing can be improved with the adoption of lean canvas on it.

### CONFLICT OF INTEREST

The authors declare no conflicts of interest regarding this paper.

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None

### FINANCIAL DISCLOSURE

None

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## ARTICLE

# A SURVEY PAPER ON COLLABORATIVE FILTERING BASED RECOMMENDER SYSTEMS IN BUSINESS INDUSTRIES

VE Jayanthi\*, C Raja Kumar

<sup>1</sup>Department of Electronics and Communication Engineering, PSNA College of Engineering and Technology, Dindigul, INDIA

<sup>2</sup>Department of Information Technology, ULTRA College of Engineering & Technology for Women Madurai, INDIA

## ABSTRACT

Big Data hype gives the most attention to the recommender systems. Business industries are able to deliver value to their customers and to get significant revenue with the comfort of recommender systems. Recommender systems are in six main folds namely Collaborative Filtering (CF), Content-Based approach (CB), Demographic, Knowledge-based, Hybrid and Community-based approach. CF technique is a preferable approach to building successful recommender systems. So an extensive survey of the CF techniques is shortened for the researcher's betterment to accomplish their further work.

## INTRODUCTION

Inexpensive digital storages availability, mobile internet access facility, social media fad and IT devices innovation produces quintillion bytes of data every day. Such kind of data is very much worth for the business to predict customer needs and take right decision at the right time. A recommender system is a legitimate paradigm helps to the customer for their deserve choice. CF is one of the classifications under the recommender systems. The author coined the term collaborative filtering in an e-mail filtering system called Tapestry [1]. GroupLens automated recommendation system is proposed to provides personalized recommendations on Usenet postings [2].

### KEY WORDS

Recommender System,  
Collaborative Filtering,  
Item-based technique,  
User-based technique

Researchers continuously developed and implemented new version of CF based recommender systems. Even though the considerable amount of clarity on the existing CF methods and its works are not up to the mark. The performance of those methods is various with respect to the number of users, number of items, and sparsity level. Some of the methods perform decently in meager environments while others perform decently in complicated environments. Existing CF based recommender systems experimental result with respect to its parameters is analyzed. This paper is organized as introduction to various CF techniques algorithm and its challenges are in section II. The comparative study of CF methods is elaborated in Section III. Conclusion and future works are in section IV & V.

## CF based technique and its challenges

CF techniques try to predict the additional items for a new user based on the list of favourite items previously rated by other users. There are two types of ratings. In the first type, ratings are explicitly asked from the user by a concrete rating scale. The second type gathers data implicitly from the user based on his/her accomplishment in a website. Captured through the user's actions and then the behaviour is analyzed to find the user's interest. This rating is easier than explicitly rating, but a user has more responsibility and it provides transparency in the rating process.

Tackle the highly sparse data, extreme scaling users and items counts are the challenges in high-quality predictions of data in CF technique's recommendations system. CF Techniques' should make reasonable recommendations in a short time period and to deal with additional problems like synonymy, shilling attacks, data noise, and privacy protection problems etc.,

CF algorithms are categorized into memory-based, model-based and hybrid collaborative filtering algorithms. Memory-based CF algorithms learn the rating matrix and find the recommendations based on the relationship between the request of user in a particular item and rating of the matrix. Based on user recommendations Model-based CF algorithm fits a parametric model to train the data to predict unobserved ratings and make recommendations. Hybrid CF algorithm is the combination of memory-based and model-based CF algorithms are investigated in the following section.

## Memory-based CF algorithms

Memory-based CF algorithms exploit the entire user/item data loaded in the memory. Here the set of neighbors are found initially and then prediction is obtained. Distance measure is used to identify the neighbors. Similarity measure [0, 1], Dissimilarity measure [0, INF] are the two different approaches used to measure the distance between the users/items.

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\*Corresponding Author  
Department of Electronics  
and Communication  
Engineering, PSNA College of  
Engineering and Technology,  
Dindigul, INDIA.

Similarity measures find out the similarity between pairs of users or the pairs of items. Similarity measures are basically correlation based or vector cosine based measurement. Correlation based similarities measures are Pearson correlation and Spearman rank correlation. Pearson correlation is introduced and it is widely and successfully used as a similarity measure between users [2]. Constrained Pearson correlation similarly [3] is measure by considering user mean vote is the midpoint of the rating scale as a constant value to get high performance of Pearson correlation. Correlation based similarity measure is carried out to test the performance of various CF recommendation algorithms are described [2] and [4]. Cosine of the angle between two vectors are measured in the Cosine similarity measurement and it is described in [5] and [9]. Probability based similarity is the exceptional category of similarity measure. Conditional probability-based asymmetric similarity measure is explained [6]. Tanimoto coefficient brought in [7] is a similarity between two data sets and it is the ratio of intersections.

Dissimilarity measures are basically Euclidean distance which computes the distance between two objects in the Euclidean space. The Manhattan distance is based on Euclidean distance; calculate the distance by traversing the vertical and horizontal line in the grid base system. Metric of Euclidean space is Minkowski distance. Memory-based learning methods are highly sensitive to noise and redundancy. To remove the noise and redundancy in the memory based learning four techniques of Training User Reduction for Collaborative Filtering (TURF1-TURF4) is introduced [8].

### Model-based CF algorithms

Machine learning and data mining techniques are used to find the patterns on the training data and make predictions for real time data to develop model-based CF algorithm. Model-based CF algorithm matches the model for the given rating matrix to issue the recommendations.

Bayesian models, clustering models, regression models, Markov decision processes (MDP) models and Latent Semantic models are proposed to fix the inadequacies of memory-based CF algorithms. Bayesian methods make a probabilistic kind model to solve the problem of inadequacies of memory in the CPU. Rule-based approach is used to find the correlation between the items in the association kind of model. Latent semantic analysis is used for MDP in aspect model based CF algorithms [10]. Multinomial mixture model in [5], user rating profile (URP) model in [11][35] are also use to overcome the fixing of inadequacies in memory-based CF algorithms. The classification algorithms are used in a model if the user ratings are categorical. Classifier is used for clustering method to groups the similar user in a class to evaluate the system. The regression and SVD methods are used if the user ratings are numerical in nature.

Probabilistic approach is enforced in model based algorithms and it is formulates the model from the user ratings on other items and predicts the expected value. Matrix factorization model is applied for extended stochastic gradient descent and alternating least squares (ALS) algorithms in [12] reduces the CF challenges. Bayesian Belief Net CF, Simple Bayesian CF, NB-ELR CF and TAN-ELR CF algorithms are developed based on Bayesian network model and they revealed [13] and [14].

Cluster model based CF are proposed with various algorithms, such as k-mean partitioning methods [15]. Density-based methods proposed [16] and extended in [17], data clustering methods [18]. Topic model based clustering algorithm [19] and [20]. The spreading activation model based CF algorithms [21] designed and implemented by the Leakey capacitor algorithm, Branch and bound serial symbolic search algorithm and Hopfield net parallel relaxation search algorithm.

### Hybrid CF algorithms

The blended memory-based and the model based CF algorithms defeat the limitation of the native CF algorithms. Performance enrichment in the prediction of end result is achieved by hybrid based CF algorithm but the implementation is more expensive due to algorithm complexity.

Hybrid CF systems combine the CF techniques with another recommendation technique to make predictions or recommendations. Similarity measures play an important role of recommendation system. The above mentioned any two similarity measures combined to form a hybrid CF system. A few models are proposed to enrich a new hybrid CF system. Blended approaches are proposed to build a hybrid CFs to improve the prediction performance, overcomes the cold start problem and the sparsity problem.

Content-boosted CF algorithm is developed [22] by the combination of naive Bayes and a weighted Pearson correlation-based CF Algorithm. Combination of TANELR and Pearson correlation-based CF algorithms is used to developed a hybrid CF system is explained [23][33,34]. R. Burke, et al. 2002 [24] developed the Weighted hybrid recommender system, which is the combination of different recommendation techniques with their weights; accordingly it is named as mixed hybrid recommenders, cascade hybrid recommenders, and meta-level recommenders. Personality diagnosis algorithm in [25] groups the memory based and model based algorithms. Possible strategies to frame hybrid CF algorithms are considered and related in [26].

### Cf system evaluation metrics

The eminence of a recommender system can be determined based on their assessment result. The type of metrics used depends on the type of CF techniques. Those metrics are broadly classified as predictive accuracy metrics, classification accuracy metrics and rank accuracy metrics. Mean Absolute Error (MAE) and its variations are the measurement of predictive accuracy metrics [27], [28], [30] and [31]. Classification accuracy metrics measures are precision, recall, F1-measure, and Receiver Operating Characteristic (ROC) sensitivity [21].

Pearson's product-moment correlation, Kendall's Tau, Mean Average Precision (MAP) are the parameters of rank accuracy metrics. hit-rate (HR) and the average reciprocal hit-rank (ARHR) are the measures in [29]. Most commonly-used CF metrics are MAE, Normalized Mean Average Error (NMAE), Root Mean Squared Error (RMSE), and ROC sensitivity.

**Table 1:** CF based recommendation systems analysis

CF categories	Techniques	Algorithm and Datasets	Performance Metrics	Implementation	Result and Remarks
Model based	Bayesian network, clustering, rule-based, MDP-based and Latent Semantic-based approaches	<p>TyCo - Typicality based CF Algorithm</p> <p>Compared with:</p> <ul style="list-style-type: none"> <li>• Classical Base Line methods                             <ul style="list-style-type: none"> <li>○ content-based (CB) - cosine similarity</li> <li>○ user-based CF - Pearson Correlation (UBCF)</li> <li>○ item-based CF - Pearson Correlation (IBCF)</li> <li>○ naive hybrid method</li> <li>○ CF with effective missing data prediction (EMDP)</li> </ul> </li> <li>• state-of-the-art methods                             <ul style="list-style-type: none"> <li>○ cluster based Pearson Correlation Coefficient method (SCBPCC)</li> <li>○ Weighted low-rank approximation (WLR)</li> <li>○ transfer learning-based collaborative filtering (CBT)</li> <li>○ SVD++</li> </ul> </li> </ul> <p>Datasets: Movielens</p> <p>943 users, 1682movies, 1000,000 ratings</p>	<p>MAE</p> <p>Coverage</p>	<p>J2SE platform</p> <p>Pentium IV 3.2GHz</p> <p>2GB RAM</p> <p>Windows XP Professional</p>	<p>Outperforms than many CF recommendation method.</p> <p>More accurate predictions with less number of big-error predictions.</p> <p><b>Issues addressed:</b></p> <p>Sparsity, Big-error in Prediction</p>

		<p>spreading activation algorithm compared with:</p> <ul style="list-style-type: none"> <li>• 3 Hop - Graph based CF</li> <li>• User based (correlation)</li> <li>• User based (vector similarity)</li> <li>• Item based</li> </ul> <p>Datasets: www.books.com.tw</p> <p>9695 user nodes,2000 cust nodes,18771 links</p>	<p>Precision</p> <p>Recall</p> <p>f-measure</p> <p>rank score</p>	<p>Stored Procedure MySQL</p> <p>Python based sparse matrix library</p>	<p>Outperformed.</p> <p>Effectively alleviate the cold start problem.</p> <p>Over activation</p> <p>may dilute the data used to infer user performance</p> <p><b>Issues addressed:</b></p> <p>Sparsity</p>
		<p>Item-based top-N recommendation algorithm</p> <p>Compared with:</p> <p>User-based, Item-based Algorithms</p> <p>Datasets: real and synthetic datasets</p> <p>customer purchasing transactions,</p> <p>synthetic transaction dataset generator</p> <p>provided by the IBM Quest group</p>	<p>hit-rate,</p> <p>average reciprocal hit-rank</p>	<p>--</p>	<p>Accurate</p> <p>recommendations better than</p> <p>traditional user-based CF techniques. Designed to evaluate the effect of the similarity normalization.</p> <p><b>Issues addressed:</b></p> <p>Sparsity</p>
Memory based	correlation based, Cosine Similarity based, Euclidean distance based	<p>Enhanced Pearson Correlation Coefficient (PCC) algorithm</p> <p>Missing data prediction algorithm</p> <p>Compared with:</p> <p>state-of-the-art collaborative filtering approaches</p> <p>Datasets: Movielens</p> <p>943 users, 1682movies, 1000,000 ratings</p>	<p>MAE</p>	<p>--</p>	<p>Outperforms than state-of-the-art collaborative filtering approaches.</p> <p>Combines users information and items information together.</p> <p><b>Issues addressed:</b></p> <p>Sparsity</p>

Hybrid	content-based aspects into CF models (or) adding CF aspects into content-based models.	<p>Combined User based, Item based approach</p> <p>Compared with :</p> <ul style="list-style-type: none"> <li>• Standard user based vector similarity</li> <li>• Item based adjusted cosine similarity</li> <li>• Cluster based Pearson Correlation coefficient</li> <li>• Aspect Model</li> <li>• Personality Diagnosis</li> <li>• User based Pearson correlation coefficient</li> </ul> <p>Datasets: Movielens</p> <p>943 users, 1682movies, 1000,000 ratings</p>	MAE	--	<p>Outperformed.</p> <p>Generative probabilistic framework.</p> <p><b>Issues addressed:</b></p> <p>Sparsity</p>
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### Comparison

Recommender systems are relatively enlightened compared with other research area in the field of information retrieval system. Research fascination in recommender systems has dramatically increased in recent days. Hence, would like to survey the existing CF based recommender systems techniques and its approaches in a broader way. Generally, CF based recommender systems outperform well compared to other legacy methods. Various techniques, corresponding dataset, technique related software, performance metrics and their merit and demerit of the existing CF algorithms are compared with state of art methods are listed in [Table 1].

It's content try to address the implementation issues of Sparsity and Big-error in Prediction issues present in the existing CF algorithm. The effectiveness of those approaches is evaluated experimentally using data from Movielens data set, the online book store data set, IBM Quest group's real and synthetic datasets. From [Table 1] model based CF algorithms gives the good performance as compared with the other types of CF algorithms is observed.

### CONCLUSION

Memory-based, model-based CF and hybrid CF techniques of successful recommender systems are reviewed based on similarity metrics measured. Correlation between item based and user based are used to find the value of similarity metrics measures to evaluate the existing CF system. Memory-based CF algorithms are easy to implement and the performance decrease if the data are sparse in nature have good performances for dense datasets. Sparsity and scalability challenges are addressed in Model-based CF techniques. Hybrid CF techniques prediction performances is good but it is complicated. Recent days buying and selling through online dramatically increases huge volume of data, variety and its velocity. The model-based CF techniques are address the above said challenges in an easy way.

**CONFLICT OF INTEREST**  
There is no conflict of interest.

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## ARTICLE

# A FRAMEWORK FOR REMOVING AMBIGUITY FROM SOFTWARE REQUIREMENTS

Sophia Segal\*

Director, Business Analyst Solution, Toronto, CANADA

## ABSTRACT

Un-ambiguous, transparent software requirements written by accomplished Systems analysts are a rarity. Too frequently, software requirements are vague and open to interpretation, leaving development teams unintentionally deviating from the project requirements at considerable expense and delay. The implementation of a single software requirement is replicated in a number of modules, so rework will not only affect a single module but a number of modules and there is a huge possibility that the budget will increase from the initial estimate [1]. Seventy percentage of software projects fail due to poor requirements with an associated rework spend just north of 45 billion USD annually. (Source: Leveraging Business Architecture to Improve Business Requirements Analysis). The strategies for project recovery report by PM solutions, is based on 163 respondents. It states that 74 million USD invested in projects annually are at risk of failure. The main cause of troubled projects are challenges that can be addressed by functional requirements that are vague and not transparent.

## INTRODUCTION

Project success is contingent on transparent requirements. Transparent functional requirements are critical in determining the success of software projects. Clearly documented functional requirements provide transparency and are critical to the project team, so all stakeholders are working towards the same project goals. There is no wasted effort on non-value requirements that do not contribute to the business needs. "If you don't have transparent requirements allowing you to comprehend the project goals and business needs, you cannot decipher whether the decisions you or your project team make are correct." To reduce vague, unrealistic and unachievable requirements being relinquished to the Developers team, functional requirements need to be formulated and documented in such a way which makes them transparent, testable and unambiguous to the project team. Capturing the right level of granularity of a functional requirement is key in avoiding ambiguity in software engineering projects and eliciting a concise, testable functional requirement. This paper discusses different approaches which can be adopted to remove ambiguity from a Software requirement, and how each approach lends itself to validation in the testing phases.

## WHY IS AN UN-AMBIGUOUS REQUIREMENT CRITICAL FOR PROJECT SUCCESS?

Concise, software requirements written by accomplished Systems analysts are scarce. Too frequently, requirements are poorly written and open to interpretation, coupled with lack of collaboration between Analysts and Testers to conceive and trace, testable requirements from customer need, through strategy, down to testing and implementation is a big enabler of software project failure. The definition of a functional requirement is 'A requirement which specifies what the system should do. Software developers don't implement business requirements, they implement Functional requirements, specific bits of system behaviour that allow users to execute use cases and achieve their goals'. Ambiguous requirements often leads to testers and developers to unknowingly misinterpret them, which causes requirement errors to slip through UAT and morph rapidly into defects. These defects surface after implementation, at a time when it costs tenfold to pursue and resolve the same defect. It is therefore important to capture and define these shifting, ambiguous requirements and flesh out meticulous acceptance criteria so that the intended results are visible to all. Ambiguity can be one of a range of critters. These include

1. Ambiguous terms: subjective or vague terms that cannot be measured
2. Conflicting requirements: Two or requirements that conflict each other
3. Incomplete requirements: Missing values, business rules, etc.
4. Missing requirements: Possible missing requirements that have not been defined
5. Unclear requirements: Requirements that can be interpreted in multiple ways.
6. Glossary: Term is not found in the glossary reference document
7. Grammar, spelling and wording: spelling mistake, grammar rewording suggestion.

A common denominator in software engineering projects is the techniques or approaches applied to requirements elicitation, requirements analysis and validation [2,3,4]. These approaches have been adopted to consistently remove ambiguity in requirements and are more testable, which leads to long-term visibility of the solution need. The two main approaches are: 1) Use Case 2) Acceptance Criteria

### KEY WORDS

Software Testing, Removing Ambiguity, Critical Analysis

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### \*Corresponding Author

Email:  
sarahdorabrown@gmail.com  
Tel.: +1 647 986 3181

## USING THE USE CASE APPROACH

Use case diagrams emphasize the functionality requirements of a system and have become a frequent practice in software development projects. They are best utilized to provide a high-level description of what an existing or proposed system should be able to do and who or what will interact with it. It is a highly regarded technique for specifying and documenting functional requirements in software projects and are often used as supplementary documentation to the business requirements document which encompasses functional and non-functional requirements. I have also adapted them for storyboard tools for agile user meetings. They define the requirements of the system being modelled and hence are leveraged to write test cases for the modelled system. Imagine travelling to an unexplored exotic country where your plans involve renting mode of transport and touring the local sights. Most travellers would not contemplate this trip without a travel sightseeing book. Despite the significance of a travel sightseeing book, or map, the development team or Quality Assurance team, too often plunge into the Solution phase without them. As a result, development teams and QA teams can unintentionally, deviate from the project objectives and software requirements at considerable expense and delay. The Use Case also provides an added layer of functional requirement details and depicts low level behaviour and usability on how users would interact with the software whereas the business requirements document is more high level and independent of Solution implementation. Use Case are a valuable approach to remove ambiguity in what the solution is delivering by eliciting conversation and collaboration with stakeholders so all functional requirements are clear and visible. Formulate Use case descriptions providing the sequence of steps an actor has to go through to achieve a goal and also provided details on exception and alternative flows. Each Use Case's purpose is to capture common user functionality requirements. Use cases can be supported by textual descriptions known as use case descriptions to provide greater level of detail on system functionality. Use cases focus on the "what" and not the "how". Below is a simple example and basic rules of a use case description.

An actor can be a person, company, software or external entity that interacts with the system. For example, a customer, a bank, a database can be referred to as actors. Actors are modelled as being external to the system boundary. A use case is an action or functionality that is performed within a system. It is represented as a combination of a verb and a noun, e.g. Print Report, Prepare Invoice; Display Amount. Main Flow is the regular flow of action in an application. The main flow of events describes a single path through the system that results in a user completing their goal. For example, in the login page after entering user name and password the standard next screen should appear is considered the main flow. An exception flow is the unintended path through the system. They are the flow of events which occur in case of the errors or exceptions. Alternate flow are any alternative actions that can be performed or variations from the main flow, if not selected. The alternate flow formulates a scenario other than the main flow that results in a user completing their goal. A precondition of a use case explains the state that the system must be in for the use case to be able to start. A prerequisite that needs to be met before the use case is triggered. A post-condition of a use case lists possible states that the system can be in after the use case is at its end state. The post-event that is actioned after the Use Case end state.

According to BABOK V2, the action "extends" allows an analyst to articulate additional behaviour of a parent use case. The parent use case is entirely functional on its own and is independent of the extending child use case. An extension is functionally similar to an 'alternate flow, but is captured in a separate use case to avoid confusion.

Use Case: A user need to enter his/her ID and password to get signed in. The login page consists of two fields and both field need to be filled in order to proceed. Once the login is successful, the user is redirected to his/her account.

Test Cases: There can be a number of test cases which will help us determine if the above functional requirement is met or not. These are listed below

**Table 1.** Test Case vs Expected Outcome

Test case	Expected outcome
1. Clicking the login button by keeping both the ID and passwords fields empty	Error messages against both field prompting the User to enter ID and password. Login attempt unsuccessful
2. Clicking the login button by keeping the ID filed empty while the password is entered correctly	Error message prompting the user to enter ID login attempt unsuccessful
3. Clicking the login button by keeping the password field empty while the ID is entered incorrectly	Two different error messages. One error message prompts the user to enter the correct ID while the other one prompts the user to enter password. Login attempt unsuccessful
4. Clicking the login button by keeping the password field empty while ID is entered incorrectly	Two different error messages. one error message prompts the user to enter the correct password while the other one prompts the user to enter password. Login attempt



	unsuccessful
5. Clicking the login button by keeping the ID filed empty while the password is entered incorrectly	Two different error messages. One error message prompts the user to enter the correct password while the other one prompts the user to enter ID. Login attempt unsuccessful
6. Clicking the login button by entering incorrect ID and password	Error messages against both fields prompting the user to enter the correct ID and password. Login attempt unsuccessful
7. Clicking login button by entering the correct ID and password	Validating user ID and password login attempt successful

## How Use Case Requirements support testability

A Use Case plays an integral part in defining a Test Case and functional requirements modelled in the form of a use case can serve as a valuable source for test cases. Capturing functional requirements in the use case illustrates exactly how functionality works in a current system, ensuring that critical functionality requirements are not overlooked. Test cases are drawn from functional specification documents, business requirement documents, design decisions or prototypes. If all the possible control flows of a system are captured, then accordingly, all scenarios of control flows can be captured and tested to verify and validate the desired output. While use cases significantly differ from test cases, they guide the QA team to elaborate Use Cases into Test Cases. "Pre-Conditions", "Post-Condition", "Main Flow", "Alternative Paths", "Exception Paths", and "Business Rules" are all source material for creating complete test scripts and establishing both the Use Case and Test Case are aligned. I have addressed below, an example, illustrating simple functionality which requires a user to enter their ID and Password in order to login to their account. While the Use Case defines the mechanism through which this functionality will be achieved, Test Cases helps capture all the possible scenarios of this particular Use Case functionality. Use Case: A user needs to enter his/her ID and Password to get signed in. The login page consists of two fields and both fields need to be filled in order to proceed. Once the login is successful, the user is redirected to their account. Test Cases: There can be a number of test cases which will help us determine if the above functional requirement is met or not. These are listed below:

## What is Acceptance Criteria and how does it support Requirements Testability

Acceptance criteria are a set of statements, expressed in clear, structured English language, each resulting in a pass or a fail that specify both functional and non-functional requirements which examines if the software requirement has been met or not. There are specific boundaries to the acceptance criteria which provides clarity to the completeness of the software requirement.

Defining concise acceptance criteria is key to a complete Test Case. Not only does it clearly illustrate what the user expects from a scenario, how the requirement should be met, but also verifies the quality and scope of a test case scenario and exit criteria. This is calculated by counting all the acceptance criteria, including scenarios, and dividing the number by how many acceptance criteria have been completed with the expected results.

## CONCLUSION

While quality use cases capturing functional requirements may seem time consuming and tedious, the result is a foundation for work by the analysis team, couples with collaboration with the development team, and the testing team. Good Use case documentation provide a valuable return on the analysis team's investment in time and resources. It is good business practice that the Use Case and Test Cases are aligned. The Use Case approach abundantly illustrates the functional requirements that a user will perform with a system. Methodically thinking through the tasks that are involved between user and system fleshes out any requirements which are ill-defined earlier in the software projects, as does generating test cases from use cases. If the use Cases for a system are complete, accurate and clear, the process of deriving the test cases is straightforward. '[karl wiegers] Project success is contingent on systems analysts delivering transparent requirements.

Project success is contingent on good requirements and collaboration. Requirements that are testable are critical in determining the success of software projects.

Acceptance criteria for requirements provide transparency to the project team, so they are working towards the same goals. There is no wasted effort on non-value requirements that do not contribute to the business needs and there is a definite boundary to when a requirement has been met. "If you don't have transparent, testable requirements allowing you to comprehend the project goals and business needs, you cannot decipher whether the decisions you or your project team make are correct."

**CONFLICT OF INTEREST**

All the authors declare no conflict of interest with in this research.

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## ARTICLE

# COMPETITION IN THE ASEAN COMMUNITY FROM AN ECONOMIC PERSPECTIVE

Osgar Sahim Matompo\*

Dekan Fakultas Hukum, Universitas Muhammadiyah Palu, Sulawesi, INDONESIA

## ABSTRACT

AEC (ASEAN Economic community) was incepted with the sole purpose of ensuring that communities in Southeast Asia better themselves economically. The whole objective of the Association of South East Asian Nations (ASEAN) was to make sure that the member countries empowered themselves so that they would be able to compete with advanced economies. As a matter of fact, the motto of the ASEAN community is clearly explained in the roadmap for the ASEAN community. This motto states one vision, one community, and one identity. The sole reason why this slogan is designed is to challenge the members of the ASEAN community to be united as they seek to strengthen their community. This slogan ensures that healthy competition is a characteristic of this community. It is necessary for a regulation and a competition law to be formulated to ensure that fairness is maintained in trade. The principle of honesty, the principle of transparency and the principle competition are all critical components to ensure fair competition among member countries.

## INTRODUCTION

The ASEAN economic community always strives to set objectives that will be achieved through a free flow of the factors of production. For the success of the AEC to be achieved, there must also be a free flow of skilled labor, goods and services. Entrepreneurs are a key component in ensuring that the AEC is always able to attain its objectives. The AEC always strives to assist southeastern Asian countries to achieve their goal of economic integration (Anbumozhi, 2016). The ASEAN community aims to achieve economic integration in the region through establishing an area which has a robust economy.

### KEY WORDS

Asean community,  
competition, South East  
Asia, global economy.

This economic integration will enable South East Asian countries to be major players in the global economy. Empirical data shows that countries which are developed and have advanced economies are majorly driven by entrepreneurs. Entrepreneurs are responsible for implementing changes by being a creative force that ensures that the countries economic policies are always adhered to (Anshari & Alas, 2015). The ASEAN economic community is founded on the principle that entrepreneurs within the south eastern countries play multiple roles in providing a steady economic development.

These roles are over and above the fundamental objective of the entrepreneur which is to meet the needs of their clients and to avail goods and services that are required in the market. Entrepreneurs can only achieve their objective if they have the necessary technical know-how, skills, and abilities that are needed to enable them to compete fairly with other business ventures both within the Asian community and in the international market (Benny et al. 2015). It has been established that the skills of an entrepreneur are closely tied to economic theories and the mastery of science.

Economic theories and science are necessary for business activities though they are not devoid of moral constraints and legal limitations. In the dispensation of the ASEAN economic community, some entrepreneurs have been seen to conduct their business activities without any regard to legal and moral values that are required to be applied in the community (Chaponnière & Lautier, 2016). As a consequence, the concept of the law is disregarded causing there to be fraudulent competition that reduces the available business opportunities for firms and companies. The result is a dishonest competition that is uncontrollable as the market structure becomes unbalanced making the market to embody a monopolistic system.

Research has also shown that an open entry of products from foreign markets in large quantities will cripple the local industries. A free market will make local entrepreneurs unable to compete in price and quality with foreign firms which have already established themselves and have a larger capital base. The influx of traders at an increasing rate has also changed the role that small businesses play in a village setting (Chia & Plummer, 2015). This is because foreign players have built shopping malls that are more luxurious. The allure of shopping in a luxurious shopping mall has made the villagers to develop a disregard for the small shops.

This article intends to discuss the role of the competition law in the ASEAN community. It also aims to propose principles that can be adopted by the industrial society of South East Asian countries (Crosby, 2016). In discussing these problems, this paper will attempt to show how a healthy business environment can be created among the ASEAN countries (Chia & Plummer, 2015).

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### \*Corresponding Author

Email: Osgar.sm@yahoo.com  
Tel.: +62 81294378195  
Fax: +62 (451) 411424

## METHODS

This study will use information from legal materials that are collected from both primary sources and secondary sources. We will also ensure that we incorporate data from current journal articles that show the latest data on this subject (Das, 2015). Legal normative research methods will also be applied as we attempt to analyze the competition themes and the legal provisions provided by the ASEAN economic community.

## RESULTS

One of the key achievements that have been made following the economic integration, in ASEAN has been the creation of single market and production base. The region has become a single production and marketing, making it stronger than when different countries produce goods and market them on their own. With such a model of production and marketing, the region has performed better than many countries that have been working on their own, not being part of any regional block. The integration has also allowed the region to become part of the global community, with globalization being viewed as the interconnectedness of economies internationally. Working in partnership with others, the countries forming the regional bloc have been able to take part, more easily, in the global economy. Chia & Plummer (2015) suggest the view of ASEAN as part of a global community, as opposed to its being viewed in isolation.

Economic performance of the region has improved because of the contributions made by the members towards the united whole, ASEAN. In fact, Chia & Plummer (2015) suggest that there has been achievement of equitable economic growth and development in the members making up the bloc. To be able to gain the benefits of being part of the bloc, the peoples and businesses in the involved countries have had to engage in the process of integration. As a result, the players have taken part in trying to better themselves and their countries to avoid being left behind in the process of development. Such an environment has allowed for all the members to reap the economic benefits resulting from the integration. Evidently, countries in the region, including China and Japan are rapidly becoming economic powers globally.

Ing & Cadot (2016) cite the following as the important pillars of the economic integration in the region: competition, integration, dynamism and stability. Implementation of the four pillars by ASEAN has allowed not only better economic performance in the region, but also greater competitiveness. Increased competition is evident between the members of the community and also with the rest of the world. The region has had to put an emphasis on competitiveness of its products and services. The integrated body has allowed greater production as well as greater capability to export the products from the region to the rest of the world. Working as a whole has been evidence of success for the exporting abilities of the region as well as by individual countries. Following the model of the European Union, ASEAN is proving to be beneficial to the region and the members.

Research has revealed that while some benefits have already been achieved, more work is needed to completely realise the benefits of the AEC. According to many leaders in business like Tony Fernandes, AirAsia CEO and leaders in politics such as Lee Hsien Loong, Singapore PM, more work is pending if the region will gain the complete benefits including competitiveness. The leaders have stated that the work will proceed to later than 2015 to realize the vision. However, this should not be taken to mean that the region has not been achieving the desired benefits, thanks to the ASEAN (Ing & Cadot, 2016). The regional trading bloc is a greatly advanced block that has made huge steps towards realising its vision, and is likely to realise the remaining benefits within the next few years. One of the efforts that are underway is the reduction of trade tariffs, a factor that plays out in its becoming more competitive.

Evidently, most part of the work has been completed towards making ASEAN more competitive. ASEAN economies and businesses are reaping the great benefits of being part of the block. A report has been produced by the Association of Southeast Asian Nations "Thinking Globally, Prospering Regionally – ASEAN Economic Community 2015" (Ing & Cadot, 2016). The report has highlighted the current achievements and the work that remains to be done in making the community stronger economically. The trading bloc has created a market of more than 600 million consumers. It has an overall Gross Domestic Product (GDP) of about US\$3 trillion. It has major prospects in terms of continued economic growth and development, for the greater good of the region and the individual countries. The future of the region is even brighter.

## DISCUSSION

Reconstruction of the rules that govern the law of competition is a positive step that will help to regulate business transactions that are conducted outside of the laws created for trade in the ASEAN community. The impact of reconstructing the competition rules will majorly be felt by the domestic markets (Das et al. 2015). The policies that govern competition will be critical in ensuring that there is a free flow of goods and services. These laws will only have a positive impact if they are adopted by all countries within the ASEAN community.

The competition policies and the law will also be necessary to ensure the integration of services and trading activities in one market. This will be majorly facilitated by the free movement of labor. This far, the ASEAN economic community has been able to establish a competitive economic region (Dosch, 2015). It is necessary that the ASEAN countries have an agreement as to the rules that will be used in ensuring a healthy competition. These rules will enable them to compete in the international market.

It is important for the current competition laws to be reconstructed for ASEAN countries to be able to adopt these standards universally. The reconstruction of these competition laws will ensure that the welfare of the residents of South East Asia is improved (Ing&Cadot, 2016). The efficiency of ASEAN member countries will also be increased to quicken economic development within the region. Reconstructing competition laws and regulations will also help to ensure that there is fair competition within the member countries of the ASEAN economic community (Dosch, 2015). This fair competition will guarantee a conducive business environment for the establishment of small-scale businesses, medium scale businesses and large scale enterprises to be successful. Restructuring of the laws is also an important step towards ensuring that unfair competition and monopolistic practices are curbed (Ing&Cadot, 2016).

Monopolistic competition is common among entrepreneurs who have large scale businesses. These policies are usually adopted to ensure that competitors are kept away from the market. Reconstructing competition laws will also ensure efficiency and effectiveness in conducting business activities in ASEAN countries (Jurje, f., & Lavenex, 2016). The tagline of the ASEAN community is clear that it is necessary for legislation to be formulated to ensure that the ASEAN economic community operates efficiently and effectively.

These laws are crucial in acting as a means for providing direction for the ASEAN community as it seeks to attain its objectives. Different officials of the ASEAN economic community have clearly stipulated that entrepreneurs within the establishment have to abide by the rule of law if they are to achieve any substantial economic gains from the community (Menon & Melendez, 2015). Competition law provides a legal framework which ensures that the rights and the obligations of all business parties are protected at all times.

Competition law also makes it possible for entrepreneurs to operate businesses with an ability to project the future. This enables the mumto design growth plans and budgets. As a consequence of the competitive law, entrepreneurs can gain legitimacy for their businesses (Mohan, 2015). The competition law also creates confidence in businesses making it possible for more entrepreneurs to enter the market. Confidence in the business framework is also as a result of the availability of the legal framework to provide solutions to business conflicts.

As such the competition law is perceived by economic stakeholders as a behavioral control tool which seeks to establish standard practices for entrepreneurs. This law also ensures that entrepreneurs who disregard the set standards are faced with punishment. The competition law also works as a tool that sets the environment for healthy competition. If the law is not implemented effectively, then the aspirations and the functions of the ASEAN economic community will not be achieved (Nguyen et al. 2016). The basic survival and continued success of the ASEAN economic community are based on a common arrangement among ASEAN countries which have shared commitments.

This agreement has been signed by the heads of government of the ASEAN member countries. This blueprint provides that all countries are required to play the role of practicing fair trade in an open and competitive manner within the ASEAN economic community (Ofreneo & Abyoto, 2015). The guiding principles of the ASEAN economic community are to ensure that there is a continued understanding of the commitments and the limitations of the freedoms enjoyed. This community always aspires to achieve its targets through the set vision of ASEAN 2020.

In the production and flow of goods within the community, there have been problems that have required legal solutions. Since the declarations of the ASEAN economic community do not provide solutions for disputes that occur in the ASEAN economic community, it is important that there be an established system of resolving the violation of the set laws and agreements (Pangestu, 2015). The agencies that are mandated to resolve disputes arising within the ASEAN economic community should be allowed to provide solutions which are binding and final. This will ensure that effectiveness and certainty becomes a hallmark of business transactions within the ASEAN community.

Such an agency will also guarantee that obligations are met and that the balance of rights is observed. To achieve an environment where healthy competition is possible within the ASEAN community, there must be a realization that entrepreneurs are synonymous with economic activities (Papademetriou et al. 2016). This will ensure that rules are enforceable within the community. This is especially necessary for an era where the ASEAN economic community is bent on creating an environment where goods and services move freely. It is required that competition among entrepreneurs becomes more open to ensure that unfair practices by entrepreneurs who aspire to gain supernormal profits are curbed. Several steps can be implemented to ensure that unfair competition is adequately controlled (Pangestu, 2015).

The principle of honesty as provided in regulation 95 of 1999 clearly enumerates the principles that must be observed to ensure fair competition between service providers (Pangestu, 2015). This law requires there to be a complete and a binding document that is recognizable by all parties involved. It also requires the admission of a lateral position between service providers and the users of these services.

Transparency in electoral processes in ASEAN countries are deemed necessary to ensure that the chances of fair competition commensurate the necessary provisions and capabilities. The principle of fair competition is required for the tender process to ensure that service users have access to reliable service providers. This ensures that jobs are generated over the set period. Principles of fair competition also set a business climate which supports the required development and growth of service providers. Article 23 and 22 of law number five in 1999 describes the principle of fair competition (Piris & Woon, 2015).

This regulation also explains the behavior that constitutes illegal acts by entrepreneurs. It states that entrepreneurs are prohibited from conspiring with other parties to determine the winner of a tender with a view of locking out other parties. This regulation states that the tendering process should always be transparent, the rule also prohibits entrepreneurs from conspiring with other individuals to receive private information on the business activities of their competitors (Secretariat, A. S. E. A. 2015). Acquisition of information that is not of public knowledge is considered to be a form of unfair competition. Principles of fair competition are deemed necessary to ensure that monopolies, collusion, inefficiency, and corruption are eliminated.

The adoption of the principles of fair competition is also needed to ensure that state losses are mitigated. The principle of transparency requires that information is available for it to be accessible by all service providers. The principle of transparency creates a fair ground for all service providers to compete in an auction process (Siraprasiri & na Thalang, 2016). The administrative requirements, evaluation of the results and the determination of the candidates who win is required to be transparent. By applying the principles of transparency, ASEAN countries can ensure that the auction process is socially reliable.

The principle of transparency also makes a provision for citizens to correct a sale if they observe that there are irregularities in the system. Law number 5 of 1999 prohibits monopolistic practices and an environment that propagates unfair competition. To ensure that this regulation is fully implemented, the law allows citizens to supervise implementation (Somjai & Moussa, 2016). This law also allows citizens who are aware of entrepreneurs who have violated this law to report them to a created Commission with details of the violation. The principle of fair competition is established to ensure that all prospective service providers are given appropriate treatment.

This allows them to enjoy all the advantages and access to information that is available to all parties. This principle emphasizes egalitarianism and non-discrimination in the treatment of service providers. The principle of equity ensures that all sides within the ASEAN community are accorded the same liberties (Verhezen et al. 2016). The principles of proportionality competition in ASEAN communities allows entrepreneurs to be given access to the international market. This is because this policy recognizes that competition is the essence of businessmen and that it is a prerequisite for economic development.

The principle of proportionality competition allows competition among businesspeople to be more open. This is because this policy recognizes that competition is vital to ensure efficiency and market transparency. Research has shown that free competition ensures efficiency in the activities of businesspeople to make sure that nonefficient businesses do not continue to operate (Yean & Das, 2015). Competition is good when it is moderated since it allows the firms which are most efficient to have access to the market and the available resources. Unregulated competition is harmful to small scale and medium scale businesspeople.

Service providers and micro enterprises may also be harmed if large scale businesses are allowed to set market prices. It is the requirement of fair competition to allow market participants to have an equal role in determining the actions taken in the market. The principles of balance and proportionality are inseparable with competition (Yoo & Kim, 2015). This is because businesspeople use competition as a means of developing their businesses and furthering their interests. By some descriptions and principles, it has been seen that laws that relate to fair competition do not show positive results in the dimension of ensuring harmonious coexistence among businesspeople.

It is common practice among entrepreneurs to constantly conspire with one another to manipulate the prices and the flow of goods and services in the market. As a result, this collusion creates a toxic environment which threatens the existence of micro businesses and small business operations. To create a business climate which is fair and competitive, there should be a thorough research on the existing laws (Pangestu, 2015). The ASEAN economic community comprises of the ten countries of southeastern Asia. Implementation of these regulations that allow for fair trade practices will ensure that this region continues to evolve as one of the most dynamic economic zones. The ASEAN plays a significant role in ensuring that the trade and investment activities within the economic zone are liberalized.

Fair competition is critical in the process of liberalization since these countries are expected to create a conducive climate for trade and investment. Because most of the ASEAN communities have deregulated and liberalized economies, it is necessary for their economies to adopt practices and regulations that promote fair

competition (Yoo & Kim, 2015). This will be beneficial in ensuring that cross-border cooperation and openness increases over time. Bilateral and regional trade pacts that continue to be signed in the ASEAN economic community necessitate the need for a competition law. Competition law has been perceived by business analysts as an effective way to reduce regulatory and administrative barriers. This is necessary to ensure competitiveness in ASEAN economies to promote economic growth.

## CONCLUSION

The mandate of the ASEAN economic community is to ensure fair competition among all the stakeholders and the member countries. This fair competition is considered necessary to help the Association of South East Asian nations to achieve their target of empowering them economically to enable them to compete with western countries which are advanced economically (Dosch, 2015). It is, therefore, necessary to establish laws which ensure fair competition among all the entrepreneurs in ASEAN countries.

To make sure that fair competition is achieved in the ASEAN economic community, it is important for policymakers to consider the incorporation of the principles of competition. Some of the required principles of competition include the principle of transparency, the principle of proportionality competition law and the principle of honesty. The application of all these policies jointly will ensure that the ASEAN economic community can establish laws and regulations that mitigate unfair competition within the region (Ing & Cadot, 2016). Establishment of a legal framework and agencies which are tasked with the responsibility of implementing these laws will ensure that a uniform standard applies to all member states of the ASEAN economic community.

## Suggestions

- It is imperative that all the members of the ASEAN economic community create a general agency that will be charged with enforcing the laws and regulations that are developed by the ASEAN legal board.
- It is also necessary for member countries of the ASEAN economic community to develop a common legal framework that will act as a guiding principle for the resolution of disputes that are common among entrepreneurs of the ASEAN economic community.
- It is also necessary that entrepreneurs be included in the formulation of these laws to ensure that the laws created do not lead to a strained relationship between entrepreneurs after dispute resolution.

**CONFLICT OF INTEREST**  
There is no conflict of interest.

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# IMPROVEMENT OF LVRT CAPABILITY BY COMBINING -SWITCH TYPE FAULT CURRENT LIMITER AND SUPER CAPACITOR FOR DFIG BASED WIND TURBINES

Srinivasan P<sup>1\*</sup>, Dhandapani Samiappan<sup>2</sup>

<sup>1</sup>Dept. of Electrical and Electronics Engineering, Saveetha University, Thandalam, Chennai, INDIA

<sup>2</sup>Dept. of Electronics and Communication Engineering, Saveetha Engineering College, Thandalam, Chennai, INDIA

## ABSTRACT

**Background:** An improved Low Voltage Ride Through (LVRT) control approach for a Doubly Fed Induction Generator (DFIG) based Wind Energy Conversion System (WECS) is offered in this paper. DFIG is sensitive to grid voltage variation; hence it requires reactive power support to overcome this drawback for safe and stable operation of power grid. The DFIG is interfaced to the AC network through a Grid Side Converter (GSC) and a Rotor Side Converter (RSC) to facilitate the variable speed operation of the wind turbine. When compared with pitch angle control, rotor side converter and grid side converter is simple and permits rotor speed to increase further than the prescribed value. Grid side converter (GSC) control diminishes the DC link instability and Rotor Side Converter (RSC) control reduces the transient current during the period of fault. The benefit of energy storage, which helps to improve the LVRT, is also applied. **Methods:** The Switch Type Fault Current Limiter (STFCL) and Super Capacitor (SC) are the two essential proposed methods used in this system. The STFCL excellently decreases the over current in the rotor side throughout the fault. Since the Fault Current Limiting Inductors are located in series with the stator to limit the rotor over current throughout the fault. On the other hand SC improves the system stability. It has huge power concentration to balance the system power. **Results:** The viability of the proposed method is established by the experimental results on a 1.5 MW DFIG system using MATLAB/SIMULINK software. From the above methods, the design of energy storage and STFCL with control on RSC and GSC the rotor voltage, current, real and reactive power remains within the safe working limit throughout the period of fault. This control works for both symmetrical and asymmetrical fault. **Conclusions:** The proposed control technique enables DFIG to carry on the power production during fault and offer the reactive power support to the grid. With this scheme, rotor current and voltage waveforms are enhanced. The torque oscillation is reduced and successfully suppressed the transient rotor current.

## INTRODUCTION

Demand of energy is increasing now a days and found difficult to balance the supply of power and demand with the conventional fossil fuel power plants. Due to the rising concern of green environmental protection and reduction of conventional sources, renewable energy is becoming an interesting subject. Among all existing non conventional energy source, wind electrical power significantly produces bulk value of electrical power. Wind power is fresh and renewable. Exponential raise of the wind electrical power generation has prepared the power system network more susceptible to the grid disturbances. Many countries revised their grid code to make sure the steady operation of the power system. LVRT is one of the most essential grid code requirements, which requires that wind turbine should stay connected to the grid and supply the stability throughout the fault. The wind system should stay connected to grid during fault and supply reactive power support to the wind system. DFIG is accepted in wind power market. Even though DFIG can generate more power, it has less mechanical stress and has independent control of active and reactive power, but less stable and consistent system. The typical DFIG wind turbine is shown in Fig.1[1].

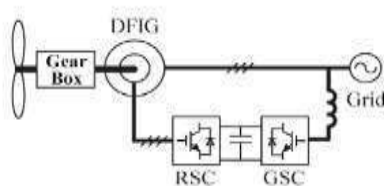


Fig. 1: Configuration of DFIG based WECS

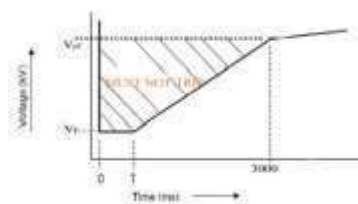


Fig. 2: A Typical LVRT Curve

In this system, the stator is connected to the grid and rotor is connected through a back to back converter fed to the grid. LVRT is the ability of the wind system to stay connected to the grid even with a serious voltage issue. When system becomes abnormal like voltage sag, it may cause certain undesired characteristics on equipment like uncontrolled active and reactive power and diminishing grid code requirements. When a grid fault occurs, the voltage across the rotor circuit becomes high which results in demagnetizing effect. Hence large inrush current flows in rotor and Stator circuit [1]. This paper proposes a combined protection and control strategy including the Super Capacitor (SC) and Switch Type Fault Current Limiter (STFCL). On selection of a suitable value for DC side super capacitor (SC), in such a way that it could facilitate wind turbine for LVRT without any need to crowbar protection. In [2] the integration of a short-term energy storage device in a DFIG design was considered in order to smoothen the fast wind-induced power variations thereby enhancing its low-voltage ride through (LVRT) capability. A decoupled P-Q control scheme of a super capacitor energy storage system was proposed in [3], this energy storage interfaced through a STATCOM, for Low Voltage Ride Through as well as damping enhancement of the DFIG system. Two-layer constant power control scheme has been proposed[4]. In

**KEY WORDS**  
 Doubly fed induction generator (DFIG), Low Voltage Ride Through (LVRT), Super capacitor (SC), Switch type fault current limiter (STFCL)

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\*Corresponding Author  
 Email:srinivasp808@gmail.com  
 Tel.: +91-9840871808

this scheme, each DFIG wind turbine in the wind farm is equipped with a super capacitor energy storage system. On the other hand STFCL inserts fault-current-limiting inductors into the stator branches upon event of a grid fault, which helps weaken the rotor back-EMF voltage and diminish the rotor over current. The LVRT capability of RSC is therefore successfully strengthened. The existing crowbar circuit provides a bypass for the fault current, whereas the STFCL limits the fault current and rotor back-EMF voltage and strengthens the controllability of RSC. The crowbar circuit can only protect the DFIG from overcurrent, whereas the STFCL can protect the DFIG from overvoltage, overcurrent, and overtorque simultaneously. The STFCL can also offer better reactive power support for the grid with the improved controllability of RSC. With the help of STFCL, the DFIG is able to ride through the most serious grid faults [5].

## GRID CODE REQUIREMENT

Due to the considerable raise of wind power penetration in the electrical power system, several countries have revised their grid code by essential detailed technical requirements for the wind farms. Grid code typically refers to huge wind farms, which is linked to the transmission system. Grid codes state that wind farms must contribute to power system control as much as conventional power generation stations and withstanding of wind system during unusual condition. The Grid Codes address fault acceptance, reactive power/voltage control requirements, ramp rate control and frequency response ability. The typical LVRT curve as per Indian Wind Grid Code(IWGC) is shown in [Fig.2].

## EXISTING CONTROL METHODS

LVRT capability enhancement techniques use existing methods such as crowbar circuit, DC chopper, series dynamic braking resistor, reverse current tracking method, stator current feed back technique, flux linkage tracking, rotor side converter control, grid side converter control, turbine drive train model and pitch angle control are discussed below

### Crowbar method

Crowbar method is the conventional method to enhance the LVRT capability of the wind turbines. Fig.3[6] shows the crowbar circuit. During voltage dip, the rotor circuit is disconnected and the DFIG run as squirrel cage induction motor. The operator can organize the switching by adjusting the triggering. By adjusting the value of crowbar resistance, operation of crowbar may vary. This is the simplest method and has the advantage of low cost. The foremost difficulty is its high short circuit current at the time of voltage sag, thereby drawing more reactive power from the network[6]. There are different methods to improve the stability namely passive crowbar, active crowbar and stator crowbar.

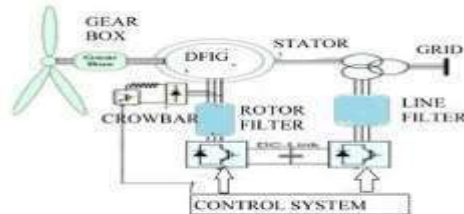


Fig. 3: A Typical Crowbar circuit

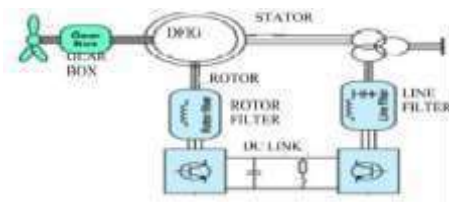


Fig.4: A Typical DC chopper circuit

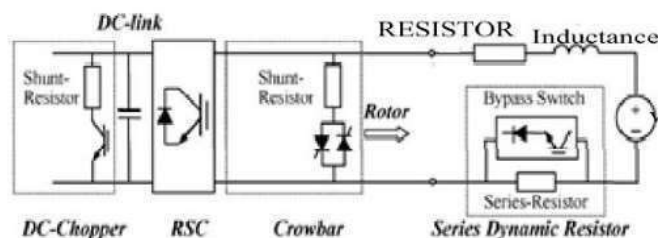
### DC Chopper

DC chopper is also known as braking resistance which is linked in parallel with the dc link capacitor to limit the over voltage and current during abnormal condition. [Fig.4] shows the schematic diagram of DC chopper. The dc-link brake chopper shorts the dc-link through a power resistor when the dc-link voltage exceeds a fixed threshold level. The brake is used to uphold the dc-link voltage when transient rotor over current occurs[8]. There are six anti parallel diodes in the rotor-side converter that are extremely rated to endure short-circuit currents. The brake chopper works on a hysteresis band i.e., the turn-off voltage is set below the turn on threshold value.

The dc-link chopper has no effect on rotor over current. To limit this over current, a dynamic resistor is linked in series with the rotor. It is controlled by a power electronic switch.

### Series dynamic braking resistor

The Series Dynamic Braking Resistor (SDBR) boosts the generator voltage and dissipates the active power[8]. At normal operation, the switch turns on and the resistor is bypassed. During the fault condition, the switch turns off and the braking resistor is connected in series with the circuit[9]. The DFIG rotor equivalent circuit with all protection schemes is shown in [Fig.5].



**Fig.5:** A Typical Series dynamic resistor circuit (SDR).

### Reverse current tracking method

The proposal behind this control method is during the fault time an EMF is induced which exceeds the utmost output voltage of rotor side converter. The rotor current is controlled to track the stator current in the reverse direction. There by prevents the rotor current in a definite range with restricted RSC output voltage. No need of flux linkage or sequence component separation. This technique reduces the fault current with little torque oscillation [10].

### Stator current feedback technique

Stator Current Feed Back method is presented in[13].This method aims to decrease the rotor current by varying the RSC control instead of installing additional hardware protection like a crowbar in the wind turbine system. When a fault affects the generator the exact and distorted stator currents are fed back as orientation for the rotor current controller. The purpose is to decrease the stator current oscillations and thus reduce the rotor current.[11].

### Flux linkage tracking

LVRT control approach based on flux linkage tracking is intended for RSC to restrain the rotor current throughout grid faults. The essential attitude of the control approach is that, when a grid fault is detected the rotor flux linkage is prescribed to track a condensed fraction of the altering stator flux linkage by changing the output rotor voltage of the RSC. As long as the dissimilarity between  $\psi_s$  and  $\psi_r$  is kept small enough, the rotor current will be restricted within the maximum current allowed. This technique suppresses the rotor current with lesser torque oscillations, suitable for industrial applications.[1].

### Wind turbine and drive train model

Wind turbines are systems that tie the kinetic energy of the wind for constructive power. Wind flow causes the shaft to spin. The resultant shaft power can be used for mechanical work, like pumping water, or to revolve a generator to produce electrical power. Two mass model of the drive train is accessible at this juncture. Wind turbine shaft is comparatively softer compared to the steam turbine shaft used in the conservative system [15].

#### Pitch Control

The pitch angle of the blade is controlled in order to optimize the power extraction from the wind. PI controllers are used to attain the pitch control. While the speed increases above the rated value, pitch angle increases by PI controllers to preserve the power output to its rated value. Pitch angle of the blade is prohibited to protect wind system from over rated power throughout the high wind speed.

#### Rotor side converter control

RSC control system presented in is used at this juncture. PI controllers are used for the regulation of reactive power control and rotor current. In order to decouple the electromagnetic torque, the induction generator is controlled in the stator flux oriented frame.  $\omega_{ref}$  value is created by wind turbine. When a fault occurs, the

incoming wind and power to the grid are unbalanced resulting a transient over current in the rotor circuit. During the fault period RSC will enlarge the generator rotor speed at the identical moment reducing the generator torque [15]. This method will not cause too much mechanical stress.

### Grid side converter control

Converter control is operated in the grid voltage oriented reference frame to attain the independent control of active and reactive power [15]. PI controllers are used for the regulation of DC link voltage. During usual operation time, power flowing to the grid and RSC is balanced, at the time of fault extreme power flow between RSC and grid will lead the DC variation. To decrease the  $P_r/V_{dc}$ , the instantaneous variation of output power of RSC is set as the reference value[15].

The above existing methods discussed have few drawbacks, in case of crowbar method, significant power will be dissipated in the crowbar resistors during high voltage sags, thereby drawing more reactive power from the grid[2]. The dc-link chopper has no effect on rotor over current. The series dynamic braking resistor boosts the generator voltage and dissipates the active power. The reverse current tracking method reduces the fault current with little torque oscillation. In case of Pitch angle control, the blade is prohibited to protect wind system from over rated power throughout the high wind speed. All the available methods in existing system has its own difficulties to enhance the LVRT performance.

## METHOD

Methods introduced in the past have certain boundaries for improving the performance of LVRT. Moreover it controls various parameters or it works only for certain type of liability. Here the scheme of energy storage and STFCL with a superior control on RSC and GSC is introduced to get better performance of system. The DFIG control includes the rotor side controller, grid side controller, STFCL and the super capacitor for improving the performance.

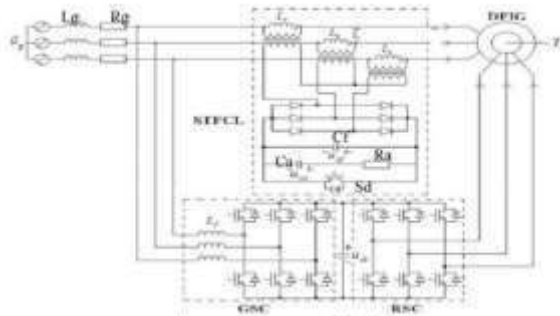
### STFCL Control

Switch Type Fault Current Limiters (STFCL) have been planned with purpose of fault current control. SFCL has been presented at this juncture. It consists of fault current limiting inductors, isolation transformer, diode bridge, semiconductor switch and snubber capacitor. Snubber capacitor suppresses the transient over voltage when the semiconductor switch turns off. During the normal condition, semiconductor switch turns on and fault current inductors are bypassed. Semiconductor switch turns off during fault time, at first, fault current is limited by the fault energy absorption. The complete structure of SFCL with DFIG is shown in [Fig.6] [16].When the voltage  $C_a$  reaches the crest value, the fault current limiting inductors are completely inserted to stator to limit stator over current and thereby weaken the rotor back EMF. STFCL can protect not only the RSC from overcurrent and overvoltage but also the gear box from overtorque. The DFIG can ride through the most serious grid fault under well protection with the help of the STFCL.

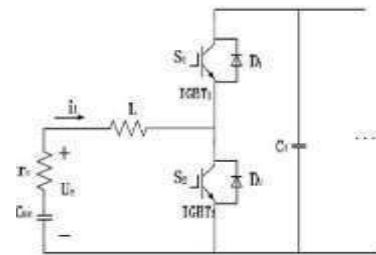
Since overcurrent and overtorque are eliminated, the DFIG system can be well protected. The stator flux oscillations are much lighter than that without STFCL, which is because the rotor back-EMF voltage is weakened with the help of STFCL, and the RCS controllability is improved to counteract the stator flux oscillations. Moreover, rotor current and electromagnetic torque oscillations are fewer important, which is also due to the weakened rotor back-EMF voltage with the help of STFCL. The grid voltage also recovers quickly and smoothly than that of the without STFCL cases, which is due to the enhanced reactive power controllability provided by the STFCL [5].

### Super capacitor

Super capacitor (SC) energy storage system improves the system stability. Super capacitor storage has big power concentration, long life cycle and good environmental performance makes feasible to balance the system power [14]. The DC-DC converter can work in three states [16].(a) Charging mode-SC charges up during this method, if surplus energy available in the grid due to light loaded condition. Converter works as a buck converter. (b) Discharging mode- SC deliver the energy to the grid to give back the voltage sag due to high load demand. Converter works as a boost converter. (c) Under normal operating condition, there is no real power exchange.



**Fig.6:** Switch Type Fault Current Limiter



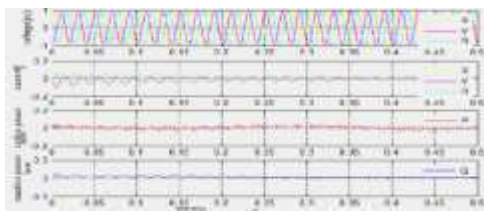
**Fig.7:** A Typical DC-DC converter.

DC-DC converter is controlled by two switches S1 and S2. During the increase in demand period S1 is controlled to cut off IGBT1 and branch of IGBT2 and D1 forms a boost converter. In light load period, buck converter is joined by IGBT1 and D2. By controlling the corresponding switches S1 and S2, DC-DC converter operates alternately.  $V_{dc}$  chooses the mode of operation of the DC-DC converter. When  $V_{dc}$  rises beyond the threshold value DC-DC converter works as a buck converter, When  $V_{dc}$  decreases below the rated value DC-DC converter works as a boost converter. In this method short-term energy storage device (SC) in a DFIG design was considered in order to smoothen the fast wind-induced power variations thereby enhancing its low-voltage ride through (LVRT) capability. A Typical DC-DC converter is shown in [Fig.7] [7]

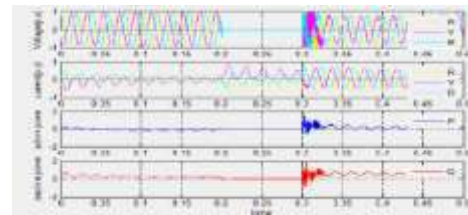
Hence by combining STFCL with SC can effectively answer the issues of DFIG during fault. STFCL limits the fault current and rotor back-EMF. The torque oscillation is reduced and successfully suppresses the transient rotor current whereas SC is allowed to be charged during the high wind speed, and this stored energy can be used as an extra energy supply for DFIG to overcome low voltage sags during faults in the grid side. Thus the above combined method provides reactive power support to the grid[2,4,5].

### ANALYSIS

For the purpose of analysis of the DFIG scheme throughout normal and faulted condition the following system is considered. DFIG of power 1.5 MW is considered here. The stator of DFIG is connected to a 575V bus. By using a step up transformer of 575V/25kV 4MVA the voltage is stepped up to 25KV. Connected to grid through a 20Km transmission line. A fault has occurred in the 20Km transmission line. The wind speed is set in to three different speeds. The fault is created at 0.2 sec and the equivalent wind speed at that time is 12m/sec. The whole system is developed and simulated in MATLAB/SIMULINK. The waveform in [Fig.8] shows the behavior of DFIG WT system during normal operation. The system parameters are represented in per unit value. The rotor voltage is 1 pu. The output waveform in [Fig.9] shows the behavior of DFIG WT system during symmetrical fault with no control on RSC and GSC. Exclusive of the appropriate control on DFIG scheme, at the time of voltage sag, system parameters are affected ruthlessly. Fault with duration of 100 ms is created here.



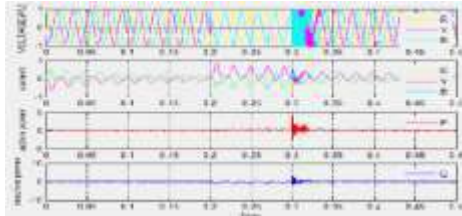
**Fig.8:** Waveform of DFIG during normal operation



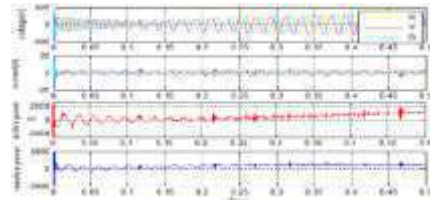
**Fig.9:** Waveform of DFIG during symmetrical fault with conventional method

The fault period is 0.2-0.3 sec. When the symmetrical three phase fault lacking enhanced control is detected, the grid voltage is decreased and the voltage becomes zero. The current is very high during this time. The real and reactive power is zero through the period of fault. [Fig.10] shows the LLG fault on the 20Km Transmission line. Here the rotor current is high and real and reactive power is almost zero with unpredictable nature. All parameters are represented in per unit value. By analyzing the waveform, throughout the fault period the voltage and current waveforms are extremely distorted. Also the real and reactive power waveform shows that throughout grid fault DFIG is disconnected from the grid. [Fig.11] shows the output waveforms of DFIG WT under the SLG fault with the proposed control method with fault at 0.2-0.3 sec, here the voltage, current waveform distortion is reduced. The preliminary variation is due to the rapid change in speed. Real and reactive power fluctuations are reduced with the

proposed method.[Fig.12] shows the waveforms of DFIG WT with proposed control during LLG fault at 0.2-0.3 sec. The rotor current and voltage waveform gets improved. The rotor transient current is effectively controlled at this time. The fluctuation of real and reactive power is reduced. With the conventional method , the performance of DFIG under LLG fault is shown in [Fig.10]. Here voltage of faulted phase is zero while with the proposed method the voltage waveform is maintained in the fault period. Likewise the rotor current is suddenly increased with the conventional technique as shown in [Fig.10], but with the control, the unexpected increase in the rotor current at the time of fault is effectively reduced. The real and reactive power waveform is enhanced compared with the conventional system.

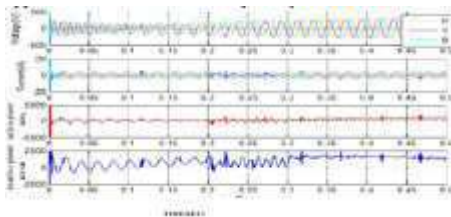


**Fig.10:** Waveform of DFIG during asymmetrical (LLG) fault with conventional method

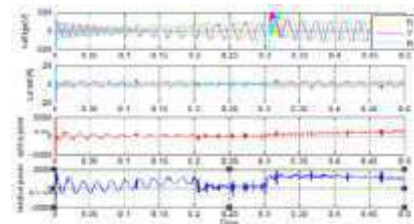


**Fig.11:** Waveform of DFIG during SLG fault with proposed method

[Fig.11] shows the waveform of DFIG WT under SLG fault with proposed control method. This technique is also suitable for the symmetrical fault. [Fig. 13] shows the output waveform under symmetrical fault. The rotor voltage and current waveform fluctuation is reduced. Also the real and reactive power does not dips to zero. Minute fluctuation occurs in the real and reactive power. Fig.9 shows the performance with conventional system, real and reactive power is zero throughout the time of fault, which means the scheme is disconnected from the grid. But proposed system with energy storage help to unite the machine at the time of fault and offers the reactive power support to improve the LVRT potential.



**Fig.12:** Waveform of DFIG during LLG proposed method.



**Fig.13:** Waveform of DFIG during fault with symmetrical fault with proposed Method.



**Fig.14:** Rotor speed Vs output power.

The [Fig.14] shows the rotor speed waveforms with the proposed control technique. The torque value is almost constant with the proposed method. Proposed method can effectively control the rotor current, voltage, real and reactive power and contribute the grid permanence. Conventional method, the DFIG is disconnected from the grid, due to the over current in the rotor during fault and failed to contribute the scheme stability and reliability [12]. From the output waveform of conventional method, it is obvious that the real and reactive power grow to be zero and fluctuation of rotor voltage and current is large and it affects stability, will unfavorably affect the power electronic converter in the system. With the proposed system, by incorporating the idea of energy storage and STFCL with control on RSC and GSC the rotor voltage, current, real and reactive power remains within the secure operating limit throughout the period of fault. Even though there are fluctuations in real and reactive power, the control effectively controls the voltage and current. This control works for both symmetrical and asymmetrical fault.

## CONCLUSION

Low Voltage Ride Through is a significant characteristic for wind turbine systems to complete the grid code requirements. DFIG is very sensitive to grid voltage variations. To overcome this, appropriate control must be implemented to protect the converter from tripping during grid voltage faults. High current transients cause voltage fluctuations, rotor current, torque variations and DC link voltage fluctuation. With the conventional crowbar method, the rotor circuit draws higher value of short circuit current at the time of voltage sag, thereby drawing more reactive power from the network. This method is not satisfactory when wind power generation is considerable. As the dispersion of wind turbine increases, wind turbines are necessary to stay connected throughout grid fault. From the analysis, it is found that conventional DFIG WT system faces troubles during grid voltage dip. The proposed control technique uses super capacitor combined with STFCL can effectively answer the issues of DFIG during fault at 0.2 – 0.3 sec. STFCL limits the fault current and rotor back-EMF on the other hand the SC is allowed to be charged during the high wind speed, and this stored energy can be used as an extra energy supply for DFIG to overcome low voltage sags during faults in the grid side.

This combined method enables DFIG to carry on the power production during fault and offers the reactive power support to the grid. With this scheme, rotor current and voltage waveforms are enhanced. The torque oscillation is reduced and successfully suppresses the transient rotor current. The only drawback of the method is bulkier compared to crowbar circuit, but considering the stupendous LVRT attractive potential the arrangement is very successful. This process protects the structure from over voltage, over current and over torque, and it works for both in symmetrical and asymmetrical fault.

## CONFLICT OF INTEREST

There is no conflict of interest.

## ACKNOWLEDGEMENTS

None

## FINANCIAL DISCLOSURE

None

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# A STUDY OF THE REMOVAL OF NATURAL ORGANIC MATTER (NOM) BY ZEOLITES CLINOPTILOLITE AND SYNTHETIC TYPE A LOADED WITH TITANIUM DIOXIDE WITHOUT DIRECT RADIATION OF LIGHT

Ramezan Ali Dianati Tilaki, Sharaf Nesa Alaei Fard\*

Department of Environmental Health Engineering, School of Public Health, Mazandaran University of Medical Sciences, Sari, IRAN

## ABSTRACT

**Background:** Titanium dioxide as an effective semiconductor used in the process of photocatalyst to easy recover and isolate it from the water on passive porous matters. The study aimed to determine and compare the removal of dissolved organic matter from water by zeolites clinoptilolite and synthetic loaded with titanium dioxide in non-loaded state. **Methods:** Zeolites clinoptilolite and synthetic type A covered by titanium dioxide nanoparticles via co-precipitation method using titanium tetraisopropoxide and ethanol was prepared. Studied concentrations were organic carbon dissolved in the water 3, 5 and 10 milligrams per liter. Discontinuous experiments has been performed at different contact time, different adsorbent dosage and conditions of acidic, neutral and alkaline at room light (Klux3-2). Reaction kinetics and isotherm were studied. Continuous experiments in the column containing the adsorbent used with Dbi 1.66 ml/min were studied. Dissolved organic matter by dissolved organic carbon analyzer was measured. **Results:** In the study, optimum pH was determined 7, optimum and maximum time of removal of clinoptilolite and modified synthetic type A for 10 minutes and, the best adsorbent dosage, was 20 g/l and 50 g/l, respectively. Absorption kinetics was pseudo-second degree and in the isotherm experiment, zeolite clinoptilolite and synthetic loaded follow by Langmuir and Freundlich isotherm. In the continuous experiments in clinoptilolite column and modified synthetic after 90 BV, 130 failed respectively. **Conclusions:** In the presence of natural light the removal of zeolite clinoptilolite and synthetic loaded with TiO<sub>2</sub> has higher efficiency in the removal of dissolved organic matter than non-loaded showed.

## INTRODUCTION

Photocatalysis is rate of photodegradation that in the presence of a catalyst increased. Transition and semiconductors metal oxides (TiO<sub>2</sub>, ZnO, ZrO<sub>2</sub>, CdS, WO<sub>3</sub>, etc) are the most common Heterogeneous light catalysts. They are mainly used in water treatment, waste, air and energy production are used. Semiconductors to destroy photocatalytic organic molecules are usually oxides and metal sulphides [1]. TiO<sub>2</sub> is neutral substance, non-toxic, suitable photocatalyst that can be used in water and wastewater treatment due to having the photocatalyst property considered [2].

Matter removed by TiO<sub>2</sub> into two mechanisms adsorption TiO<sub>2</sub> and photocatalyst oxidation occurred. The process of removal by TiO<sub>2</sub> should be noted that absorption occurs faster than photocatalytic oxidation. However, application of TiO<sub>2</sub> as attractants or photocatalytic due to a problem retrieving in water was limited. For this reason, various passive methods are examined [3]. The use of preservatives is one method of increasing of photocatalytic activity of photocatalyst which can increase the effective surface area or form photocatalytic in the structure of the nanofibers [4]. The combination of zeolite and TiO<sub>2</sub> to remove many substances, such as humic acid, nitrogen oxides and volatile acetone, 2-propanol in the presence of visible and ultraviolet light is used [3,5].

Mixture natural organic matter derived from organic compounds with different molecular weight and diverse chemical nature such as humic acid with high molecular weight and fulvic acid with low molecular weight [6]. This is a complex mixture of organic compounds containing both hydrophilic (phenolic and carboxylic) and hydrophobic humic substances (HS) (aromatic, aliphatic) [7]. Humic substances consists the bulk of organic matter dissolved in water and it is about 90% soluble organic carbons [2]. NOM can influence smell, taste and color of raw water as well as the growth of bacteria in drinking water and reduce the efficiency of water treatment [8].

The potential of formation of Disinfection By-Products (DBPs) such as trihalomethanes (THMs) and Haloacetic acids (HAAs) are suspected to carcinogenic [9, 10]. Health risks such as Bladder cancer and other have been attributed to the consumption of water containing DOC and DBPs [11]. Properties of NOM including structure (aromatic, aliphatic, hydrophilic and hydrophobic nature), Average Relative Molecular Mass (RMM), distribution RMM, distribution and density load are the most important factors in the formation of DBPs [12].

Concentrations of organic matter in the exhaust secondary treatment are typically about 6-10 mg/l in terms of total organic carbon (TOC) [13].

Thus, effective removal of NOM in water increasingly in water treatment systems is important and coagulation and flocculation is common method for removal of NOM and large particles during treatment processes [6]. Also several methods of removing NOM from natural water sources, such as ozonation, advanced coagulation, membrane separation, carbon adsorption, biodegradation and advanced oxidation processes (AOP) has been carried out [14].

### KEY WORDS

Dissolved organic carbon, Zeolites, Dioxide titanium, Adsorption

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### \*Corresponding Author

Department of  
Environmental Health  
Engineering, School of  
Public Health,  
Mazandaran University of  
Medical Sciences, Sari,  
IRAN



Most of these methods have high cost and sludge disposal resulted of treatment is difficult [15]. Of these absorption methods has wide application and a wide range of absorbents such as activated carbon, Granular ferric hydroxide, natural minerals such as zeolite, Iron oxide and silica and carbon nanotubes have been used and examined [3]. Three-dimensional Aluminosilicates zeolites with porous structure has physical properties such as cation exchange, screening molecules, and as they catalyze and attract negatively charged on their surface, are dominant which thus had the high cation exchange capacity and organic matters tend to absorb a little while anions in the aquatic environment [3].

Zeolites also to remove pollutants, such as heavy metal ions, ammonium, inorganic anions, phenols, pesticides and color placed in the studied water. Zeolite to remove hydrophobic and anionic pollutants because of the negatively charged and surface is inappropriate. These reactions are modified to improve energy surface modification of particles reduces hydrophobic properties. In order to improve performance of zeolite to remove water-soluble organic surfactants, Zeolites modified by cationic surfactants and have achieved satisfactory results [16, 2]. Neary et al (2015) in a study using modified clinoptilolite via cationic surfactant HDTMA to remove NOM found that the sorbent for the removal of NOM is very effective aqueous solutions [17]. In the removal of soluble and homogeneous organic matter from industrial wastewater using natural zeolites and active and passive synthetic zeolite found that passive synthetic zeolite has further removal efficiency (93%) of natural species (85%) and active synthesis (89%) [18]. Clinoptilolite is a crystalline aluminosilicates which its usual molecular structure is  $\text{Na}_6[(\text{AlO}_2)_6(\text{SiO}_2)_{30}]\cdot 24\text{H}_2\text{O}$ . Ion exchange capacity (CEC) is 100 to 300 meq/100g [19]. Zeolite Type A is zeolite with a small pore and eight-ring pore with diameter free 0:30 to 0:45 nm [20,21].

One of the disadvantages of Modified Zeolite with cationic surfactant is production of waste in the process of recovery. Accordingly modified zeolite using nanoparticles of titanium dioxide was used to remove water-soluble organic matters which does not produce using side waste photocatalytic recovery [3]. Liu et al (2013) conducted an experiment using the modified zeolite with titanium oxide, 80% removal of humic acid during 5 minute in primary contact reported [3].

Mansouri et al in a study in 2015 on the removal of humic acid by nano-particles  $\text{TiO}_2\text{-SiO}_2$ , the removal efficiency of 85% and 97% respectively for synthetic and real samples at concentrations 1 mg/1 humic acid in pH =3 on contact time 30 minutes was obtained [2].

According to different studies of direct of sunlight and ultraviolet radiation in activating the photocatalytic properties of semiconductors this study aimed to determine the performance of remove the dissolved natural organic matter (NOM) using zeolites clinoptilolite as modified natural zeolite (MNZ) and Modified Synthesis Zeolite type A (MSZ) with nanoparticles of dioxide titanium and comparison with the natural zeolite (NZ) and synthetic (SZ) in concentration, pH and diverse dosage of adsorbent in indirect sun light.

## MATERIALS AND METHODS

This study is an experimental study at laboratory scale as discontinuous and continuous experiment was performed. All tests in the light 2-3 Klux by photometer TES1335 were measured.

### Preparation of zeolite covered with titanium oxide

In the study, the natural zeolite clinoptilolite zeolite in Semnan mines and synthesis Zeolite in DAE JUNG company (Zeolite, synthesis, A-3 granular) with ion exchange capacity 80 meq/100g was used as the first zeolite is washed several times with distilled water to the impurities to be removed. Then, using a sieve shakers, size range of mesh 18X30 (that passes through the sieve 18 and retained on sieve 30) of zeolite was chosen. The zeolite as natural zeolite were used and its feature in [Table 1] shown [22].

To modify it ten grams of zeolite added to a solution containing 957.5 ml ethanol and 7.5 ml water and then the suspension was stirred at 500 rpm. The absorption of the nanoparticles of titanium dioxide on zeolite by hydrolysis of tetra-iso propoxide titanium (TTIP) was prepared from Sigma-Aldrich Company. TTIP diluted solution by adding 1.75 ml TTIP to 33.25 ml ethanol produced from Merck Company. Then dilute solution of TTIP was added into the zeolite suspension drop by drop. After 3 hours, the product repeatedly with distilled water to remove free  $\text{TiO}_2$  particles don't sticking to zeolite washed. Zeolite/ $\text{TiO}_2$  sample at 80 °C dried and in 45 °C for 3 hours at the furnace was heated [23].

**Table 1:** Feature of natural clinoptiloli

Compounds	The amount of natural clinoptilolite%
SiO <sub>2</sub>	66.5
Al <sub>2</sub> O <sub>3</sub>	11.81
Fe <sub>2</sub> O <sub>3</sub>	1.3
CaO	3.11
MgO	0.72
Na <sub>2</sub> O	2.01
K <sub>2</sub> O <sub>3</sub>	3.2
P <sub>2</sub> O <sub>3</sub>	0.01
MnO	0.04
TiO <sub>2</sub>	0.21
L.O.I*	12.05

\* Waste due to heat

**Construction of dissolved natural organic matter (NOM)**

In order to construct NOM stock solution of contact 100 grams of soil plant with distilled water for 24 hours on the shakers were used and solution first by paper filter to smoothing and to separate the soluble from filter 0.45 micron was passed [23]. DOC by Shimadzu TOC analyzer device was determined and the concentration of 25 ppm was obtained.

The stock solution in concentration of 3, 5 and 10 mg were prepared. Tests at different pH and adsorbent dosage were different. To change the pH of HCL and NaOH, a normal was used. All tests at ambient temperature of 25° C were conducted.

**Determining the optimum pH to remove natural organic matter**

Using a solution of NOM, concentration of 5 milligrams per liter of dissolved organic matter NOM were made and the amount 30 ml was poured in the bottle and its pH using HCL and NaOH, a normal were set on 10,9,7,6,4,3. Then adsorbent with dosage 20 g/l was added to the bottle and for 10 minutes put on a shaker with speed 180rpm. After the end of touch time, 0.45 samples by micron filter was separated. Sample by Shimadzu TOC analyzer device was read.

**Determine the kinetics of absorption**

In order to determine the optimal time of solution NOM with concentration of 5 ppm with dose of absorption 20 g/l and the optimum pH of previous step was used. At the time of the touch 20, 15,10,5 1440,360,300,240,180,120,60,30,25 minutes, remaining concentration of dissolved organic matter using a Shimadzu TOC analyzer device was determined. To describe the kinetics, pseudo-first and second models were used.

The first linear kinetics following equation  $\log(q_e - q_t) = \log q_e - \frac{k_1 t}{2.303}$

Here qe and qt respectively the adsorption capacity in balance and time t (mg/g) and k1 is Velocity factor (min-1).

The values k1, qe are the intercept and slope of the linear Fig. ln (qe-qt) vs. t are calculated [22] Second-degree kinetics linear equation is  $\frac{t}{q_t} = \frac{1}{k_2 q_e^2} + \frac{1}{q_e}$

qe and q1 is similar to the first equation. In equation k2 pseudo-second reaction constant is according to min (mg/g). Qe and k2 values can intercept and the slope of the linear Fig. t/qt against t be determined.

**Determine the optimal dose of adsorbent**

In the optimal time and optimal pH, different doses to determine the optimal dose were used. 50, 40, 33, 26, 20, 13 doses grams per liter were examined and concentration of dissolved organic matter remaining in the solution was measured.

**Determine the adsorption isotherm**

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In this study, Langmuir and Freundlich isotherm mathematical model to attract natural dissolved organic matter were used. Using the optimal contact time of 10 minutes, optimum pH 7 and optimum doses 20 g/l at concentrations of 1, 5, 10, 15, 20 mg/l, isotherm tests were conducted.

**Freundlich isotherm**

Freundlich mathematical equation is as follows:

$$q_e = K_f C_e^{1/n}$$

qe: the amount of absorption per unit mass of sorbent (mg/g)

Ce: matter equilibrium concentration in solution (mg / l)

k and n: are Freundlich constants

Linear equation of Freundlich isotherm is as follows:

$$\ln q_e = \ln k_f + \frac{1}{n} \ln C_e$$

**Langmuir Isotherm model**

Mathematical model of isotherm shown in the following equation:

$$q_e = \frac{q_0 b c}{1 + k c}$$

q<sub>0</sub> : The maximum adsorption capacity (mg/g)

Kl: fixed Langmuir (L/mg)

Parameters qe and Ce are similar to Freundlich isotherm [33]

Langmuir isotherm linear model is as follows:

$$\frac{q_e}{q_0} = \frac{K_1 C_e}{1 + K_1 C_e}$$

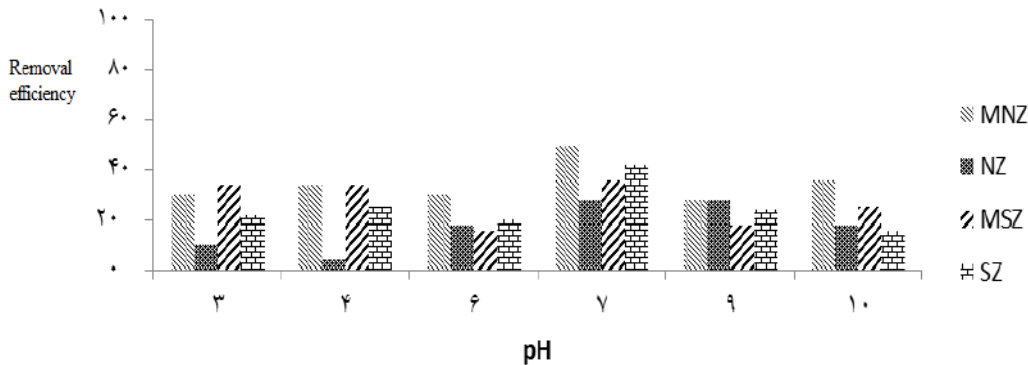
**Absorption column tests**

To perform continuous testing of the glass column with a diameter of 6 mm and length of 50 cm was used that a solution of Nom with dbi 1.66 ml per minute passed and two columns with modified zeolite clinoptilolite and modified synthetic type A was filled and sampling after each 10 BV with an average time of 170 minutes and the concentration of dissolved organic matter was measured [25].

**RESULTS**

**Optimum pH of removal of dissolved organic matters**

[Fig. 1] shown the effect of pH change solution on the removal of dissolved organic matter from water using adsorbents was tested. As you can see for all absorption at neutral pH the maximum of organic absorbents can be seen. In all studied pH absorption efficiency dissolved organic matter by MNZ was more than NZ for MSZ in the range of pH <5 and pH = 10 has higher energy efficiency compared to the SZ in the removal of dissolved organic matter is shown. But in the range of 5 > pH <10 removal of synthetic zeolite was more than modified synthetic zeolite and therefore attract more absorption in neutral pH, as the optimum pH selected and to continue testing the pH 7 were used.



**Fig. 1:** The removal efficiency of MNZ, NZ, MSZ and SZ in different pH for concentration of dissolved organic matters ppm 5 and adsorbent dosage 20 g/l

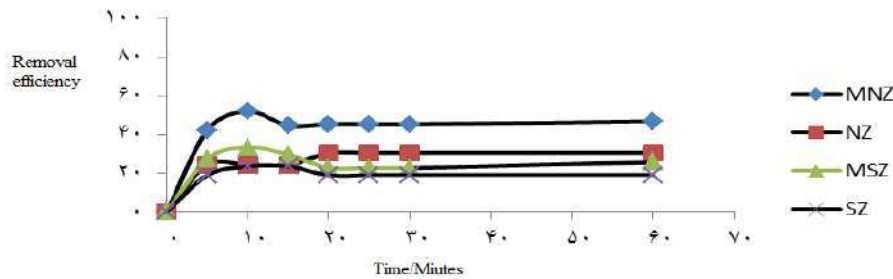
**Contact time and kinetics of removal**

Different contact times of removal of NOM in [Fig. 2] shown. As can be seen in Fig. for all four tested adsorbent time from 30 minutes to above reached to equilibrium status and for adsorbent MNZ highest removal efficiency at 10 minutes 52% is obtained. And after 15 minutes decreased, and then absorption

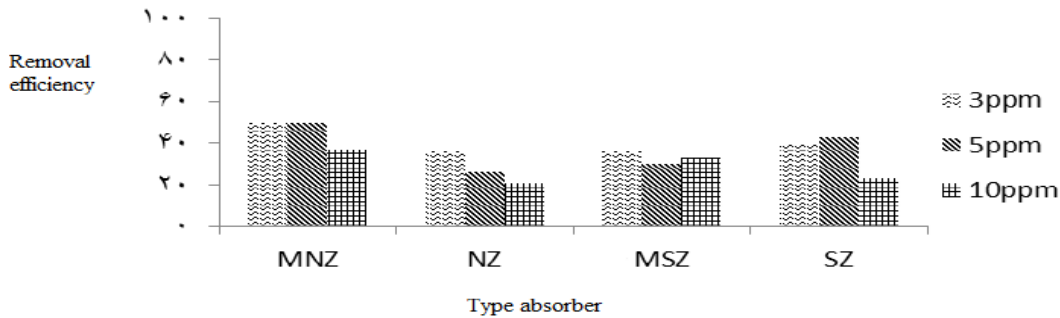
rate has been fixed. For NZ the removal of time 10 to 15 minutes was same and increase at 20 minutes and after the absorption rate constant reached to equilibrium after which the removal efficiency is 30%. Optimum time for MSZ at 10 minutes reach to 33% observed at after 10 minutes reduced the absorption rate and has been fixed. In adsorbent SZ highest removal efficiency at 10 minutes and the rate of 23% was observed and that this trend will continue in 15 minutes and then dropped until it has been proven performance. Kinetics coefficients in Pseudo-first and second degree in [Table 2] was shown.

As can be seen the process of adsorption of pseudo-second degree kinetics followed for every four adsorbent has been tested and does not correspond to pseudo-first degree.

The effect of different concentrations of dissolved organic matter on removal at pH =7 and adsorbent dosage 20 g/l is shown in [Fig. 3]. As can be seen with increasing concentrations removal efficiency by MNZ is decreased and similar efficiency at a concentration of 3 and 5 ppm a rate of 48% was obtained. Reducing the removal amount with increasing concentrations by NZ observed and highest removal efficiency at 3 milligrams per liter appeared and 42% is obtained and at the concentration of 5 milligrams per liter, MSZ lower absorption than the concentration 3 and 10 mg that this process is inconsistent with the other adsorbents tested. While the concentration of 5 mg per liter in the SZ maximum removal efficiency shows amount 40%. In general, MNZ in different concentrations had maximum removal rates compared to other adsorbents.



**Fig. 2:** The removal efficiency MNZ, NZ, MSZ, SZ to the concentration of NOM 5 ppm at 7 pH.



**Fig. 3:** The removal efficiency MNZ, NZ, MSZ, SZ for different concentrations of NOM at pH 7 and adsorbent dosage 20 g/l.

**Table 2:** Adsorbent kinetics parameters of dissolved organic matter by MNZ, NZ, MSZ, SZ

Pseudo-second degree		Pseudo-first degree			Type adsorbent
K2	qe	R2	K1	qe	R2
6.0	117.0	9858.0	04.0	13.0	2649.0
07.2	079.0	9139.0	075.0	076.0	4599.0
11.3	0625.0	09834	024.0	0835.0	0995.0
68.2	046.0	09759	04.0	059.0	1598.0

Determine the optimal adsorbent dosage

Suitable dosage results are shown in [Fig.4]. Due to the dosage change, different performance appear to the best dosage for MNZ rate of 20 grams per liter by 50% and at dosages of 33 and 50 grams per liter the same performance was observed at a rate of 48%, while highest absorbance values for NZ in 33 g/l was about 30%. SZ similar MNZ maximum removal rates in 20 g/l showed while such synthetic modified sample he maximum removal at dose 150 g/l appeared. Similar efficiency in the removal of adsorbent dosage of 20 and 33 grams per liter by MSZ was observed. In doses 13-26 g/l by increasing the removal adsorbent by synthetic zeolite was further modified in doses of 33-50 grams per liter, while the removal rate by modified synthetic zeolite was higher.

In general, the maximum removal in different doses than the dose 13 g/l by MNZ obtained.

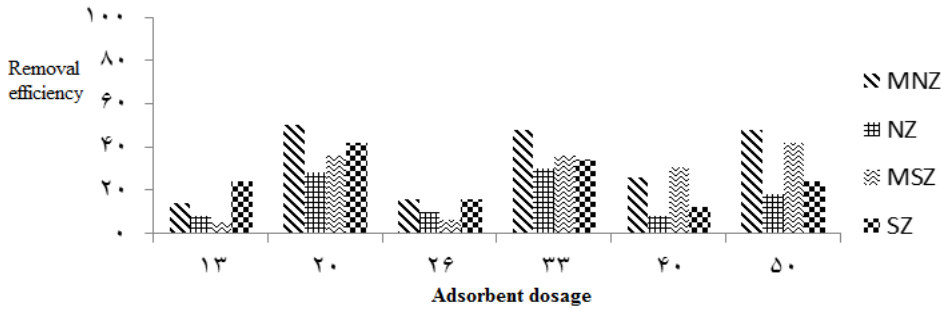


Fig. 4: The removal efficiency MNZ, NZ, MSZ and SZ at adsorbent different dose at concentrations in 5 ppm

Results adsorption isotherms

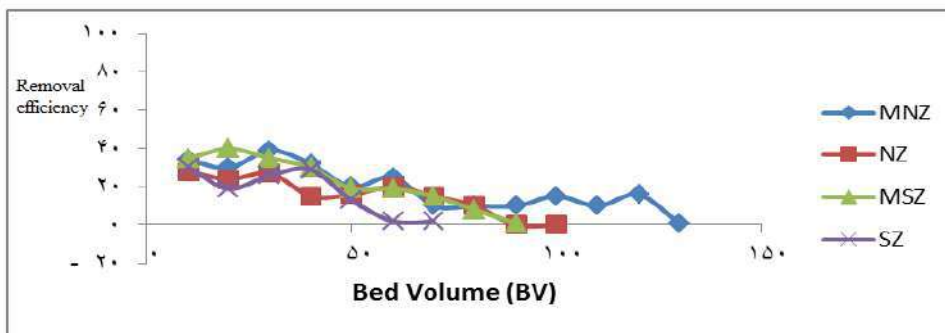
In [Fig. 5] the results of commissioning columns for MNZ, NZ, MSZ and SZ are shown. The column contains MNZ and the removal in 10-20 BV reached 35% and a maximum rate of removal in the 30 BV has been reached to 40% and later with the reduction of removal to 90 BV reduced by 10% and in the 130 BV input and output was same and column is completely saturated. Maximum removal in column containing NZ in 10 and 30 BV can be seen and then reducing the 30 BV in 100 BV is saturated and MSZ column in 20 BV maximum removal efficiency 40% emerged and the same amount was the maximum removal by MNZ in 30 BV. In column 30 BV removal efficiency reduced and in column 90 BV were saturated and in the column containing SZ the maximum removal in 40 BV emerged and in column 70 BV was saturated.

Table 3: Adsorption isotherm model coefficients of dissolved organic matter by MNZ, NZ, MSZ, SZ

Parameters	Langmuir isotherm		Freundlich isotherm		Type absorber	
	R2		Kf	R2	qm	Kl
0.57	0.24	0.9897	0.08	0.4	0.9876	MNZ
0.107	0.24	0.7862	0.027	0.63	0.9868	NZ
0.046	0.58	0.455	0.026	0.85	0.9688	MSZ
0.179	0.27	0.719	0.045	0.57	0.9267	SZ

The results of continuous experiments using column

In [Fig. 5] the results of commissioning columns for MNZ, NZ, MSZ and SZ are shown. The column contains MNZ and the removal in 10-20 BV reached 35% and a maximum rate of removal in the 30 BV has been reached to 40% and later with the reduction of removal to 90 BV reduced by 10% and in the 130 BV input and output was same and column is completely saturated. Maximum removal in column containing NZ in 10 and 30 BV can be seen and then reducing the 30 BV in 100 BV is saturated and MSZ column in 20 BV maximum removal efficiency 40% emerged and the same amount was the maximum removal by MNZ in 30 BV. In column 30 BV removal efficiency reduced and in column 90 BV were saturated and in the column containing SZ the maximum removal in 40 BV emerged and in column 70 BV was saturated.



**Fig. 5:** The performance of the fixed-bed column filled with MNZ, NZ, MSZ and SZ at concentration 10ppm NOM at pH 7

## DISCUSSION

The results obtained from continuous experiments show that the removal efficiency of NOM by all four adsorbent used in the neutral PH than other pH is higher.

NOM compounds are weak organic acids and their ionization is highly dependent on the PH solution. In low PH solution, NOM molecules are neutral. Un-ionized NOM adsorbent positively charged surfaces, by electrostatic attraction force is small, so the bands of hydrogen bonds and other organic products to absorb NOM in PH solution are low. NOM molecules completely are ionized at higher PH. Increasing PH in solution from 3 to 11 leads to reduced hydrogen bonding of NOM [17].

Natural zeolite in various PH has a negative surface charge, but in the zeolite coated with TiO<sub>2</sub> in low PH surface charge is positive with increasing PH positive charge decreased and Electrostatic point was 6 is equal to TiO<sub>2</sub> which is compatible with TiO<sub>2</sub> particle deposition on the core zeolite. Reducing the negative charge to absorb HA on the surface of TiO<sub>2</sub> on the zeolite is supported. The study found that humic acid is absorbed mainly by the TiO<sub>2</sub> carboxyl groups [3]. The major adsorption of HA occurs at neutral PH (point above zero TiO<sub>2</sub> charge) that shows in addition to electrostatic interactions, adsorption mechanisms occurs for zeolite such as hydrogen bonding reaction with the surface hydroxyl groups TiO<sub>2</sub> or hydrophobic reaction [3]. Nirri et al in 2015 investigating the effect of PH on NOM removal by modified zeolite via surfactant HDTAM, PH 5 as the most effective PH in the removal of NOM and electrostatic reactions to major mechanism to remove NOM to SMZ in addition to hydrophobic interactions and hydrogen bonding announced [17]. The removal of humic acid by SiO<sub>2</sub> the best removal efficiency in pH, 4 was observed [26].

Karimi Pasandideh et al in a study on the removal of humic acid as natural organic matter by magnetic iron oxide nanoparticles coated with silica concluded PH changes is effective in removal and increase the PH from 7 to above and increased removal efficiency and maximum rates occurred at around 10-11 PH because of two active removal mechanisms that is the hydrophobic absorption by nano-particle and hydrogen groups reactions are known [24]. The removal of natural organic matter by TiO<sub>2</sub> loaded on glass labyrinth increase the pH of 3 to 9 that increase removal which it attributed to hydroxyl ion and increase the photocatalytic power [27]. While the removal of humic acid with activated carbon composite with TiO<sub>2</sub> found with the increase in pH due to the reduced amount of removal are known to reduce the activity of photocatalytic [28]. Liu et al in 2013 zeolite covered with TiO<sub>2</sub> used for quick removal of humic acid and in PH 7, best efficiency for removal observed [3]. The study according to different organic contaminants matched Liu study.

In continuous experiments best absorb dosage for modified clinoptilolite and modified synthetic 20 and 50 g/l while for the two unmodified adsorbent was 33 g/l. For the removal of humic acid by zeolite covered with TiO<sub>2</sub>, the best performance in the range of 20 to 50 g/l was observed [3]. NOM removal by modified zeolite with surfactant by increasing the absorption dosage increased and absorption capacity decreased [17]. The use of modified zeolite with cationic surfactant alkyl dimethyl benzyl ammonium chloride was 20 g/l [29]. At present study efficiency variable was observed at different doses and dose of 20 to 50 g/l per liter has higher efficiency for the modified zeolite that is consistent with the study of Liu et al. In the present study reaction kinetics for zeolite/TiO<sub>2</sub> and non-modified zeolite is pseudo-second degree and optimum time during four absorption used except usual clinoptilolite was 10 minutes. Liu et al in 2013 in their study of 10 minutes in removal efficiency 80% to remove humic acid by zeolite/TiO<sub>2</sub> compared with 20% by conventional zeolite were mentioned by its free adsorbent surface modification due to rapid absorption after 5 minutes after touch was declared [3]. Mansouri et al in 1393 in the removal of humic acid by removal of nanoparticles SiO<sub>2</sub> best time to removal is time 10 minutes and adsorption kinetics is pseudo-second degree [30]. The removal of humic acid by magnetic iron oxide nanoparticles coated with silica, the best time to remove is 90 minutes and adsorption kinetics is pseudo-second degree [24]. NOM removal by modified zeolite with a cationic surfactant HDTMA, Kinetics is pseudo-second degree and optimal time to remove is 150 minutes [17]. The results of this study due to the different types of organic pollutants by Liu et al for humic acid and Mansouri for silica adsorbents for the removal of humic acid is compliant [3,30]. We can attribute to a difference in the removal efficiency to photocatalytic power TiO<sub>2</sub> and loaded adsorbent removed and the removal of non-adsorbent surface to absorb is the photocatalytic effect. In continuous experiments with increasing concentrations decreased efficiency in the removal of methyl orange with clinoptilolite loaded with TiO<sub>2</sub> photocatalytic activity was higher in low concentrations and zeolites have attributed it to higher-order [31]. The removal of humic acid by composite zeolite/TiO<sub>2</sub> photocatalytic activity was higher at higher concentrations [32].

In this study, removal of humic acid by zeolite/TiO<sub>2</sub>, data with Freundlich and Langmuir isotherm is consistent [3] and in the study of Nirri et al Langmuir isotherm had a better suited to data [17] and removal isotherms of humic acid covered with silica nanoparticles and magnetized iron nanoparticles with silica of both Langmuir [24].

The removal of humic acid by TiO<sub>2</sub>-SiO<sub>2</sub> the Langmuir isotherm is more fit [2] as for natural and active zeolites and passive synthetic, Freundlich isotherm is appropriate [18]. In this study, for zeolite / TiO<sub>2</sub> both Freundlich and Langmuir isotherm with r<sup>2</sup> with 0.97 and 0.98 have a good match but for usual zeolite (NZ) Freundlich isotherm with r<sup>2</sup>, 0.98, has good match that shows the main cause of NZ, MSZ and SZ was multilayer adsorption while MNZ both single-layer and multi-layer adsorption mechanism with the dominance of a single layer can be seen. The removal of fulvic acid by column containing modified zeolite with surfactant column after BV200 with speeds 5, 8, 10 Bv close to input concentration that the value in the study for modified clinoptilolite 130 and modified synthetic was 90 [25].

## CONCLUSION

The results of this study indicate that clinoptilolite modified with titanium dioxide increases removal efficiency in dissolved organic matter compared to the non-loaded and this increases in the load removal by synthetic zeolite can be seen in comparison with conventional synthetic generally, however, clinoptilolite loaded has more the removal efficiency than modified synthetic. Fixation TiO<sub>2</sub> on preservatives such as zeolite increase photocatalytic TiO<sub>2</sub> and increase access to positions of power absorbed.

### CONFLICT OF INTEREST

There is no conflict of interest.

### ACKNOWLEDGEMENTS

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### FINANCIAL DISCLOSURE

None

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## ARTICLE

# ISSUES AND CHALLENGES IN FETAL ELECTROCARDIOGRAM EXTRACTION – REVIEW

P. Sutha<sup>1\*</sup>, VE. Jayanthi<sup>2</sup>

<sup>1</sup>Dept. of Biomedical Engineering, PSNA College of Engineering and Technology, Dindigul, Tamil Nadu, INDIA

<sup>2</sup>Dept. of Electronics and Communication Engineering, PSNA College of Engineering and Technology, Dindigul, Tamil Nadu, INDIA

## ABSTRACT

**Background:** Early diagnosis of cardiac abnormalities paves way to efficient medications and precautions during delivery. The absolute benefit of cardiocardiographic surveillance is very less. Non-invasive electrocardiography reveals itself to be a very interesting method to obtain relevant information about the fetus state, assuring the well being of fetus at the time of pregnancy. The whole PQRST complex of fetal Electro Cardiogram (fECG) is essential to identify fetus distress. fECG and Fetal Heart Rate (FHR) are derived from maternal ECG, gives cardiac condition for the fetus. Location and number of electrodes plays an important role in maternal ECG acquisition and abdomen ECG acquisition. Many filtering methods, algorithms are employed to extract the fECG from abdomen ECG. Various filtering methods used to extract the fetal ECG from the abdomen and various electrode placements are reviewed.

## INTRODUCTION

Heart is developed in the fetus during very early stages of pregnancy. The most critical period of this development is in between three and seven weeks after fertilization. The heart begins to beat by the 22nd day of life and externally monitored using ultrasound imaging from 7th to 9th week; although only unclear images are recordable. Fetus status during pregnancy is monitored using Echocardiography, Phonocardiography, Cardiotocography & Magnetocardiography. Now a day's routine Ultrasound scan gives prepartum diagnosis of congenital heart disease but Cardiac defects could not be identified with this modality. With this modality prepartum technology improvement is essential to know about additional information of fetal cardiac health. Ultra sound machines with higher than usual levels of ultrasound energy leads potential side effects on the fetus. Fetal movements affect viewing later planes and gives lower quality data and sound shadows can hinder the view if the fetal spine is not at the bottom of the scanned field.

Fetal heart rate identification technology is developed in the 19th century. Mid of 20th century Fetal Heart Rate monitor (FHR) is developed to observe fetal heart sound. Though this is unreliable, fetal hypoxia is diagnosed by the help of continuous monitoring. Misinterpretation leads to painful and expensive Cesarean, depression and post operative pain to the Pregnant Woman. There is still little evidence that reductions in adverse outcomes are attributable to the use of FHR monitors. The non-invasive fetal ECG (NI-FECG) recorded on the maternal abdomen represents an alternative to Doppler ultrasound recording. NI-FECG provides an accurate estimation of FHR and information related to the electrical activity of the fetal heart from FECG morphology. The cardiac waveforms and beat-to-beat variability of the heart rate are not measurable in ultrasound imaging. Fetal cardiac status is diagnosed as early as eighteenth to twentieth week by the fetal ECG and MCG. However, the FECG is difficult to extract from the abdominal signal.

During delivery the fetus may get resuscitation problem. During resuscitation, fetal distress appears and the problem is identified only by predicting fetal Electrocardiogram signal rather than Ultrasound signal. The detection of the electrical activity of fetus heart helps in the reduction of the rate of fetal still birth by providing confidence measures for estimated cardiac signals. In this review, the fetal cardiac signal extraction methods and its challenging issues are discussed. This study, gives the information in improving the signal processing aspects in order to facilitate the extraction of fetal cardiac signals from abdomen ECG.

The information obtained from the World Health Organization is long-term trend in still birth: implications for developing countries states that late-fetal demise (28 completed weeks of gestation and over) considered as important for both the current and future trends. Even now the child mortality is still remaining as one of the objectives in health programmers', also attention is given to the fetal death. In many developed countries, late fetal death is higher than infant death. Among obstetricians and pediatricians, prenatal deaths are primary subject of concern and causes of ante partum stillbirths and preterm live births, led contribution towards more research initiatives. In developing countries like India and Nigeria during 21st century, late-fetal demise varies from 25 to perhaps 60 per 1000 births, also less than 1 in 250 viable fetuses die before birth, less than 1 in 10,000 mothers die from childbirth related issues and life expectancy at the time of birth is at least 80 years in the most favorable circumstances. A systematic literature review [3] on preterm delivery and small-for-gestational-age births performed from 1985 to 2002 based on maternal age, reviewed that older maternal age is associated with preterm birth. Rather than targeting mothers and newborn, prepare to focus on the unborn.

### KEY WORDS

Fetal Electrocardiogram,  
Fetal Heart Rate,  
abdomen ECG, Fetal  
distress

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\*Corresponding Author  
Email: sutha@psnacet.edu.in  
Tel.: 91-9940873236

In 1906 fetal electrocardiogram monitoring technique is proposed to get information about fetal heart status. Fetal ECG detection plays significant role in fetal abnormality detection during labor rather than heart beat and heart sound. Noninvasively, the fetal status is observed from the abdomen ECG of the pregnant woman. Abdomen ECG is acquired from the pregnant mother by placing electrodes on the abdomen. Abdomen ECG is the mixture of fetal ECG, maternal ECG, maternal muscular noise and power line interference. The accurate information obtained from fECG helps clinicians to make timely decision during labor. Maternal ECG is 10 times stronger than fetal ECG and coincides in time domain and frequency domain. MEGC removal from abdomen ECG is the major challenge in extraction of fECG.

**MATERIALS AND METHODS**

In signal processing, filters plays vital role in reproducing original signal by removing unwanted signal. Rarely, the filtering technique completely or partially suppresses some features of the acquired signal. The main features of the filter are to remove unwanted frequencies, to suppress the interfering signals and decreases background noise. There are different bases of classification in filters and many filters are used to eliminate the maternal Electro Cardiogram (mECG) from the composite signal.

**Adaptive filtering technique**

The extrication of fetal ECG from the abdominal ECG is done by various filtering technique. The author reveals that the adaptive filtering and de-noising technique involve in cancelling of maternal ECG [17] from the abdominal ECG leads to enhance fetal ECG.

Adaptive filtering block diagram

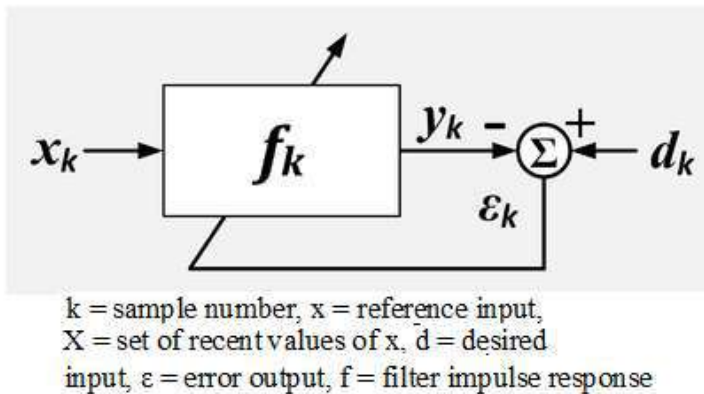


Fig. 1: Adaptive filtering block diagram.

The combination of Recursive Least Squares filter (RLS), Least Mean Square (LMS) algorithm results the high detection ability with accurate sensitivity and positive predictivity with one abdominal signal and one thoracic signal. Based on spatial filtering and adaptive rule, the author developed an algorithm [13] to extract fetal ECG (fECG) with the measurement of mean square error of fetal heart rate and root mean square error of fetal RR interval by validating 75 and 100 fECG datasets. The cardiac residues are obtained after maternal ECG (mECG) attenuation and adaptive fetal QRS beat insertion may not be at true QRS location. The windowing technique is also applied to eliminate the maternal ECG based on wavelet transform

**Wavelet transform technique**

The author states [20] fECG is extracted from the abdomen ECG based on wavelet analysis and LMS adaptive algorithm. Initially, Stationary Wavelet Transform (SWT) is applied to process abdominal signal and thoracic signal then wavelet co-efficient is obtained from the SWT are processed with LMS algorithm. Secondly, abdominal signal co-efficient as original input and co-efficient of thoracic signal as reference input, correlations are computed. Then, Spatially Selective Noise Filtration (SSNF) is employed to remove the noise component. Finally, inverse SWT is applied to obtain the fetal ECG signal and the performance is qualitatively checked for twenty simulated data and twelve clinical data by estimating Signal to Noise Ratio (SNR).

The author described a technique [6] to classify ECG signal into abnormal and normal class by employing Back Propagation Network (BPN), Feed forward network (FFN) and Multi Layered Perceptron (MLP) as neural network classifiers. In this, three classifier performances are measured in terms of sensitivity, positive predictivity and specificity. The performance result shows that MLP produced 100% accuracy than other two classifiers. The Kalman Filtering (KF) is also applied for the extraction of getting fetal ECG from the single channel abdomen ECG.

### Kalman filtering technique

A synthetic dynamic ECG model within a KF framework is designed by the author to extract desired fetal ECG from a unique mixture of maternal and fetal ECGs and noise. The model [15] uses a single channel for the extraction of fetal ECG for long term monitoring. Performance of this system is examined with respect to the noise level, heart rate and amplitude ratio. The system is reliable for the detection of R-peak in a single pregnancy than the multiple pregnancies. Since, only a single electrode placed on the mother's abdomen for the acquisition of abdomen ECG is more convenient and portable device at home. The author designed an efficient extended KF method to extract fECG from an ECG by using multiple electrodes in the robust tensor decomposition algorithm [9]. Here, preprocessing is carried out by low and high pass filter to remove base line wandering and higher frequency components. Various source separation techniques are applied after normalizing the preprocessed signal. Template subtraction, principal/independent component analysis, extended KF and a combination of a subset of these methods called FUSE are also employed to extract fECG signal. Then, Pan and Tompkins QRS detector is applied on all residues to detect fQRS signal and smoothest fetal Heart Rate (FHR) time selection. FUSE algorithm, the Q-T interval measurement requires different extraction condition though it is performed better than all the individual methods on the training set data. On the validation set, error scores obtained from two different events. Identification of fetal status with blind source separation is possible with various algorithms.

### Blind source separation method

The author states that automatic identification of fECG sources performed by the block-on-line tracking algorithm. This algorithm is applied for both synthetic, real signals and it is tested successfully. The on-line-tracking algorithm performance is compatible with an embedded system integrated with OL-JADE (On-Line - Joint Diagonalization of Eigen matrices) based on OMAP L137 processor [4] though the signal quality is poor. The author [21] developed an Adaptive Neuro Fuzzy Inference system (ANFIS) for extricating the fECG from the abdominal ECG. Initially, infinite impulse response (IIR) zero phase filter and notch filters are applied to eliminate noise in the signal. After filtering the fECG the diagnosis of fetal status is performed by detecting fQRS complex then fetal heart rate. The better result is obtained from Sugeno inference method in Matlab tool.

### Fetal QRS complex detection

The author reveals that the detection of fQRS is achieved with augmented principal component regression model (PCR) using multi lead template matching technique [8], where as in [10] impulse train, matched filter (energy of fRR), complementary filter (capture noise energy) are involved. The PCR model removes mECG successfully with accurate template identification. In this, the maternal ECG attenuation is performed by PQRST wave template subtraction and principal component analysis. Also, component values are obtained, a single QRS wave is detected by using a modified linear combiner, produces an output signal containing peaks in the respective locations of all fQRS complexes. The best fQRS estimation is achieved by different fQRS detectors [7] and accurate fetal RR is obtained with different abdominal ECGs. Better suppression of Electro Myo Gram (EMG) noise, QT estimation and mECG cancellation are achieved by better Signal to Noise Ratio (SNR) ratio. SNR of fECG is measured by matched filters semi-blind source separation, rCA algorithm and wavelet de-noising [18]. Accurate estimation of cardiac components, fECG subspace preservation is obtained with minimum MSE and RMSE. From this data, single or limit channel signals are not strong, it is highly dependent on matched filter template.

The author [14] describes that the extraction of maternal ECG using tensor decomposition is used. Additionally [9] [1] [12] fetal R-peak detection is performed by extended KF with 25 states in which ECG beat is modeled by 3 state equations (P, QRS and T). This method is useful for the estimation of mECG amplitude for each beat, applicable when mECG and fECG waves fully overlap. It is not applicable to pathological mECG, where mECG morphology varies significantly. The Mean Square Error of fetal Heart Rate, Root Mean Square for fetal RR interval is measured, the detection of QRS complex of the fetal is performed by echo state recurrent neural network [11] from two events. Finally, Performance of the system is improved by sacrificing speed. A robust algorithm is developed with frequency filtering and wavelet de-noising [2]. Maternal QRS time markers are applied to cancel mECG with adaptive cancellation technique. Adaptive cancellation of the mECG is performed using maternal QRS time markers obtained from the principal component containing the largest mECG. The fetal QRS time markers are determined with a local peak detection algorithm from the principal component. The derived fetal HR (event 4) and fetal RR (event 5) time series were compared to the reference values obtained from a scalp electrode signal. This algorithm scored 223.23 for Challenge event 4 and 19.34 for Challenge event 5, outperforming the sample algorithm.

The author [16] proposed a joint filter based and template matching strategy for identifying fQRS complexes from 4-channel non-invasive abdominal recordings at 100 Hz. The low pass zero phase digital filtering is applied in noise interference reduction. Attenuation of P and T waves, emphasizing of QRS complex is performed in two stages with high pass zero phase digital filters. Initially the detection and subtraction of the maternal QRS complexes is performed then fQRS complex is identified. The MSE of fHR and RMSE values of fetal R- R is observed for two different dataset. A method is developed to locate fQRS complex from the Physionet challenge [19]. In the preprocessing base line wandering and artifacts are eliminated using median filter, Notch filter and low pass filter. The maternal QRS complex is removed from the

abdominal ECG with an adaptive linear filter. The location of QRS complexes in the channel is done with the peak detector. The MSE and RMSE value of fetal R-R interval from two different sets are obtained and compared. In future the elimination of steep mother P and T waves is essential and other method is used to reconstruct the maternal QRS complex.

## CONCLUSION

The features and limitations of various filtering techniques involved in extraction of fECG from the abdomen ECG are discussed. Signal to Noise Ratio, Mean Square Error, Root Mean Square Error, Sensitivity, Positive Predictivity and Specificity are the quantitative and qualitative parameter for analysis of identifying efficient filtering method used to diagnose fetal status of the pregnant women. Further investigation in these methodologies would be helpful to better understand the fetal status to avoid fetal still birth during pregnancy, the efficient method can be identified and applied in biomedical research & clinical diagnosis. In future, filtering technique limitations will be overcome in the design of Bio-signal Equipment especially for fECG extraction.

### CONFLICT OF INTEREST

There is no conflict of interest.

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### FINANCIAL DISCLOSURE

None

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## ARTICLE

# EXPERIMENTAL STUDY ON BEHAVIOUR OF PAPER SLUDGE CONCRETE

G.L. Abishek

Department Of Civil Engineering, Mar Ephraem College Of Engineering And Technology,  
Elavuvilai, Marthandam, Kanya Kumari, Tamil Nadu, INDIA

## ABSTRACT

Concrete is strength and tough material but it is porous material also which interacts with the surrounding environment. The durability of concrete depends largely on the movement of water and gas enters and moves through it. To produce low cost concrete by blending various ratios of cement with hypo sludge & to reduce disposal and pollution problems due to hypo sludge it is most essential to develop profitable building materials from hypo sludge. To make good quality paper limited number of times recycled Paper fibers can be used which produces a large amount of solid waste. The innovative use of hypo sludge in concrete formulations as a supplementary cementations material was tested as an alternative to traditional concrete. This research work is concerned with experimental investigation on strength of concrete and optimum percentage of the partial replacement by replacing cement via 10%, 20%, 30% and 40% of Hypo Sludge. Keeping all this view, the aim of investigation is the behavior of concrete while adding of waste with different proportions of Hypo sludge in concrete by using tests like compression strength, split tensile strength and flexural strength.

## INTRODUCTION

In order to diminish nonrenewable material utilization as well as maintaining natural property concepts of recycling and sustainability were globally introduced. Paper sludge mainly consists of cellulose fiber and inorganic materials. The wetness content normally present in paper sludge may vary from 60-75% [1]. Hypo Sludge (HS) is a ravage material produced from paper industry that can used as a cement proxy material in concrete since the lime content in the sludge is huge[2].Paper sludge contains silica and magnesium like cement which develop the setting of the concrete. The capacity of sludge changes from mill to mill. The quantity of sludge generated by a cast-off paper mill is greatly reliant on the nature of unrefined material being used and end product being artificial [3].

The use of paper-mill soft tissue in concrete formulations was investigated as an substitute to landfill dumping. If current tendency continues, with ravage production proposed to rise by 5% every year, landfills would be at filled capacity by 2020 [4]. About 300 kg of sludge is created for each tone of cast-off paper. This is an appealing huge amount of sludge formed every day that makes landfill wasteful as paper mill sludge is massive[5].Hypo sludge is a current arrival amid cementitions materials. It was initially introduced as artificial pozzolana while producing paper the variety of wastes are come out from the various processes in paper industries[6].The problem of hypo sludge utilization is not confined to India alone but is being experienced all over the world. However this problem is particularly acute in India. Where utilization of hypo sludge has not received much attention. Hypo sludge properties make it very suitable for all construction activities including roads, embankments and reclamation of low lying areas [7]

## Scope

The scope of this paper is to provide a most economical concrete. It should be easily adopted in field. The wastes from paper production can be converted in useful manner. To reduce the cost of the construction, to promote the low cost housing to the E.W.S. group people, to find the optimum strength of the partial replacement of concrete, minimize the maximum demand for cement, minimize the maximum degradation in environment due to cement and safeguard the ozone layer from greenhouse gases.

## MATERIALS USED

### Cement

The cement used is OPC (Ordinary Portland Cement). The specific gravity of cement is determined by adopting standard procedure.

### Fine aggregates

Aggregate which is passed through 4.75 IS Sieve and retained on 75micron (0.075mm) IS Sieve is termed as fine aggregate. Fine aggregate is added to concrete to assist workability and to bring uniformity in mixture.

### KEY WORDS

Hypo sludge,  
Compressive strength,  
Tensile strength, Flexural  
strength

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\*Corresponding Author  
Email:  
abishekg@gmail.com

**Coarse aggregates**

The coarse aggregate for the works is river gravel or crushed stone. Angular shape aggregate of size is 20mm and below. The aggregate which passes through 75mm sieve and retain on 4.75mm are known as coarse aggregate.

**Admixture**

**Retarder**

The Retarder is added for slow down chemical process of hydration so that concrete remains plastic and workable for a longer time than concrete without the retarder. They used to accelerating effect of high temperature on setting properties of concrete in hot weather concreting and them delay the setting and hardening of concrete. This is liquid type i.e., GLUCONATES. Colour of retarder is water colour.

**Hyposludge**

Hyposludge is a solid waste from paper industries. Hyposludge is the primary waste material from the paper industry. It consists of cellulose fibers, calcium carbonate, silica, magnesium, calcium chloride, china clay and residual chemicals along with water. The presence of silica, magnesium and calcium in hyposludge makes it similar to that of cement and hence there is a possibility to replace cement with hyposludge. The Hyposludge can minimize the demand for cement and reduce the cost of construction.

**TESTING OF MATERIALS**

**Specific gravity of cement**

The specific gravity of cement is to be found in the laboratory by using pycnometer and other accessories. Value of specific gravity of cement is obtained as 3.05.

**Specific gravity of coarse aggregate**

The specific gravity of the coarse aggregate is to be found in the laboratory by using pycnometer and other accessories. Value of specific gravity of coarse aggregate is found to be 2.81 [Table 1].

**Table 1:** Specific Gravity test for Coarse Aggregate

Description	Sample
Wt of empty pycnometer(gm)	673
Wt of pycnometer + coarse aggregate (gm)	1537
Wt of pycnometer +Water+ coarse aggregate (gm)	2085
Wt of pycnometer + Water	1550
Specific Gravity	2.74

**Specific gravity of fine aggregates**

The specific gravity of sand is to be found in the laboratory by using pycnometer and other accessories. Value of specific gravity of sand is 2.63.

**Bulk density for coarse aggregate**

**Table 2:** Bulk Density of Coarse Aggregate

Description	Sample
Wt of empty cylinder w1 (kg)	110.024
Wt of cylinder +coarse aggregate w2(kg)	118.9
Net wt of the aggregate w2-w1 (kg)	88.276
Bulk density, V (kg/litre)	11.65

**Water absorption of coarse aggregates**

The water absorption of aggregate is determined by measuring the increase in weight of a dry sample when immersed in water for 24 hours. The ratio of the increase in weight to the weight of dry sample expressed as percentage is known as absorption of aggregate. The water absorption of aggregate is to be found in the laboratory. Values of water absorbing capacity of coarse aggregate are 0.5%.

### Abrasion value of coarse aggregates

The abrasion value is to be found in the laboratory by using Deval's abrasion machine and other accessories. Abrasion value of coarse aggregate is 8.6%.

### Properties of cement

The properties of cement tested were listed below in [Table 3]

**Table 3:** Properties of Cement

Sl.No	Particulars	Values
1	Specific gravity	3.05
2	Initial setting time	30min
3	Final setting time	5hrs 10min

### Properties of coarse aggregates

The properties of coarse aggregate tested were listed below in [Table 4]

**Table 4:** Properties of Coarse Aggregates

Sl. No	Particulars	Values
1	Specific gravity	2.81
2	Water absorption	0.5%
3	Deval's abrasion	8.6%
4	Fineness modulus	7.12
5	Bulk density	$1.42 \times 10^3 \text{ Kg/m}^3$
6	% of voids	50 %

### Properties of fine aggregates

The properties of fine aggregate tested were listed below in [Table 5]

**Table 5:** Properties of Fine Aggregates

Sl.no	Particulars	Values
1	Specific gravity	2.63
2	Bulk density	$1.21 \times 10^3 \text{ Kg/m}^3$
3	Fineness modulus	2.46
4	% of voids	54 %
5	Water absorption	1.0 %
6	Moisture content	1.4 %

### Properties of Hyposludge

The properties of hyposludge tested were listed below in [Table 6]

**Table 6:** Properties of Hyposludge

Sl.No	Particulars	%
1	Lime	49
2	Silica	5.5
3	Alumina	2
4	Magnesium	1.4
5	Sodium oxide	1.6

## TEST ON HARDENED CONCRETE

### Compression test

The compressive strength of concrete is defined as the load which causes the failure of specimen, per unit area of cross-section in uniaxial compression under given rate of loading. The strength of concrete is expressed as N/mm<sup>2</sup>.

For structural design the compressive strength is taken as the criterion of quality of concrete and working stress are prescribed as per codes in terms of percentages of the compressive strength as determined by standard tests. The specimens are cured for 7 days and 28 days, for 7 days testing and 28 days testing with water cement ratio of 0.5 [Table 7]. The Fig.1 depicts the compressive strength of concrete for 7 days and 28 days with various percentage of sludge.

### Split tensile test

The specimens are cured for 28 days and tested with water cement ratio of 0.5[Table 8]. The Fig.2 depicts the tensile strength of concrete for 28 days with various percentage of sludge.

### Flexural strength test

Concrete as we know is relatively strong in compression and weak in tension. In reinforced members, little dependence is placed on the tensile strength of concrete. The value of the modulus of rupture depends on the dimension of the beam and manner of loading. The system of loading used in finding out the flexural tension is central point loading and three points loading. In central point loading, maximum fiber stress will come below the point of loading where the bending moment a maximum.

This ensures that top and bottom surfaces of the beam are parallel so that loading is uniform across the width. Loading is applied through 2 rollers, each at a distance of L/3 from the supports on either side. Apply the loading without shock and increase at a constant stroke rate (0.02mm/min) with water cement ratio of 0.5 [Table 9]. The Fig.3 depicts the flexural strength of concrete for 28 days with various percentage of sludge.

## RESULTS

**Table 7:** Compressive Strength of Concrete Cubes

Sl. No	Partial Replacement In (%)	Ultimate Compressive strength(KN)	
		7 days	28 days
1.	0	16.30	28.12
2.	10	18.55	30.33
3.	20	19.11	31.19
4.	30	19.870	28.12
5.	40	17.90	36.33

**Table 8:** Tensile Strength of Concrete Cylinders

Sl.No	Partial Replacement In (%)	Ultimate Tensile strength (KN) (28 days)
1.	0	3.21
2.	10	3.00
3.	20	2.90
4.	30	2.77
5.	40	2.48

**Table 9:** Flexural Strength of Concrete Beams

Sl.No	Partial Replacement In (%)	Ultimate Flexural strength (KN) (28 days)
1.	0	1.21
2.	10	2.60



3.	20	2.95
4.	30	3.57
5.	40	2.88

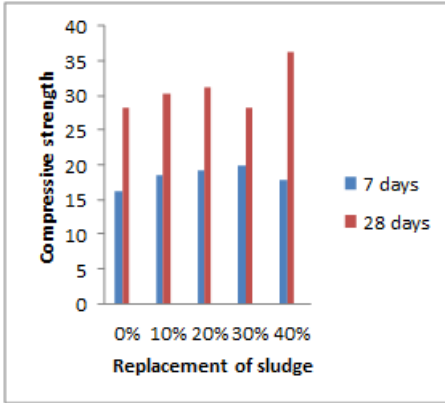


Fig. 1: Compressive strength of concrete.

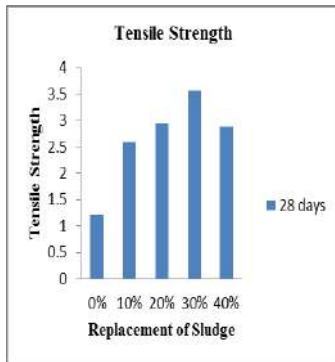


Fig. 2: Tensile strength of concrete.

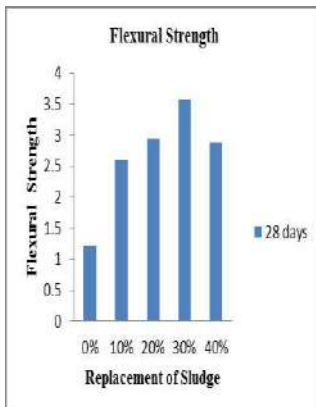


Fig. 3: Flexural strength of concrete.

### CONCLUSION

The following conclusions could be drawn from the study, Hyposludge as waste product from paper industry available in India could be used as mineral admixtures in concrete. Its use in concrete could save as much as 40% of cement as binding material, while providing the same strength. Under certain

conditions, replacement of cement by hyposludge appears to increase the strength of concrete. The compressive strength and sulphate attack of cement mortar cubes results indicated that increased with curing period but above 30% replacement, decreased with increasing hyposludge percentage. Partial replacement of Ordinary Portland Cement with about 30% Hyposludge in concrete gives more strength compared to conventional concrete. The 40% replacement slightly equal to the conventional concrete. Here we can conclude 30% hypo sludge with cement will give good strength, so it is considered as optimum content.

#### CONFLICT OF INTEREST

There is no conflict of interest.

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None

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ARTICLE

AN ANALYSIS OF THE INDONESIAN WOOD BASED INDUSTRY

Inna Sri Supina Adi<sup>1\*</sup>, Hari Muharam, Ferdisar Adrian

Fakultas Ekonomi, Universitas Pakuan, Bogor, INDONESIA

ABSTRACT

In this research, the Indonesian wood-based industry is studied. This is one of the largest industries in the country and has significantly contributed to the economic growth of the country. A special focus is made on the sources of wood in the industry, consumption versus the production capacity, and lastly the exported and imported quantities of both the raw materials used and the industry's finished products. The research takes a qualitative approach as there have been several researchers whose work has focused on the wood based industry in Indonesia. For this case, therefore, secondary data is used. This data type is selected because of the advantages it has such as availability and reliability. Time constraint is another considerable reason secondary data has been used in this research. The results are presented using graphs which are accompanied by brief explanations of the data represented on the graph. A summary table on the production quantities is also given. It is noted that plywood has got the highest demand thus the second largest in the production quantity. Indonesia exports more plywood than it consumes. Veneer, Sawn wood, and round wood are the other produced wood products by the industry. The study concludes by pointing out the major aspects of the wood-based industry in Indonesia. Of the materials exported, plywood is taken the largest percentage followed by sawn wood. The country does not import as much as it consumes. The research later gives some recommendations that are appropriate for improving the state of the wood based industry based on the results of the study. Some of the recommendations given include planting more production forests and failing to increase the production capacity in order to bring about the sufficiency of the current production.

INTRODUCTION

Urban Indonesia is a country that is located in South East Asia [1]. It is one of the industrialized countries in the region especially when it comes to the wood based industry. It is one of the largest economies globally in terms of both the GDP and nominal GDP. The wood based industry has contributed significantly to the economic growth of this country. With about 91.0 million hectares of land under forest cover, the country is literally a home for the wood industry because this constitutes about 53% of Indonesia. Some of these forests are natural while others are planted forests. The planted forests are majorly aimed at providing the raw material for the industry which leads to the conclusion that a lot of entrepreneurs in Indonesia have ventured into the wood based industry [2]. This has been supported by information from ITS Global (2011) that half of the forests in Indonesia are production forests.

The percentage of forest cover in Indonesia is also increasing steadily as can be noted by the increase that took place in Bali, Maluku, Sulawesi, Papua, and Java, between the years 2000 and 2003[3]. Most of these increases in the forest cover are due to the protection and production forest gains. This is clear indication that the people of Indonesia have embraced forestry as it considerably supports the country's wood based industry. This study focuses on the production forests which cover about 60.9 hectares in millions. These are the forests that are used in the provision of raw materials for the wood based industry in Indonesia.

In 2014, 67 million m<sup>3</sup> of round wood were produced by the Indonesian wood based industry. This wood type is used within the country. Exports of the same timber products account for \$2593.4 million of the total export value. Plywood and to a smaller extent sawn wood are the most exported wood types in this case [4]. The species that are commonly harvested in Indonesia include Kapur (*Dryobalanops spp.*), Misawa (*Anisoptera spp.*), Keruing (*Dipterocarpus spp.*), Meranti (*Shorea spp.*), and Teak (*Tectona grandis*) [1]. [Table 1] below gives a list of the wood types produced in Indonesia, coupled with the details on domestic consumption, the quantity exported, quantity imported, and the production quantity according to ITTO, 2005.

Table 1: List of the wood types produced, imported, exported, consumed by Indonesia

	Production quantity (*1000m3)	Imports quantity (*1000m3)	Domestic Consumption (*1000m3)	Exports quantity (*1000m3)
Logs (Ind. Round wood)	67272	72	67310	34
Sawn Wood	4169	132	3339	962
Veneer	816	34	836	13
Ply Wood	5768	105	2110	3763

The Indonesian wood based industry consumes a higher percentage of the produced wood in the country as has been proven by the higher values of domestic consumption [5]. This is attributed to the paper and pulp

KEY WORDS  
 Indonesia, furniture,  
 Plywood, Sawn wood,  
 Production capacity

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\*Corresponding Author  
 Email:  
 innadiss2017@gmail.com  
 Tel.: +62 81381911452  
 Fax: +62 251 8380137

industry and other tertiary industries that utilize the wood through furniture production. It is also noteworthy that the country is a net exporter of the products of timber and timber itself. The major exports comprise already manufactured wood products such as paper and pulp, joinery and moldings, plywood, veneer, sawn timber, and furniture. Wood charcoal and articles of wood comprise 40% of the wood-based products that are exported while the products of paper and pulp, on the other hand make up 50% of the total exported wood based products in Indonesia [6]. This is a clear demonstration of how important the wood-based industry is to the Indonesian economy [1]. This research article is aimed at finding out the most important wood products that are of significant value to the Indonesian economy.

## MATERIALS AND METHODS

The methodology of this research will take a qualitative approach [7]. Secondary data from previous studies will be used because of its time-saving ability. Secondly, the data is easily available and has been used by previous researchers in their respective studies and institutions. This, to some extent, proves the reliability of the data [8]. The use of secondary data will also lead to new discoveries that may not have been noticeable at the time the data was being collected. Secondary data is also less expensive as compared to other data collection procedures [9]. Larger data sets over a long period of time like those that have been used in this study have been analyzed at no extra cost. This, compared to primary data collection is the best option for purposes of this study [10].

Various literatures will be reviewed to get information of the manufactured wood products from Indonesia, some of which are Round wood, Sawn wood, Veneer, and Plywood [11]. The sources of the wood will be evaluated and consumption will also be highlighted in comparison to the demand of the same. The current situation of the wood based industry over a period of time in the recent past will be analyzed then compared with the potential of the current resources for the most relevant recommendations and conclusions to be drawn from the research.

## RESULTS

The [Fig.1] below gives a summary of the information on the development of the Indonesian wood based industry from 1991 to 2003 in terms of the sources of supply of wood used in the industry as earlier outlined in this research. The industry has been dominated by the manufacture of plywood and paper and pulp earlier in the 21<sup>st</sup> century.



Fig. 1: Wood supply.

It is noteworthy that most of the wood used in the Indonesian wood industry is from the production plantations. It can also be noticed that the plantations started being dominant during the late 20<sup>th</sup> century. Before then, a major source was the industrial logging concessions.

It is also important that we delve into the types of wood produced in Indonesia and what type of wood dominates the wood based industry in terms of manufacturing [13]. The [Fig. 2] below gives information on the development of the industry from 1978 to 2014. It can be noted that the industry manufactured plywood in plenty from the late 1980s to the earlier 21<sup>st</sup> century.

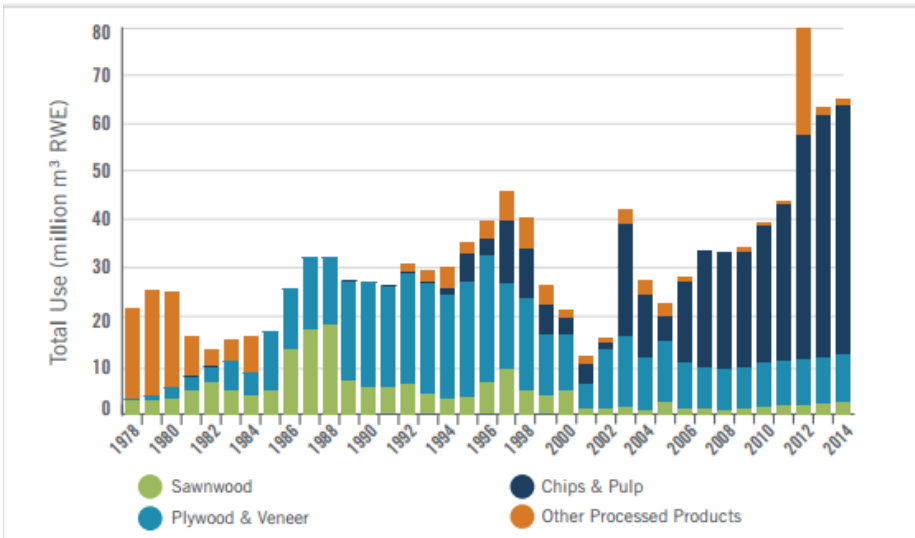


Fig. 2: Use by industry.

Research has also proven that the consumption of wood in Indonesia is greater than the production of the same. This means that supply cannot meet the demand for these products [14]. The consumption is too high in that the imports can still not solve this problem. This is an indication that there is a gap in the production of wood for the industry which is undoubtedly filled by illegal sources, the [Fig.3] below is an illustration of this scenario [12]

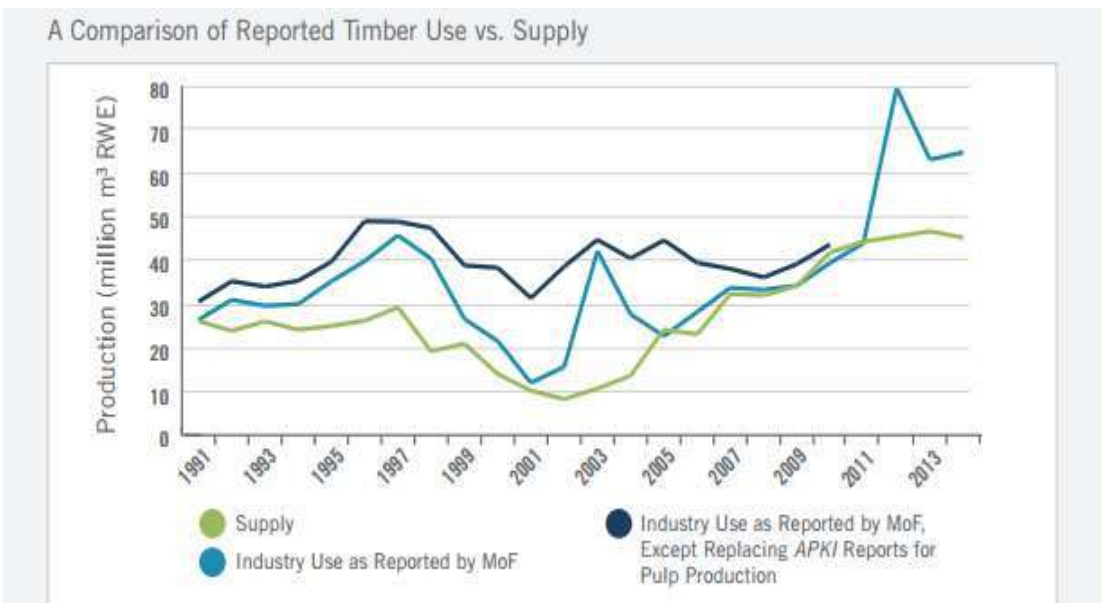


Fig. 3: Consumption versus supply.

It can be deduced that there is a need for more production plantations in Indonesia to sustain the wood based industry because consumption exceeds the supply of raw wood, which is an important raw material in the wood based industry.

## CONCLUSION

Conclusively, the Indonesian wood-based industry is one of the largest in the world and has been supported by the geographical location of Indonesia and the climatic conditions of the area (14). These have supported the forestry sector that provides a major resource and raw material to the wood based industry. The supply of wood for the industry is majorly from plantations as has been shown in the results of the study. The study also shows that plywood and Veneer are the most used wood types in the industry both currently and in the recent past. Of the produced goods, the country consumes most of it and exports the rest [16]. Of the

materials exported, plywood is taken the largest percentage followed by sawn wood. The country does not import as much as it consumes. As a result, consumption of wood materials is higher than the available supply which has led to companies sourcing the raw materials illegally from natural forests. A number of importers should be increased if demand is to be met.

## RECOMMENDATION

The Indonesian wood industry being one of the largest industries on the planet has faced a lot of pressure as a result of struggling to meet demand. Wood production is only about half of the expectations of the ministry of forestry as illustrated in the data displayed on graphs earlier in this research report [17]. The current plantations are not sufficient to support the ever-growing industry [18]. The industry is, therefore, exerting a lot of pressure on natural forests as their only reliable source of raw materials which are quickly becoming extinct. Producers are demolishing natural forests which have remained as the only source of raw material for the wood based industry. This is not a legal supply of wood as it is slowly leading to deforestation [19].

It can, therefore, be recommended that any investors and financial institutions find other ways of obtaining raw materials legally. This can be through increasing imports or planting more forests. In addition, the production capacities of the wood products should not be increased. These include milling capacities and mills. The current ones should be utilized to meet the demand for wood products because increasing the production capacity would mean an increase in the demand for the raw materials that are unavailable [20]. This will, in turn, contribute significantly to criminal activities as firms in the industry will seek to obtain wood at any costs. The Indonesian wood based industry has to be stable before any other mills are added in a bid to increase the production capacity.

### CONFLICT OF INTEREST

No conflict of Interest stated.

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### FINANCIAL DISCLOSURE

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## ARTICLE

# NEED FOR A MORAL VALUE BASED CURRICULUM IN EDUCATION

Abas Mansur Tamam\*

*Student, Pascaserjana, Universitas Ibn Khaldun- Bogor, Bogor, INDONESIA*

### ABSTRACT

The changing situation in the world has seen a sharp decline in values. Ideally, as the world becomes more integrated with the development of strong cross-cultural ties, conventional moral and cultural norms get lost. Initially, these norms are the ones who guide the way a society operated by setting morals and values for community members. One of the main determinants of morals from the ancient days was spiritual courses. People always humbled before moral beings and are from them that good virtues and societal values were developed. However, this does not apply to moral consideration. It is an aristocratic system where failure to follow morals and set norms can result in punishment of community members. One factor that is vital in shaping and instilling moral virtues in a community is education. This is because young community individuals are exposed to education which has a strong chance of influencing their personality as well as their wholesome growth. This paper offers an inductive research that utilizes various qualitative and quantitative approaches to establish the exact effect of curriculum based on moral values in a morally declining society.

### INTRODUCTION

The modern society has failed to give a consensus definition to how value/values in a society should be defined. These aspects have been found to differ from person to person, culture to culture as well as from one society to another. However, in advanced community's individual have accepted that values are those principles that form part of the crucial aspect of living together in harmony. Thus, they make a connection between individuals and the society as well strengthen the relationships that exist among them.

Furthermore, values are seen as a tool that helps human beings generate ethos so as to be able to guide their lives. Therefore, moral values have been greatly associated to be the symbols which represent what is deemed important to individuals within moral societies have over the years been associated with strict moral values that are followed by every member [1]. These values have lost meaning due to the introduction of new curriculum-based studies that focus less on strengthen them. As a result, various sections of the moral values have shown significant changes in how they deal with an individual whose moral standards are declining. This has been affected due to the classification of values depended on whether they are cultural, moral, aesthetic, political and legal values [2]. Consequently, these classifications have led to the corrosion of moral values in many nations a phenomenon which had not been witnessed before. In addition, Islamic nations have also been affected by the change in values as the new curriculum based teaching only focus on deteriorating the character of individuals rather than give them a foundation [3]. These teaching have escalated the incidences of violence, self-centeredness, bullying, dishonesty and rudeness within the society. As a result, researchers have found out that young individuals care less over morals as well as ethical values [4]. The individuals have shown the little potential of changing and are in turn focused on themselves by promoting their own agendas.

Educational theorists of the ancient days have held the belief that if only the adult world would find a way of getting away from the path of their children, then growth in society would be witnessed [5]. Thus, the case of a society whose moral values are declining should not be viewed as the only that affect a community, but a lot of considerations have to be put on the kind of curriculum used to teach them. The curriculum based form of teaching has had significant impacts on the way a morally declining society ends up behaving [6]. As a result, most educational practitioners, parents and world thinkers believe that children are born helpless and need to be guided by adults through the kind of teaching received. Therefore, in a society whose moral standards are in question and declining the Islamic community believes that the child's behavior is depended on the type of curriculum he/she will be subjected to [7]. As a result, Islamic teachers advocate for peaceful coexistence in the society, and this has been enshrined in their curriculum with emphasis given how it is changing the way a child views the world.

Increased deterioration in behavior among children in various communities has allowed Islamic clerics to hand over the mandate of changing the society to teachers and specified schools. The mission of these schools has always been to develop the young generation both intellectually as well as in their moral virtues which include aspects such as honesty, respect for others and responsibility which form part of the moral education curriculum [8]. These forms of education are carried out in order to enable children to acquire virtues and moral habits that help to individually live a straightforward life. This is aimed at ensuring that they become productive as well as active members in the community [9].

#### KEY WORDS

Morals, Curriculum,  
education, society

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#### \*Corresponding Author

Email:  
abasmansurt@gmail.com  
Tel.: +62 81298036356

## MATERIALS AND METHODS

### Research design

This study utilized a descriptive study design. This is because the amount of data needed will be diverse. This can be well understood if it is obtained over a large area. The reason for this is because there are various diverse Muslim societies in the world which utilize different curriculums. Moreover, the research does not have a theory to prove instead it wants to generalize the influence of the Muslim-based curriculum in a society where morals are declining [10]. To achieve this, broad spectrums of research participants need to be utilized. Moreover, using a descriptive study in conjunction with survey tactics such as sampling will be effective in knowing, understanding, and being conversant with various circumstances so as to be able to advise, explain, defend, decide or reject a given condition, argument, or situation.

### Research strategy

This research used the grounded theory as its primary research strategy because the researcher begins on an open slate without any prejudice or previous ideas. In this regard, data will be collected qualitatively; that is from existing literature on climate change [11]. The sources for the research range from the internet, scholarly articles and publications to already done surveys and interviews<sup>3</sup>. Moreover, an online survey will be carried out in which respondents from various regions where the curriculum used is Muslim based will be interrogated using questionnaires.

### Population and sample size

The survey used about 200 qualitative information sources that were peer reviewed. Furthermore, the numbers of respondents targeted by the study were 200. A careful selection of respondents whose views helped explain the issues that were being studied was made, and it helped offer strong in-depth analysis. It is important to note that the respondents were not Muslims but all individuals who had in one way or another interacted with the Muslim-based curriculum.

### Participants

There was both a physical respondent as well as the use of already conducted research. The literature provided data from across all sections of the world since there is a strong cultural integration at the moment which has made almost all regions to be cosmopolitan. However, representative results were obtained by getting information from different regions that use the moral curriculum. Moreover, a comparison was made between the influence of a Muslim based curriculum and a Christian based on the norms and moral values of the surrounding community [12]. Christianity was selected for comparison because it represents the largest religion before Muslim.

### Materials and equipment

The main material used for this research was existing articles and publications on different education curriculums. Moreover, questionnaires were also utilized in getting data from the research participants from different parts of the globe.

### Procedure

Data collection was through both quantitative and qualitative approaches. In this regard, qualitative techniques were attained via the analysis of previously carried out literature on the matter. On the other hand, online interviews, surveys, and questionnaires were the techniques utilized to collect quantitative data.

### Data analysis and presentation methods

After the data collection stage, data which was raw was edited in order to locate and eliminate errors. After that, the data was categorized into specific categories with similar or closely related groups. Subsequently, the data was verified, validated, and lastly analyzed. Lastly came the data presentation stage which was mainly done using tables.

## RESULTS

### Details of the information sources

The research mostly utilized secondary sources of data which were mainly already done studies. However, all the sources were not utilized except those that could be validated as having been reviewed by other scholars. The study could not be completed without using primary sources of information. Mostly, these were interviews carried out on individuals from different regions which have had experience with the



Muslim-based curriculum [13]. The aim of this was to make sure that there was a good representation of all cultures and communities in the world which had instituted the Muslim-based curriculum.

### Primary research

This comprised of seeking information for the research from people who were respondents. This was carried out via interviews and in some instances questionnaires were utilized. Online administering of questionnaires was preferred because it offered a chance to reach many people in different places or regions.

### Details of the respondents

The number of targeted respondents was 200. Regarding the high number of regions in which the curriculum is Muslim based, this was seen as an enough figure to use in formulating a theory about the impact of Muslim based curriculum in areas with declining morals. However, not all respondents respondent as can be seen from the below [Table 1].

**Table 1:** The Respondents

Respondents	200
Respondent	160
Not respondent	40
Percentage	80%

The above [Table 1] indicates 80 percent of the targeted respondents responded. This was considered to be an enough percentage to offer enough information for the study.

**Table 2:** Responses based on adherence to morals

Respondents	Those who felt that Muslim curriculum has a strong influence on morals	Those who did not feel that Muslim curriculum has a strong influence on morals
Total	142	18
Percentage	88.75%	11.25%

[Table 2] shows over 88 percent of the total respondents felt that Muslim based curriculum has an impact on the moral of the surrounding society.

**Table 3:** Responses based on the nature of influence

Respondents	Those who feel that the influence if the Muslim-based curriculum is positive for a society	Those who feel that the influence is negative
Total	121	39
Percentage.	75.63%	24.37%

[Table 3] shows about 75 % of the respondents felt that the Muslim-based curriculum had a positive effect on the moral wellness of society and growth of an individual.

## DISCUSSION

The quantitative data findings agree with qualitative findings specifically Thurston's work which states that there is a strong influence that the Muslim curriculum has on the morals of the society [14]. This is supported by Ryan [12] who believe that most Muslim curriculums have tailored the education techniques to incorporate similar dressing styles as those expected to be used in the normal societal settings. Shang [15] supports the influence of Muslim culture on the morals of the society by stating that the way individuals are punished in the education system rhymes with the way people receive punishments in the outside society.

There seems to be a strong agreement among scholars as most of them including Parker [16] feel that the Muslim curriculum usually helps to cultivate positive moral values within the society. For instance, the school helps to propagate good virtues, positive growth, and strong intercultural learning among students

and even societal members [17]. Mai [18] agrees with the concept of positive moral propagation within the society based on the Muslim curriculum and he feels that it can go a long way in reinstating morals in amorally declining society.

Lastly, there is a section of scholars such as Davies and Glenn who feel that there is a negative effect of a Muslim based curriculum in morally declining society [19, 20]. Primarily, they point out the influence of terrorism and how it has spread through many Muslim schools set up as an example of a negative influence of a Muslim based curriculum [8].

## CONCLUSION

It is apparent that Muslim societies and curriculum rely on strict moral values in their daily activities. As a result, there are various systems which have been put in place to support the development and adherence to these moral values. One of these systems is school. Usually, most of the values that are observed and instilled at school resemble in many aspects to the societal moral expectation. Therefore, schooling can play a significant role in minimizing, eliminating, or reinstating morals in a morally declining society. This is because there is overwhelming evidence which points out to the fact that moral based curriculum has a positive effect on the development of desired morals within the society.

### CONFLICT OF INTEREST

No conflicting interest.

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### FINANCIAL DISCLOSURE

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ARTICLE

# AIDING AUTISTIC CHILDREN LEARN ARABIC THROUGH DEVELOPING AN ENGAGING USER-FRIENDLY ANDROID APP

N. H. Anas\*, Z. R. Mahayuddin

Faculty of Information Science & Technology, National University of Malaysia, Selangor, MALAYSIA

## ABSTRACT

Study via cell phone technological innovation for children and also teenagers is designed suitable for healthy children as well as children with bodily and also psychological disabilities. Resulting from innate health issue of autistic children they comprehend idly which consists of poor communicating proficiency and split attention over the course of study procedure for instance Arabic alphabet. Thus, this article focuses at recommending a conceptual system that perceives the style as well as design challenges driven by preferred approach of tutoring to ensure it is more appropriate by blending the entertaining platform which includes audio, video and animation.

## INTRODUCTION

Autism is known as neurodevelopmental disorder which disturb the way of communication, emotion expression, thinking, sociability, language, behavior, and imagination[1]. Based on IQ and verbal or non-verbal communication disability High-Functioning Autism (HFA) and Low-Functioning Autism (LFA) exists[2]. It is reported that in 2010, the United State data indicates children with autism disorder as 1 in 68 [3]. Autistic children with low emotional control show aggressive behavior while not able to focus on learning sessions during teaching[4][5].

This paper aims to present a conceptual idea of autistic children application for learning Arabic alphabets with the aid of interactive element and augmented reality enhancement. A number of researches had been performed to support the learning process of the autistic children[6],[7] [8]. There are also studies that implementing augmented reality from various aspect in application built for the children with autism[9],[10][11].

## MATERIALS AND METHODS

The following [Fig. 1] shows the methodological frame work. Two facilities at Selangor and Malaysia were consulted to put together suggestions and even interviews.

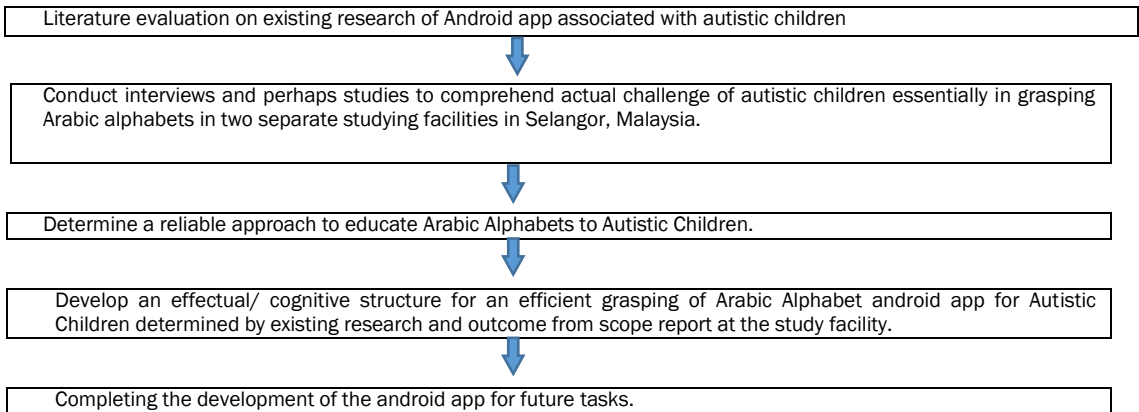


Fig. 1: Methodological frame work.

### \*Corresponding Author

Email:  
nurulhidayama2017@gmail.com  
Tel.: +60134592944  
Fax: +6038925 6732

### Literature review

To gain attention it is vital that the children must find interface of application attractive and graspable visual language so fakhir method was introduced[6]. Researches have been made on qualitative and quantitative approaches of design according to autistic children profile. It has been found that the multimedia like video, animations and images are quite attractive for the autistic children while attraction may vary as human nature varies[8]. Several prototypes of digital game-based learning where listening, arranging, constructing and pronunciation skills were emphasized [7]. A mobile game application to teach a skill known as multiple cue was introduced which was initially refused but finally accepted when teacher shows how to play [12].

### Interview and observation at the learning center

Interviews conducted between two lecturers from Anjung Kasih, Bangi and two lecturers from Akademi Fakh Inteltek, Petaling Jaya. From the interviews, it is most certain that the autistic children have the ability to recall swiftly through Digital Pen Audio comparing other approach. The child has the ability to recall name of the alphabet though the child seems to have challenges in recalling the signs involved with the alphabet. In Iqra' approach; the children conjointly would be instructed methods to study the alphabet with the signs involved. Foremost, each alphabet would be instructed with top sign amid the pronunciation. After covering this top sign, subsequent tutorial to persist and replicate with bottom and front signs aiding in pronunciation for the whole distinct alphabet.

The following [Table 1] summarizes the observation on the autistic children and the current progress using existing teaching method.

**Table 1:** Autistic children observed at the center

Farhan (9 years old)	Fariz (9 years old)
<ol style="list-style-type: none"> <li>Using digital audio alphabets, but must guide by teacher and read together</li> <li>Repeat 2 to 3 times and break time</li> <li>Reward is a must after performed every task: reward given : play puzzle or hold a straw</li> <li>Current progress in identifying arabic alphabets: Alif to Jim alphabets names</li> <li>For identification process, the child introduce to Alif and Ba. Then, to test either the child can remember or not, a distractor included such as by introducing other alphabets, if he can remember Alif and Ba without fail, thats indicated he can remember well. The level of distractor depends on the autistic level.</li> <li>Learning session must be alternate with other activity such as writing activity during test of identification to avoid the child get bored</li> </ol>	<ol style="list-style-type: none"> <li>Using digital audio book and able read without teacher</li> <li>Repeat 2 to 3 times and break time</li> <li>Reward is a must after performed every task: reward given : jump on trampoline</li> <li>Current progress in identifying arabic alphabets: can recognize all alphabets names, so introducing to alphabets with signs</li> <li>The child is introduced to the three signs for a single alphabet directly. Example ! i straightforward with one shot lesson, to avoid confusion.</li> <li>Learning session must be alternate with other activity such as writing on a sheet together with pronunciation and intentionally hide the sheet.</li> </ol>

### Selection of learning method

There are various ways to tutor alphabets in Quran designed to be integrated in the app this includes Al-Furqan, Iqra, Al-Baghdadi, Al-jabari, and Qiraati although Iqra was meant for feasibility study. [Table 2] describe briefly about the methods to tutoring Alphabets in Quran.

**Table 2:** Methods for tutoring Arabic alphabets

Approach	Explanation
Al-Furqan	Offers learning method with only 14 Arabic characters which are selected on baby's first speech sounds which provide tones understood by newborn babies right after birth[13].
Iqra'	Iqra' method emphasis the teaching of reading Quran through the phonic method[14].
Al-Baghdadi	Marginal approach to muqaddamand iqra. A research was already held in Kuala Lumpur Tahfiz.
Al-Jabari	Practically, after 30 hours of learning Al-Quran through Al-Jabari method, the students might be able to read and write appropriately[15].
Qiraati	The method is from Indonesia alternative to Iqra brought through <i>Malaysian Islamic Youth Assembly</i> (ABIM) [16].

## RESULTS

### Development of a conceptual framework for android application

#### Interactive Multimedia

Attractive element of the application is called multimedia interactive. Visual, animation, video, audio and colorful display can be integrated in an application. Interactive and systematic visualization are suggested as main aspect of teaching for austictic children in order to attract attention[6]. Integrating the visual and audio learning system does not overload the limited working memory capacity of the autistic children so multimedia interactive van be proved a great solution to autism split attention[1].

#### Persuasive design

It is an established actuality and confirmed from the scrutiny that the autistic children are unable to actively focus for an extended time therefore their attentiveness is reached employing persuasive model

and this is a medium to sustain lasting attentiveness of autistic children to indulge in the studying app possibly in the kind of incentive or perhaps any kind of component of revitalizing or beneficial.

### Handwriting

Due to motor abilities the handwriting impairment can be faced so by giving reward after completing task can motivate them sorting out the issue [17, 18]..

### Separation of categories

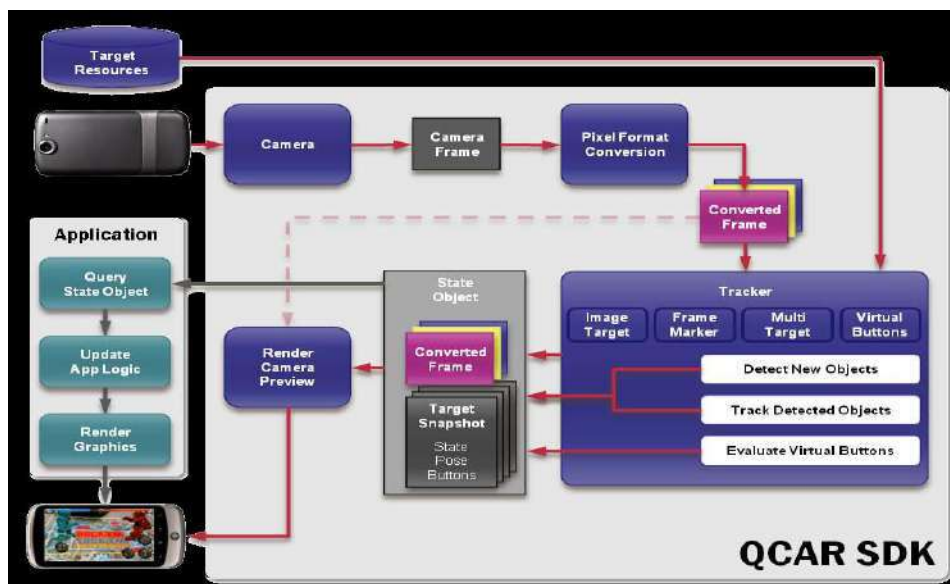
Dividing the alphabet with signs or without signs might be ascertained so induction of without sign alphabet after alphabet with sign can become proved to be more suitable approach after perception in the interviews.

### Augmented Reality as application's additional feature

The problem statement is to deal split attention so AR and interactive game is introduced to focus virtual and real admix.[19]Augmented Reality (AR) can be defined as a tool that allow virtual objects to overlaying real environment, coexist in the same view which result in a meaningful way of experiences. AR users used computers or HMD earlier [20-23. Medical visualization, maintenance and repair, annotation, robot path planning, entertainment, and military aircraft navigation and targeting and education are specified with AR.

### Development of AR

To develop an AR for Arabic alphabet in the application, this study used Unity and one of the library of AR which is Vuforia. Autodesk 123D is used to create 3D alphabet and additional arts and decoration such as animals and cars. This study used marker-based to track instead marker-less which requires advance programming and setting. [Fig. 2] shows a workflow of how AR application to be developed.



2

Fig.2: Vuforia workflow.

Vuforia uses following steps:

- a. Capturing pictures,
- b. tracking for marker detection,
- c. conversion into RGB565 format,
- d. evaluation by tracker
- e. accessible by application code,
- f. rendering to video background,
- g. output files are in binary file and an XML file and combination of application

## CONCLUSION

This paper clarified the significant of developing an effective application for autistic children which mainly cause by inherent issue of split attention especially during education purposes [6]. The study focuses on how interactive technology motivates the learning experience of autistic children in the future.

### CONFLICT OF INTEREST

No conflict of interest

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## ARTICLE

# DETERMINING THE EFFECT OF DIGITAL TECHNOLOGY ON POVERTY ALLEVIATION AND REDUCTION IN LENDING RATES

Hari Gursida\*

*Fakultas Ekonomi, Universitas Pakuan, Bogor, INDONESIA*

### ABSTRACT

There are various increased efforts to reduce poverty all over the world. This is because there is need to improve the living condition of people as well as better their economic status. One of the reasons for this is that development cannot be achieved within societies which lack primary essentials and necessities. As a result, the individual needs of the people have to be catered for first before developing the world. The need for poverty alleviation can also be viewed from the developed world where economic progress is high because individuals are able to live quality lifestyles. The current level of improvement in the world can be associated with technology in various aspects. Therefore, it is possible that technology can have an effect on the level of poverty at the moment. This is interconnected with the lending rates in that a decline in interest rates will increase income and in turn will reduce poverty. However, the decline in interest rates is not related to communications technology. In-depth interviews provide information that microfinance institution customers still need assistance in running their business, related to low knowledge and innovation levels. Since credit interest rates also include institutional overhead costs, it is difficult for these microfinance institutions to reduce their interest rates regardless of the communications technology applied. Therefore, the results explained in this paper explain the effect of digital technology on poverty alleviation and reduction in lending rates.

### INTRODUCTION

The term digital technology refers to features and processes of technology which influence particular design decisions of digital systems and how various digital systems can be used [1]. Primary, digital technology is an aspect of technology that deals with special enhanced technological systems mind devices. It is among the highest levels of technology at the moment. Digital technology emerged in the early part of the 21st century as are reference to improved technologies [2]. The emergence was primarily visible in communication devices which could ease human and machine interactions. The first devices used were communication devices such as mobile phones and computers. Since their first introduction, digital technology has been improving steadily, a factor that has enabled it to be incorporated in various production as well as world processes.

Regarding business, digital technology has a variety of uses which have appreciated over time [3]. On the other hand, lending rates refer to the levels of interests that are charged on borrowed loans. Primarily, interest rates encourage or discourage borrowing by individuals or organizations because they offer a projection of the total amount that person will be required to pay in the end [4]. In this regard, low lending rates encourage borrowing by individuals as they will incur reduced interest at the end while high-interest rates discourage borrowing as potential borrowers shy away from incurring high interest that will translate into a high amount to be paid in the end [5]. Lastly, poverty refers to a state of having insufficient primary wants. In this regard, the existence of poverty is influenced by various external factors one of which is financial ability. In this regard, lack of accessibility to finance and related services might lead to the inability to acquire primary human wants which translates into being poor [6].

There is an enhanced penetration of technology in various parts of the world from the poor areas to the rich societies. The effect of this has been a variation in the mindset of individuals regarding how certain activities can be carried out. One of the areas which technology is widely spread is in communication. It is currently easy to the community thanks to the variety of communication devices that are available at the moment [7]. For instance, mobile phones are easily available and are becoming more of a necessity and not luxury. Moreover, factors such as wireless technology have enabled individuals to reduce the boundaries of communication using various portable communication devices. There is a large penetration of computers in the society in which case many individuals are able to access them, use them as well as manage to explore the internet [8]. In the same way, businesses have utilized digital technology in carrying out various practices. Aside from communication, digital technology simplifies various business practises [9]. Similarly, digital technology thus has the potential to change the financial services in two major aspects. Firstly, digital technology has the possibility to reduce the cost of loan processing. This relates to borrowing or advancing finances to individuals thereby enhancing penetration of financial services to remote areas [8]. This is because of the ability to simplify communication in many areas without regarding the existing sovereign or geographical boundaries.

Technology has the ability to reduce technology by incorporating it in activities which enhance the ability of individuals to access better incomes as well as financial ability. One of the primary ways through which this can be achieved is enhancing the conditions related to financial borrowing [10]. Ideally, this resonates around lending rates. Using credit to alleviate poverty is referred to as Credit-based poverty reduction. However, in using this technique to reduce poverty, chieftain conditions have to be met. These includes limiting the maximum credit tours \$ 5m, issuing a credit period of 12 months as the maximum period, financing only in groups, meeting the eligibility criteria for borrowing [11]. Technology can play a vital role in credit based poverty eradication practices by simplifying the transactions and relationships. However, it

#### KEY WORDS

Communication technology, lending rate, micro finance institution, poverty alleviation

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#### \*Corresponding Author

Email:  
horigursida2017@gmail.com  
Tel: +62-81298036349

cannot directly, reduce or decrease lending rate because for small entrepreneurs the need is assistance, where the cost is quite high because it must be face to face and cannot be overcome with technology [12].

## MATERIALS AND METHODS

This study utilized a descriptive study design. This is because the amount of data required was diverse. This can be well understood if it is obtained over a large area. The reason for this is because poverty has affected many societies all over the world [13]. Also, the research has many hypotheses that has to be tested as listed below.

### Research strategy

This study uses a quantitative method approach to collecting data generated from field survey aimed to gauge how the effect or impact of digital technology on poverty and its effect on reduction in lending rates. This study will test the digital technology as the dependent variable and the dimensions of poverty reduction and reduction in lending rates as the independent variable.

### Research hypothesis

This study tested the six hypothesis as follows: H1: Dimensions digital technology (ease of communication, information search effort, and speed information) effect on poverty alleviation and lending rates

H2: Ease of communication effect on poverty alleviation and lending rates

H3: The information search business through digital technology impact on poverty reduction and lending rates

H4: The speed of information through digital technology impact on poverty reduction and lending rates

H5: The decline in mortgage interest rates affects the poverty reduction

H6: Instalment credit's effect on poverty alleviation and lending rates

### Population and sample size

The survey used about 250 qualitative information sources that were peer reviewed. Furthermore, the number of respondents targeted by the study was 250. A careful selection of respondents whose views helped explain the issues that were being studied was made, and it helped offer strong in-depth analysis.

### Participants

There were both physical respondents as well as the use of already conducted research. The literature provided data from across all sections of the world regarding the current influence of digital technology on poverty and lending rates.

### Materials and equipment

The main material used for this research was existing articles and publications on different education curriculums. Moreover, questionnaires were also utilized in getting data from the research participants from different parts of the globe.

### Procedure

The survey was conducted in ten districts with the human development index of less than sixty, and each district was represented by one of the villages. Surveillance techniques were used to spreadsheets questions on the financing of the group (group lending) consisting of 5 persons. 250 sheets were distributed to targeted research questions and the returns amounted to 240 sheets. 230 respondents have answered in full and after removing several questionnaires have charging errors, obtained 95% of otherwise valid question sheet.

### Data analysis and presentation methods

After the data collection stage, descriptive statistical analysis of the data was used to obtain an overview of the groups of data acquisition survey in each region.



## RESULTS

### Details of the information sources

The study used secondary sources of data which were mainly already done studies and had to be validated as being peer reviewed by other scholars. Moreover, primary sources of information were also used which included interviews that was carried out on individuals from different regions which have experience or knowledge regarding poverty issues.

### Details of the respondents

The following [Table 1] shows the number of targeted respondents were 250. This was seen as an enough figure to use in determining the outcomes of the research to formulate the responses to the research hypothesis.

**Table 1:** The respondents

Respondents	250
Respondent	240
Not respondent	10
Corrected Responses	230
Respond Percentage	96%

96% of the targeted respondents responded. This was an enough percentage to provide data for the research.

#### **Responses based on Ease of communication.**

Over 87.5% of the total respondents felt that ease of communication has a reducing effect on poverty and lending rates.

#### **Responses based on the speed of information through digital technology**

Over 84.17% of the total respondents felt that speed of information through digital technology has a reducing effect on poverty and lending rates.

#### **Responses based on decline in mortgage interest rates affect the poverty reduction**

Over 93.75% of the total respondents felt that the decline in mortgage interest rates has a reducing effect on poverty reduction.

#### **Responses based on Instalment credit's effect on poverty alleviation and lending rates**

Over 89.5% of the total respondents felt that the installments of credit have a reducing effect on poverty reduction.

## DISCUSSION

The primary data showed that technology could reduce poverty by leading to more efficient process regarding the accessibility of credit facilities by individuals. Usually, technology and lending rates integrate into each other in reducing poverty under the concept of credit based poverty reduction [14]. Primarily, there is an overwhelming agreement that simplifying communication helps individuals to understand all factors involved in borrowing which makes them make concise credit terms and reduced lending rates.

In the same, information search makes individuals increase their know-how which offers them information on how they can enhance their situations [15]. Subsequently, this transforms into reduced poverty due to increased returns. Regarding lending rates, extensive information search can make individuals access credit facilities that have low-interest rates as compared to the one currently in use [16]. This resembles the speed of information as fast accessibility to information leads to fast borrowing and accessibility to

low-interest credit facilities.

The type of credit extended to borrowers has various characteristics that determine the urge of customers to use them [17]. However, the most significant characteristic is the interest rates. The data show that low interest rates encourage borrowing. Therefore, a decline in mortgage rates lead to high borrowing which enhances the living conditions if individuals. Similarly, low payment installation encourages borrowing.

## CONCLUSION

Both results from the primary and secondary data showed that digital technology has an effect on lending rates and poverty eradication. In this study, the chosen region of Indonesia has over 24.7 million people who are poor. These individuals have the following characteristics, the range of poverty rates between regions is too wide, the example of Jakarta 3.7% while the province holds the poor as much as 32% of the total population, Majority of the poor live in rural areas and working in the agricultural sector, Many of the people who moved between the poor become virtually destitute and vice versa. The government utilized poverty eradication techniques seems to have had a little effect. The use of digital technology helps reduce poverty by increasing the chances and borrowing potential of individuals who are poor. The effect on lending rates is not direct but allows individuals to have access to better credit facilities that attract low-interest rates. In the same manner, the increased efficiency as a result of technology leads to reduced cost of operation which could transform into fewer interest rates.

## CONFLICT OF INTEREST

No conflict of interest to declare

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ARTICLE

# A COGNITIVE STUDY TO EVALUATE ANTIHYPERGLYCEMIC PROPERTY OF ORYZA SATIVA GLUTINOSA ON SPRAGUE DAWLEY

Prasetyorini Djarot<sup>\*</sup>, Mulyati, Faulenly

Fakultas Matematika dan Ilmu Pengetahuan Alam, Universitas Pakuan, Bogor, INDONESIA

## ABSTRACT

Current study aims at evaluation of the anti-hyperglycemic property of *Oryza Sativa glutinosa* on Sprague Dawley. Initially 20 male rats (Sprague-Dawley spp.) to eliminate error that may ensue due to cyclic hormonal variation in female rats in pregnant and non-pregnant states, induction of diabetic state was done by administering 150mg/bb of alloxan intraperitoneally until the blood sugar level rose to  $\geq 200$  mg / dL upon which Sprague-Dawley were divided into 5 groups. The treatments were positive control (metformin 0.012 g), negative control (distilled water), 1 dose of black glutinous rice (0.53 g), dose 2 black glutinous coffee (0.27 g), and dose 3 black glutinous coffee (1.06 g). Results: Changes in body weight and blood sugar levels were evident from day 3 of therapy, black glutinous coffee at dose 1.06 g / 200 g BW could decrease blood glucose level by 58% from the baseline readings (271.75 mg / dL to 114.25 mg / dL ) within 12 days of treatment ( $P < 0,01$ ) Black glutinous rice (*O. sativaglutinosa*) proved to be antihyperglycemic on Sprague Dawley's male rat. ( $P < 0, 01$ ). The prognosis of diabetes is highly dependent on weight and blood sugar control. The potency of *Oryza sativa glutinosa* in a reduction of blood sugar levels as well as its efficiency in weight reduction on Sprague-Dawley makes it a promising drug in the management of diabetes. The drug is also cost effective and tolerable making it accessible to many and has the potential of modifying the current rising trend of diabetes mellitus type 2 globally.

## INTRODUCTION

Diabetes mellitus is a complex metabolic disorder, involving abnormalities of insulin secretion and insulin action, and causes glucose intolerance and hyperglycemia [1]. According to 2011 International Diabetes Federation statistics out of the 451 million people who have diabetes worldwide an estimate of 153 million people were from the 21 West Pacific members of which Indonesia is a member corresponding to 34% of global diabetes burden. Diabetes contributes to 43% of all premature deaths, 80% end stage renal disease and thrice increases the risk of cardiovascular disease. About 10 million of diabetes cases was documented in Indonesia in 2015[2], The rise in global prevalence of diabetes (422million in 2010 to 451 million cases in 2015), pose a significant threat to developing healthcare systems like Indonesia with regard to direct health care costs, disability and time.3 About \$4.47 trillion was used in the management of diabetes in terms of medications and emergency care in 2015[3]. Over the years due to rising incidence of diabetes significant increase in the use of oral anti-hyperglycemic agents and insulin without meeting the recommended glycemic target has been reported. According to the WHO 2016 statistics, the prevalence of diabetes in Indonesia is 6.6% in males and 7.3% in females [4]. The prevalence of diabetes in Indonesia is 4.4% and 10.2% for glucose intolerance among the urban productive age groups consisting of 3.5% undiagnosed cases[. Obesity contributes to 68.7% of diabetes cases with 42.7% having central adiposity diabetes comorbidities in adult age group in Indonesia consist of hypertension contributing to more than 40% of cases and Dyslipidemia occurs in more than 50% of diabetic patients. The rise in risk factors, for instance, obesity 31.4% and physical inactivity 22.8% in addition to sedentary lifestyles have shown a direct link to the rise in diabetes burden in both urban and rural populations [5].

In 1994 there were 2.5 million DM patients in Indonesia and is expected to raise about 5 Million by 2020. In recent years, there has been increasing attention to the role of plant bioactive components in the treatment of diabetes mellitus. Brown rice can reduce the risk of type 2 diabetes; this is because the Aleurone found in brown rice can increase glucose metabolism [6]. Other bioactive contents which can decrease blood glucose levels include flavonoids [7]. Flavonoids can be found in the anthocyanin pigment contained in black glutinous rice [8].

Based on its flavonoid, black glutinous (*Oryza sativa glutinosa*) allegedly has anti-hyperglycemic properties. People consume black glutinous rice in the form of porridge, so its bioactive component decreases. According to previous research black glutinous rice prepared by steeping can preserve the bioactive ingredient [9]. However, at the moment only a few people know the benefits of black glutinous rice coffee, so there are still many who consume coffee. According to Suhartatik, consuming more than 5 cups of caffeine coffee per day will increase the occurrence of damage to blood vessel walls [9]. This is very risky for people with diabetes mellitus who have a higher risk of cardiovascular disease, so it is necessary to find another alternative. Based on the research conducted empirically, consuming 30 g of black glutinous rice brewed with hot water per day can lower blood glucose levels for people with diabetes mellitus, and of course, this steeping is free of caffeine ingredient. This needs to be tested through scientific research to establish the most efficient dose of black sticky rice as an anti-hyperglycemic agent so it can be used as a substitute for coffee for people with diabetes mellitus.

### KEY WORDS

Antihyperglycemic, coffee, black glutinous rice, Sprague dawley rats, diabetes mellitus

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### \*Corresponding Author

Email:  
prastyorinidjarot@gmail.com  
Tel.: +62-81298036348  
Fax: +62-2518375547

## MATERIALS AND METHODS

The materials used in this study are black glutinous rice, 20 male white rats Sprague Dawley, 70% ethanol and 95% distilled water, 512 type pellets for rat feed, alloxan, metformin, 10% gelatin solution, magnesium powder (Mg), 2 N (HCl) hydrochloric acid, and 10% sodium chloride (NaCl). The tools used in this research include gloves, masks, injections, oral sonde, scales, er Len Mayer, Brown bottles, watch glass, measuring flask, test tube, measuring cup, beaker, stirrer, spatula, Wooden clip, porcelain bowl, funnel, mouse cage, refrigerator, water bath, blender, easy touch, and glucometer strips. Current research used 20 male Sprague-Dawley rats aged 3 to 4 months old and weighed approximately 200g. The treatment group of 5 each were made consisting of 4 rats in each group. The tested groups were separated in a cage of a plastic box and a wired cap. The cage was floored by husks and to be replaced every two days once the cage condition remains dry. During the study, all groups of rats were fed pellet type 512 and drank water daily. Weight assessment and measurement of the number of consumptions was done every day. All the experimental animals were treated for 12 days.

### Preparation of black sticky coffee

A total of 30 g of black glutinous rice was washed and drained. Then it was roasted until the smell, and the color became darker. Then the black glutinous rice is mashed by a blender. The black sticky rice powder is sieved to obtain a fine powder. The black glutinous powder is brewed using boiling water, then administered orally according to the given dose. Treatment was given for 12 days after known alloxan induction of hyperglycemic state. Induction of hyperglycemic state in healthy mice that have been fasted for 10-12 hours was done by giving alloxan with a dose of 150 mg/kg BB intra peritoneal. Blood sugar levels were measured before alloxan administration (day 0) and after alloxan administration (day 3). Only mice with blood sugar content of 200 mg / dL were used in this study. The sample that attained blood sugar levels of  $\geq 200$  mg / dL was divided into 5 treatment groups, namely:

1. The treatment I: Positive controls gave metformin 0.012 g in 1 ml distilled water.
2. Treatment II: Negative controls given only 1 ml of distilled water.
3. Treatment III: (Dose I) Black glutinous coffee with a dose of 0.53 g in 1 ml of distilled water.
4. Treatment IV: (Dose II) Black glutinous coffee with a dose of 0.27 g in 1 ml distilled water.
5. Treatment V: (Dose III) Black glutinous coffee with a dose of 1.06 g in 1 ml of distilled water.

Each group of mice received different treatment dose, for 12 days. Blood glucose measurements were performed on days 3, 6, 9, and 12.

### Parameter of research

#### 1. Blood Sugar

Levels Measurement of blood sugar levels was done using Easy Touch tool. A blood sample was obtained by the pricking the tail followed by dripping on strips which were then installed on the tool Accu. Blood glucose levels were expressed in mg / dL.

2. Weight The analytical weighing machine was used to monitor the weight of the rats.

3. Dietary intake During the study, all groups of rats were given food and drinking water. Meals were measured to ensure uniformity.

4. Active ingredient To identify the active ingredient in black glutinous rice phytochemical tests which include flavonoid test, saponin test, tannin test, and terpene test was done.

### Phytochemical test

#### Flavonoid test

Black glutinous powder of 0.5 g was dissolved in 3 ml of 95% concentrated ethanol from which 2 ml of black glutinous powder and ethanol mixture is added to 0.1 g of magnesium powder. The above preparation is shaken gently by adding 10 drops of concentrated hydrochloric acid (HCL). The orange-red to red-purple that formed showed positive flavonoids. [10]

#### Saponin test

Black glutinous rice powder as much as 0.5 g is put into the test tube, added 10 ml of hot distilled water, cooled it and shaken it for 10 seconds. Positive results are characterized by the formation of foam that is not less than 10 minutes and as high as 1 to 10 cm. Also, 1 drop of hydrochloric acid 2 N foam is not lost [10].

#### Tannin test

Black Black glutinous rice powder of 0.5 g was dissolved in 3 ml of distilled hot water and stirred after cooling and centrifugation, 10% Of sodium chloride solution was added and filtered. The filtrate of 1 ml was added to 10% gelatin solution, the presence of precipitate signified a positive result.

**Penetration test**

0.5 g of black glutinous powder was dissolved in 2 ml of chloroform followed by addition of 3 ml of concentrated sulfuric acid carefully. The formation of reddish brown color on the surface of the solution is a positive test for the presence of terpenoids [11].

Research Design (Data Analysis): To get a conclusion from the study, the data obtained was analyzed by using Data analysis was done using SPSS 16.0 software, then described as the average which was then presented in table form for easy comparison. In the comparison of treatment outcomes, a t-test was used to compare the difference between the study sample, the negative and the positive control. Paired t test was used relate data before and after treatment. All P values of less than 0,001 were considered statistically significant

**RESULTS**

**Phytochemical test results**

The phytochemical test is one of the necessary steps in exposing the potential of plant resources, particularly to know the compounds in it. The results of phytochemical screening can be seen in following [Table 1].

**Table 1:** Phytochemical test results

Chemical Test	Reactants	Physical Indicators	Value
Flavonoid	Magnesium powder and HCl	P	+
Saponin	Aquadest	Froth formed	+
Tanin	FeCl <sub>3</sub> 3%	Brownish brownish green or blackish blue colour	+
Terpen	Chloroform and HCl	Forms reddish brown colour	+

Black glutinous rice showed positive results on flavonoids, saponins, tannins, and terpene. On the flavonoid test, positive results are indicated by orange color; this is due to the reduction of flavonoids with magnesium (Mg) producing complexes with red or orange color. In the saponin test, the positive results were characterized by the formation of foam [10], In tannins positive results was marked by the formation of brownish green or Blue foam, on addition of 3% FeCl<sub>3</sub> reagents to the sample, it reacts phenolic moiety of the tannin compound. In the terpene test positive results is characterized by the formation of a reddish-brown foam, due to the oxidizing effects of HCl[11]. Alloxan Induction of hyperglycemic states in Sprague-Dawley Intraperitoneal alloxan treatment (IP) with a dose of 150 mg/kg was able to increase blood glucose levels of rats by 169.25% from 102.50 mg / dL to 271.75 mg / dL, listed in [Table 2]

**Table 2:** Percentage of blood glucose level prior to Alloxan induction

Group	Day 1	Day -3	Percentage rate
1	102.25 ±	271.75	169.50 ±
	2.63	± 34.33	31.70
	102.75 ±		
2	3.20	271.75	169.00 ±
	3.20	± 32.60	29.40
	103.00 ±		
3	2.16	271.75	168.75 ±
	2.16	± 35.48	33.32
	102.25 ±		
4	3.86	271.75	169.50 ±
	3.86	± 11.47	7.613
	102.25 ±		

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5	3.86	271.75	169.50 ±
	3.86	± 32.34	28.48
Approximately	3.14	271.75	169.25 ±
		± 29.24	26.10

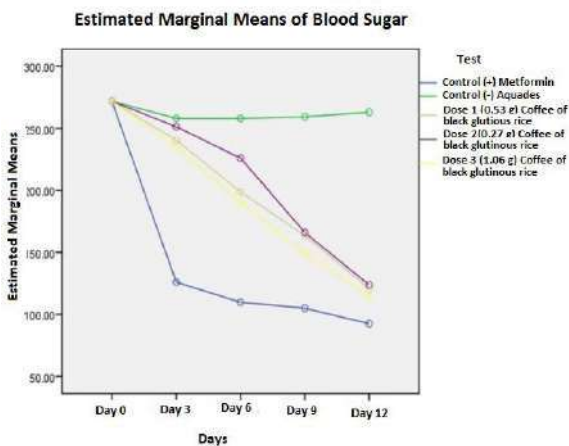
Intraperitoneal (IP) treatment was the preferred route in this test due to the advantages of intraperitoneal treatment over the abdominal cavity infiltration. Intraperitoneal (IP) route is attributed to the rapid onset of Alloxan action on the target pancreatic  $\beta$ -cells compared to the intra-abdominal route. During the study, changes in body weight were used as one of the markers of drug efficacy [12].

The average increase in body weight after induction with Alloxan was recorded and taken as the baseline value for follow up [Table 3].

**Table 3:** Body weight before induction of Alloxan

Group	Day 1	Day 3	Rate of increase
1	236.75 ±	253.75	17.00 ±
	8.65	± 8.09	0.56
2	238.00 ±	256.00	18.00 ±
	8.12	± 2.44	5.68
3	235.75 ±	255.75	20.00 ±
	7.13	± 5.32	1.81
4	236.75 ±	254.00	17.25 ±
	9.94	± 4.89	5.35
5	236.75 ±	253.75	17.00 ±
	39.94	± 6.75	3.19
Average rate	236.80 ±	254.65	17.85 ±
	8.82	± 5.49	3.32

Based on the above results, the increasing in body weight occurred on the third day after alloxan induction.



**Fig. 1:** Graph of average blood glucose level in S dawley.

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Obesity is one of the factors that influence the incidence of diabetes mellitus type 2. Visceral adiposity, for instance, is associated with impaired leptin signaling and peripheral insulin resistance that affects blood glucose levels in people with diabetes mellitus [13].

**The Effect of Black glutinous rice Coffee on Blood Glucose Level**

The results of black glutinous coffee activity test as the anti-hyperglycemic agent in experimental mice are presented in graphical form in [Fig. 1].

Based on the graph, decrease in blood glucose levels of rats started on the 3rd day after black glutinous rice was given.

In the positive control group given metformin, a significant decline in blood glucose levels on day 3, followed by a decrease in blood glucose levels to baseline on day 12 is observed. The reduction in blood glucose level in the positive control is due to metformin action through increase glucose uptake by tissues. Whereas in negative control the anti-hyperglycemic effects are due to physiological action of insulin in response to high blood sugar.[14]

[Table 4] shows that giving black glutinous rice at a dose of 1 (0.53 g), a dose of 2 (0.27 g), and a dose of 3 (1.06 g) can lower blood glucose levels in rats significantly (P<0, 01). The decrease in blood glucose levels was noticeable on day 3 of black glutinous rice. However, blood glucose levels were still high when compared with positive controls. Decreased of blood glucose levels are also caused by secondary metabolite compounds contained in black sticky rice.

Flavonoids have properties as antioxidants that provide protective properties against insulin- producing cells- β flavonoids also act via inhibition of glucose transporter isoform 2 (GLUT2), intestinal transporters for glucose. According to Arulsevan saponin compounds can regenerate the pancreas to increase the number of β-cells [6, 13]. Tannins enhance glucose uptake and inhibit adipogenesis in 3T3-L1 adipocytes through PTP1B inhibition modifying disease in peripheral insulin resistance. Liu et al show that tannins increases blood glucose transport by activating insulin-mediated signaling pathways. Terpenoid compounds also exhibited antidiabetes action through inhibition of the α-glucosidase enzyme [15, 16].

**Table 4:** Bloog Glucose content (mg/dL) in S dawley during the test

Test	Day 1	Day 3	Day 6	Day 9	Day 12	Average
Positive control	271.75±3 4.33	126.00±3 2.60	109.75±8. 81	105.00±6. 00	92.50 ±7.51	141 <sup>a</sup>
Negative control	271.75±3 2.60	258.00±3 5.28	258.00±3 5.28	259.25±3 4.76	263.00± 35.39	262 <sup>d</sup>
Dose 1 (0.53 g)	271.75±3 5.40	240.50±1 9.64	198.75±1 1.5	163.50±5. 51	120.75± 0.96	199.05 <sup>b,c</sup>
Dose 2 (0.27 g)	271.75±1 1.47	251.25±6. 08	226.00±3. 55	161.00±2. 31	123.75± 1.71	207.75 <sup>c</sup>
Dose 3 (1.06 g)	271.75±3 2.34	234.50±2 9.72	190.00±2 2.64	149.75±1 6.46	114.25± 2.87	192.05 <sup>b</sup>
Average	271.75 <sup>e</sup>	222.05 <sup>d</sup>	196.50 <sup>c</sup>	168.70 <sup>b</sup>	142.85 <sup>a</sup>	

Explanation: the number followed by different superscript in each column or rows show significant variations in blood sugar levels. (P<0.01).

**Total dietary intake during the Study**

During the acclimatization period, all animal groups were fed pellet of 512 types as much 100 g per day. After the induction of alloxan and blood glucose levels is ≥ 200 mg / dL, The amount of feed consumption was 110 g per day, it aims to see the effect of feed consumption when blood glucose rises. Based on this research it was concluded that when the blood sugar increased feed, consumption was also increased, as people with diabetes mellitus tend to experience symptoms of polyphagia and dysfunction in leptin-satiety pathway, especially in visceral obesity [14].

**The effect of black glutinous rice coffee on body weight**

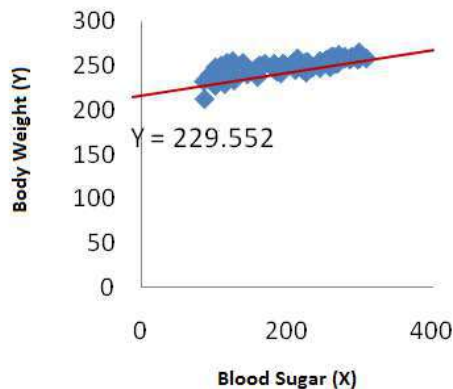
In [Table 5], it can be seen that the lowest body weight is seen in the group of positive control treated rats given metformin that is equal to 227.75 g. As metformin is associated with a reduction in appetite in diabetes type II and cannot increase body weight [20]. Furthermore, the lowest body weight is also seen in the rats that were given black glutinous rice at a dose of 3 (1.06 g) it is 237.75 g. The high content of fiber in black sticky rice provides longer safety effects hence suppressing the addition of body weight. The highest body weight was seen in the group of negative control treatment rats corresponding to 261.25 g.

[17]

**Table 5:** The weight of rats (g) during treatments

Treatment	Day 1	Day 3	Day 6	Day 9	Day 12	Rata-rata
Positive control	253.75±8.09	250.00±5.72	247.25±2.98	240.00±2.22	227.75±2.11	244.45 <sup>a</sup>
Negative control	276.00±2.44	245.75±2.21	256.75±2.22	259.00±1.58	261.25±1.58	257.55 <sup>c</sup>
Dose 1 (0.53 g)	255.75±5.32	252.75±5.31	250.25±5.12	247.50±4.20	244.00±4.09	249.50 <sup>b</sup>
Dose 2 (0.27 g)	254.00±4.89	252.25±4.50	250.00±4.24	247.50±4.20	244.75±4.03	249.70 <sup>b</sup>
Dose 3 (1.06 g)	253.75±6.75	249.75±29.72	245.75±6.75	241.75±6.75	237.75±6.75	245.75 <sup>a</sup>
Rata-rata	254.65 <sup>d</sup>	252.45 <sup>c,d</sup>	250 <sup>b,c</sup>	247.25 <sup>b</sup>	242.60 <sup>a</sup>	

Explanation: the number followed by different superscript in each column or rows show significant variations from baseline body weight (P<0.01).



**Fig. 2:** Graph of correlation between blood glucose levels with animal body weight test.

The above [Fig. 2] explains that the relationship between blood glucose level and body weight can be expressed in the equation  $Y = 229.52 + 0.99x$ , meaning that each addition of 1 g of body weight will increase blood glucose level of 0.099 mg / dL. Obesity is one factor that affects the incidence of diabetes mellitus type 2. Excessive fat deposits in the body can cause insulin resistance that affects blood glucose levels in people with diabetes mellitus. So the above regression equation can be modeled to determine the effect of body weight on certain blood sugar levels [5].

## CONCLUSION

The prognosis of diabetes is highly dependent on weight and blood sugar control. The potency of *Oryza sativa glutinosa* in the reduction of blood sugar levels as well as its efficiency in weight reduction on Sprague-Dawley makes it a promising drug in the management of diabetes. The drug is also cost effective and tolerable making it accessible to many and has the potential of modifying the current rising trend of diabetes mellitus type 2 globally. Further research is needed to evaluate the efficacy and tolerability of *Oryza sativa glutinosa* in diabetic patients in order to achieve lower blood glucose level that meet the positive control level.

### CONFLICT OF INTEREST

There is no conflict of interest.

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## ARTICLE

# A REVIEW ON ANDROID APPLICATIONS FOR ARABIC LANGUAGE LEARNING

N. H. Anas\*, Z. R. Mahayuddin

Faculty of Information Science & Technology, National University of Malaysia, Selangor, MALAYSIA

## ABSTRACT

There are various disabilities that have a major implication on the whole concept of verbal communication. Autistic people are the most affected. Autism ultimately ends up limiting the range of social interactions of patients and crucial activities such as playing. Over the past few years, there has been a rapid increase in the number of children that have been diagnosed with Autism Spectrum Disorders. Mobile applications have continued to be generally accepted among children with ASD as they are easy to use. The applications have proven to be convenient to use so that children with issues regarding autism can be in a position to employ the use of technology. It is essential to note that autistic children, more so those that are still very young, are not in any way similar to non-autistic children.

## INTRODUCTION

There are various disabilities that have implication on the whole concept of verbal communication. On top of the list of those that are most affected are people with autism, which end up limiting the range of social interactions and even activities such as playing. It can, therefore, be said to be a scenario which has implications on the daily functions among the upcoming lives of people. Some of the impairments that accrue from Autism Spectrum Disorder affect the whole process of social interaction and even communication. ASD results in a complex developmental disability that normally appears during the first 3 years of their lives. The condition is associated with a neurological disorder [1]. Over the past few years, there has been a rapid increase in the number of children that have been diagnosed with Autism Spectrum Disorders. This has sparked an increase in mobile applications that are focused on making improvements and enhancing the social skills among children with ASD. One of the major disciplines that have proven to experience immense changes is the emergence of Arabic mobile applications. These applications have been designed with the aim of being used to the advantage of children with Autism Spectrum Disorder [2].

## LITERATURE REVIEW

### ANDROID APPLICATIONS FOR ARABIC LANGUAGE LEARNING

Mobile applications have continued to be generally accepted since they are easy to use especially for children who have been diagnosed with ASD [3]. Mobile applications can be said to be software applications normally designed to run in mobile devices ranging from smartphones to tablets. Mobile applications are available on platforms which run on the various mobile devices. Some of the platforms which have embraced the initiative are available in Apple store and Google play store.

The past few years have been characterized by an increase in mobile applications, which has ultimately led to an increase in the number applications that are difficult to use for some users. Some of the issues that can be used to determine the ease of use of some of the applications include assessing the usability of the applications. Basing on the definition outlined by the International Organization for Standardization, usability entails the extent to which a particular mobile application goes so that it can be in a position to achieve effectiveness, satisfaction and also efficiency [4].

Effectiveness is concerned with the accuracy of the application or the aspects of completeness which can be met by particular users of the application. Efficiency, on the other hand, looks into some of the resources which the application exploits so as to come up with the desired results. Satisfaction is about ensuring that the application is in a position to ensure comfort and also ensuring that it achieves acceptability among the users of the application [5].

It is therefore essential to ensure that Arabic applications, more so those that are aimed at benefiting the children that have been diagnosed with ASD, are in a position to present maximum usability. The children that are of central focus fall in between the age bracket of three and twelve. The applications should also be usable by people that are concerned with aiding the children with these conditions. Users should not at all have challenges in manipulating the applications and ensure that high productivity is achieved [6].

## METHOD

The people affected by the usability of such applications are not only those that have been diagnosed but also their teachers, parents and even non-autistic children. The usability of these applications can be

**KEY WORDS**  
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\*Corresponding Author  
Email:

nurulhidayama2017@gmail.com  
Tel.: +60134592944  
Fax: +6038925 6732

assessed and even analyzed based on a series of measures that have been standardized and recommended. Some of the applications include 'Touch to Speak' devices and 'Tap to Talk' devices which have managed to embrace the Arabic languages among other major languages such as English.

The two forms of communication that have been employed extensively by application developers have acted as the forms of the most precise alternative forms of communication which are also augmentative. They give models which can be used to express needs, wants and even thoughts. They can be used to give expressions of ways to convey ideas because they employ the use of augmentative aids. Some of the augmentative aids which are usually employed are use of symbols as a mode of communication or in some cases pictures. The aids are essential because they help in ensuring people are in a position to express themselves, which sometimes integrate the use of electronic devices [7].

Children with ASD have serious issues in terms of making speeches or extensive language problems and the two aids ('Touch to speak' and 'Tap to Talk') have proven to be essential to them. The fact that it is in a position to cater for the needs of some people with special needs gives them the opportunity to also learn Arabic [8]. It is thus clear why mobile technology has been in a position to adopt a variety of applications created for the sole purposes of ensuring that people with such conditions do not face challenges in establishing communications and interactions [9].

A very essential aspect of mobile technology is that games have also been integrated to tackle the needs of children with special needs. Various studies conducted in the past have come up with important conclusions regarding the essence of mobile technology [10]. The researchers came to the conclusion that mobile technology plays a very crucial role in cognitive development. Some of the other positive aspects highly likely to be recorded include general development in psychological capabilities and also positive results in the general academic performance of such children.

## RESULTS

The results which aided in the conclusions were based on studies involving interviews conducted with tutors and also an extensive examination of some of the software that has been utilized to assist in boosting the performance of children with ASD. The researchers find out that autistic children showed immense satisfaction with the technology which had been adopted, more so those that they used in playing. Some of the research focused on finding out how educational games aided in the performance of autistic children [11].

However, there has been immense concern pointing to the essence of techniques that can be used to evaluate the usability of some of the games [12]. The techniques have been adopted so that the interface of some of these games and even the mechanics of the game can be assessed and aid in the establishment of whether they are in a position to enhance interactivity among children with ASD. A huge aspect that is prevalent, based on the games aimed at assisting children with ASD, is that they end up coming up with routines [13]. The routines are also accompanied by a predictable environment which has always been essential for cognitive development.

Children diagnosed with ASD are seen to be visual learners and most of them also do not always seem to respond to the audio cues [14]. It is therefore essential for mobile application developers to take into account some of the issues that should be integrated to the applications, which will eventually ease the use of mobile devices among those with ASD. It is fundamental that there is a consideration for some aspect of difficulty to ensure that maximum results are achieved. The results can be assessed based on the ease of use of the mobile application and the ability for the users to learn. There is also need to ensure that the application is in a position to be interactive and eventually translate to easier learning and usage [15]. Mobile applications have therefore proven to be convenient to autistic children and they can easily employ helpful aspects. Arabic concepts can also be grasped through such platforms which will enhance communication and interactivity. However, it is important to ensure that the forms of mobile application technology should be standardized in such a way that there will be no negative effects be recorded as a result of problems usually associated with some of the technological devices [16].

It is crucial to ensure that the special needs of the users have been taken into account during the process of developing the applications [17]. Some of the issues which can be addressed include the interface designs, considering that there are varied categories that are essential for the applications to be of great use. This consideration will ensure that all the aspects of the developed application are taken into consideration. It is an approach which may address the issues of those that may find visual presentations more crucial since they do employ these illustrations [18]. The images can be used as a way of creating connections with some of the places familiar with the users or even their family members.

A key factor that cannot be ignored is that the audio levels of mobile applications need to be regulated in such a way that there will be minimal disturbances. In the event that the children with autism begin interacting with the applications, extreme audio levels are likely to result in disturbances and discomfort. Audio should, therefore, be strictly regulated since it is a concept which is very essential for interaction with other people. One challenge that is prevalent among children with autism is that they tend to show a preference for people that they have always known. This is a clear implication that a major challenge may arise when establishing alternative ways to train them to embrace new ways of interactions. A complete

way of making interactions, where for this scenario is the use of mobile technology, may prove to be a challenge. It may be a challenge to introduce the type of technology more so if it is from new parties [19].

It is however very clear that the whole process of exploiting some of these applications is relatively easy. This despite the fact that in some cases, the visuals used in the mobile technology may be a challenge to evaluate and even translate [20]. The applications should be in a position to address the whole aspect of customizing them so that they can be adjusted to suit the needs and the taste of the patient. Some of the applications may be accompanied by other issues which may come as a result of the unpredictability of the mobile application [21].

## CONCLUSION

Autism Spectrum Disorder is a condition which has been on the rise throughout the past decade despite some failing to be diagnosed. Most Arab countries have experienced the issue and have not been in a position to adequately blend in the technology of mobile application as much as they have advanced in technology. As much as there have been applications which have been adequately crafted to meet the needs of children with ASD, all the usability aspects should be paramount so as to enhance the productivity of such applications.

## RECOMMENDATION

It should, therefore, be paramount to ensure that there is an optimal design which will ensure that mobile applications can serve as an alternative for the for the conventional methods of communication [22]. Benefits of the technology should be embraced and blended to ensure that the issues associated with the mobile applications can be minimized by all means. New features can be essential based on prevailing experiences and study of some of the aspects that are likely to be essential. New features are necessary for the recommended standards of the platform to be achieved. All in all, there is a need for a robust framework that will tackle the issues which may come in terms of functionalities through the presence of guides that will assist users [23].

## FUTURE WORK

It is essential to note that autistic children are not in any way similar to non-autistic children, more so those that are still very young. They easily get bored while performing various tasks [24]. There is a call for more research to dwell on ways to find out different approaches that can be employed to ensure that children with ASD do not maintain certain specific positions for a significant amount of time [25]. It is a proposal based on the fact that most of the applications that have been under intensive research, have not tackled issues related to boredom as a result of sticking to one position for a while.

## CONFLICT OF INTEREST

No conflict of interest

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## ARTICLE

# GROWTH OF A METROPOLITAN CITY; JAKARTA

Nandang Najmulmunir\*

Lecturer, Universitas Islam 45, Bekasi, INDONESIA

### ABSTRACT

Indonesia was recently categorized as a newly industrialized country. Jakarta is the country's capital and is the center of economic and political dynamics of the country. The capital city is also a gateway to the rest of Indonesia which is a result of its Geographical location. The city has undergone significant changes in developmental level over the last decade and is currently one of the most eminent metropolitan cities in Asia. This development which dates back to the 14th century is affected by a variety of factors including; climate, political factors, population density, infrastructural aspects related to governance and the neighboring regions to the metropolitan city. This study aims at evaluating these factors with a major focus being on Jabodetabek an abbreviation derived from Jakarta, Bogor, Depok, Tangerang, and Bekasi. The study entails a thorough analysis of literature that is related to growth and development of the region. The factors analyzed are categorized separately, and the impact of each factor to regional development is identified. Negatively impacting factors will be identified and reported in the study. This will provide qualitative data on each of these factors and can be used in other studies as the basis of quantitative analysis of the impacts of these factors.

### INTRODUCTION

Jakarta, Bogor, Depok, Tangerang, Bekasi, abbreviated as Jabodetabek form a unique metropolitan region of Indonesia known as the Greater Jakarta and constitutes an important economic region of the country [1-3]. The region was formerly known as Djakarta or Batavia until 1949. Jakarta city which is the capital is surrounded by this area making it a megacity referred to as Greater Jakarta. In the early 1970's the region was known as Jabotek until "De" was introduced to include five municipalities which are those constituting Jabodetabek and the Cianjur Regency was incorporated in the 2011 making up Jabodetabekjur [1,4]. The region has an area of 6392km<sup>2</sup>, and according to a census conducted in 2014, it has a population of 28 million, and by 2014, the population is estimated to have grown to over 30 million [5]. Jakarta is home to over 300 different ethnic groups of Indonesia making it widely diversified in culture and social practices. The region has seen uninterrupted growth over the last 30 years, and this has made it the center of government, a significant economic power to the country, an educational center owing to a large number of research institutions in the country and a tourist attraction center. The region is the premier center for commerce, manufacture and finance of Indonesia due to its economic power. The region accounts for 25.52% of the total national gross domestic product of Indonesia and accounts for 42.8% of the total GDP of Java Island [6]. The rapid development and economic power of Jabodetabek are attributed to a variety of factors which are discussed in the literature below.

#### Geographical favorability

The city is located on the west side of Java Islands, and it is at the entrance to Indonesia which makes its accessibility easy. Massive land neighbors it on the northern side which allows more room for expansion [7, 8]. It has a tropical climate with temperatures ranging between 25-31 degrees Celsius which makes it a favorable place for most human activities hence its massive expansion and growth.

#### Well-developed means of transport

There is a strong interaction between Jakarta and the neighboring metropolitan (Greater Jakarta) due to well-developed transportation networks. Air travel is facilitated by Soekarno Hatta International Airport which is also referred to as Cengkareng Airport (CGK) and Halim Perdanakusuma International Airport which mainly serves the civilians of Jabodetabek. South Tangerang airport acts as an oil transportation airline besides being used by the army [8,9,10]. Railway network is also a factor that promotes the development of the Megacity. Jabodetabek is served by five major lines which include; the Bogor-Jakarta Kota line which is the busiest rail road, the Bogor- Jatinegara loop line which has six major terminals. The Bekasi- Jakarta Kota rail road which is the second busiest line and has four major terminals, the Maja- Tanah Abang line has four major terminals, and the Tangerang - Duri line with two terminals. This rail network serves as a means of lowering congestion at bus stations and airports. Bulk transport is also made easier by the well-organized network [1, 4]. Bus transport system is well developed in the region [11]. The region has 12 active corridors which serve as the Trans Jakarta bus rapid transit also known as the bus way. Plans are underway to construct three more bus ways [2,7].

#### Link between metropolitan and micropolitan regions

Jakarta city as a metropolitan is well linked to the surrounding minor regions which form the metropolitan area. These are the regions abbreviated as Jabodetabek. This linkage creates The Greater Jakarta, a megacity that is surrounded by other fast developing regions [12, 13]. Unlike Jakarta, other parts of Java islands lack a

#### KEY WORDS

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Jakarta, metropolitan,  
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#### \*Corresponding Author

Email:  
nanduz2017@gmail.com  
Tel.: +62-81382293429  
Fax: +62-21 8801192

clear link between major and minor cities which can be described as the underlying reason for a slower growth when compared to Jakarta.

### Jakarta watershed

Jabodetabek region is surrounded by natural water sources which are also a similar case to other Java islands. This predisposes the region to flood considering the daily evening showers which occur in the region [14, 15]. This watershed is, however, advantageous in times of minimal rainfall and serves as the primary source of water for the Jabodetabek region [4]. The watershed also serves as a reservoir besides providing water to the megacity. It has undergone construction recently to include canals such that during floods, excess water is lost through them minimizing outflow into the metropolitan region [3, 16].

### Jakarta population

Jakarta region is one of the most populous cities in the world [10, 17]. Its approximate population was estimated to be over 10 million people in 2016. The metropolitan area of Jabodetabek has a population that exceeds 30 million inhabitants over the available square area of 1693 square meters. This population has grown from 8.2 million in the year 1970 to the over 30 million people in 2016. The ever growing population is starving the resources of Jabodetabek [10, 18]. It exceeds the estimated population and the governmental resources allocated to the region. It is estimated that by 2020, the problems of Jakarta will intensify with an increased population from 25 million to more than 35 million [16]. The large population has its advantages despite the associated disadvantages. Among them are automobile industries, transport sector, and bio medic.

### Setbacks in greater Jakarta `s development

The watershed surrounding the region is advantageous but predisposes the metropolitan region to flood. Every year the region of Jabodetabek is faced by annual floods which are accompanied by massive destruction of property and infrastructure [5,14,15,19]. The residents surrounding the region are poor and every year statistics report their migration to areas that are less likely to flood. This is likely to result in a significant drop in the development rate of the region as well as drive away foreign investors from the region due to fear of natural calamities. Another setback is related to the high population in Jabodetabek. The region has the largest number of foreign Chinese and other people from Asia [7, 12, 13]. This overwhelms the natural resources of the region and leads to over-exploitation of the available resources. An example that is evident is the encroachment of people and human settlements towards the watershed. Yearly, the number of people settling on the shores of the natural drainage increases and this predisposes them to flood effects and displacement. There is an issue in the planning and implementation of various infrastructural programs by the Indonesian government over the Jabodetabek region [2,3,5]. This occurs through the failure of governmental organizations to meet the set deadlines for implementing various programs. The central and regional governments of Indonesia seem to lack the required team approach in managing developmental projects over the megacity region which slows down expansion [2, 16, 20, 21].

## MATERIALS AND METHODS

The study involved an analysis of different literature to identify the factors that have been affecting the growth of Greater Jakarta region and the entire Jabodetabek megacity. The study also entailed focused group discussions with authorities and government representatives of Jakarta, West Java, Banten, Bekasi, Depok City, and the city of Bogor, Tangerang City, Bogor, Tangerang, and South Tangerang City, also with the Ministry of Home Affairs, Ministry of Forestry and Ministry of Public Works. This occurred between the months of March and August 2014. The responses given by the authorities were well recorded in written formats as well as those obtained from the different literature sources. The search words that were applied in identifying the research journals were; Jakarta, Jabodetabek megacity, Greater Jakarta, and growth of Jakarta. Data obtained was then categorized into various groups which included; factors favoring the expansion of Jabodetabek region, and setbacks to expansion of Jabodetabek megacity. Continuous climate change has the potential of negatively impacting the growth of Jabodetabek. The sea level increase which is a global phenomenon is likely to cause more displacements in the future with increased flooding incidences [9, 13, 16].

## RESULTS

According to the literature analyzed and the responses identified by governmental officials from various ministries, Jabodetabek region has a variety of favorable factors which promote its expansion, but there are a significant number of issues which slow the growth of the megacity despite its current ranking as one of the most fast-growing cities in Asia. Favorable factors include; the well-developed transport and communication networks including railway, bus transport, and air travels. In terms of communication networks, the Greater Jakarta is the fourth most connected city in the world via the LinkedIn network [8- 10]. This makes

communication between one parts of the town to the other easy and positively contributes to its rapid growth and advancement.

The city has a well-developed connection with its neighboring municipalities and regencies [15]. Unlike other regions in Java Islands, Jakarta city is surrounded by other parts, and their growth is interdependent with that of Jakarta which has eventually resulted in the development of a megacity. Its geographical characteristics also promote its rapid development compared to other regions in Asia [5,16]. It is located at the entrance of Indonesia which makes its accessibility easy as well as developmental projects initiated by investors [17]. The climatic condition of the region is favorable for most human activities and businesses, and this attracts more people to the region. The metropolitan region has an ever increasing population [21, 22]. This occurs due to immigration with most of the immigrants being the Chinese. They provide skilled labor in the industrial sector of the city as well as business related investments.

Tourism acts as a source of revenue for the region with tourists being from different regions including Europe and Asia [20]. The watershed surrounding Jabodetabek is both advantageous and a disadvantage to regional growth and development. During floods, the high population which some has settled along the water margins is displaced. The watershed, however, serves as a source of water for the megacity. Governmental efforts to combat the annual flooding in surrounding areas have been initiated such as the construction of canals to allow runoff of excess water. Water supply cannot match the demand which continues to increase [5,9,14]. For example, in Jakarta is estimated that lack of clean water for 10099 liters per second at 2015. This negatively impacts the growth of Jakarta and predisposes residents to health risks.

## CONCLUSION

Jabodetabek region is highly advanced regarding growth compared to other cities in Asia. The rapid growth could be attributed to a variety of factors as discussed [8, 23]. The city, however, faces setbacks which might slow down this progress in development if not well combated. The research did not clearly quantify the effects of the analyzed factors in the growth and development of Jabodetabek. This calls for further research which should be quantitative in nature to identify the contribution of each of the analyzed factors as a percentage towards growth either positively or negatively.

### CONFLICT OF INTEREST

No conflict of interest to declare

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## ARTICLE

# PUBLIC PERCEPTION OF ENERGY CONSERVATION: A STUDY CONDUCTED IN THE CENTRAL JAVA PROVINCE OF INDONESIA

Inna Sri Supina Adi\*, Hari Gursida, Jaenudin, Didiek Notosudjono

*Fakultas Ekonomi, Universitas Pakuan, Bogor, INDONESIA*

### ABSTRACT

The world has grown significantly, and with this growth, industry and population continue to mitigate and develop new resources. Energy is one such resource where sustainability has been threatened by the very institutions that sought to use the resource. Natural gas, for instance, continues to dwindle, creating a concern for alternate sources of energy. One measure that can improve the sustainability of energy is its conservation. In this paper, the perceptions of energy conservation in Indonesia bring to focus some of the most critical elements meant to improve the use of energy in their country. The study area took a sample of PLN respondents, who make up 100 percent of the energy consumers in the Central Java Province. This paper should improve the understanding of energy conservation about public awareness and social marketing.

### INTRODUCTION

The conservation of energy is perhaps one of the most innate priority causes in the world. It is critical that the developments in science, industry, and technology are sustainable and environmentally sensitive. All over the world, governments have engaged their people and countries, through institutions of campaigns to improve the efforts to save energy in all spheres of their industry. Looking at Central Java province of Indonesia can further expand the understanding of the strides the country has taken to improve the use, distribution, and conservation of energy.

Legal control of the energy sector in Indonesia could be traced after the launch of the first private Energy Company (PT Paiton Energy). The Electricity Law of 1985 defines some predispositions that formed the foundation of the Energy Sector. Some of the earliest details of the same saw a lot of the involvement of private companies as Independent Power Producers (IPP). These institutions were tasked with their responsibility for commercialization of the energy products in the country. The companies would be able to address the energy needs of the country through a state-owned company called PT Perusahaan Listrik Negara (PLN). The company saw much of the modern development in energy integrate into the industries and households in Indonesia.

Looking at the strides the country has experienced in the dissemination of information and creation of awareness on issues pertaining energy conservation, the understanding of the public on the issue of energy conservation and specifically its value to industry and sustainable economic development has been noted to be important influences in improving the energy conservation efforts of a country. The government has set a target to reach an electrification ratio of 92% by 2021. Such creates the need and perceived value of energy in the country. Some of the monetary investments that must be made in the same breadth total an astonishing \$96 billion [1]. The IPPs and other private investors are expected to meet this investment capital demand.

To capture the full value of this energy, the creation of awareness on matters like energy conservation preempts its importance and, more than that, its sustainability. The energy goals of the country are steep. They will have a significant impact on the economic performance and industrial growth of the country [1]. Countries that have seen such economic and industrial development often fail to consider the core issues that come about environmental and energy conservation. Effects, such as climate change and global warming, threaten the sustainability of the planet. Looking at the public perception and, specifically, its value in improving the use of energy can improve the understanding of the intended course of action that the government of Indonesia ought to institute.

As of 2012, the economy of the country recorded a growth rate of 6.2% in the GDP. In 2013, the GDP was recorded to be growing at a rate of 6.8%. These statistics preempt the energy needs of the country. It has been estimated that the demand for electricity should rise to an average 7.4% by 2019. Such figures also inspire analysis of the value of the energy conservation. The country has a population of 248 million with an inclusive 74 million in the emerging middle class [1, 2]. This increase in the population of the country makes environmental and energy conservation primary concerns for the government of Indonesia.

### MATERIALS AND METHODS

The paper analyses some reforms that have been implemented for the improvement and development of infrastructure in the energy sector. Some of the critical inferences the paper makes include an in-depth analysis of the core functions of the government and corporate institutions in improving the state in which the country uses and distributes energy. The research performed a qualitative analysis on Indonesia and, more importantly, the Java District in the country.

#### KEY WORDS

Public perception,  
Energy conservation,  
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#### \*Corresponding Author

Email:  
innadiss2017@gmail.com  
Tel.: +62-81298036356  
Fax: +62-251 8380137

The aim of the study was to uncover the measures taken to improve the value of energy conservation and critically analyze the creation of awareness and distribution of information regarding energy conservation. The perceptions of the public are also included in the paper, citing from relevant studies performed by both academic institutions and professionals in the energy sector of the country. These tools were critical in understanding the discourses that may have been formed in the economy, institutions, and public of Indonesia. In this paper, the baseline understanding of energy conservation is with people of Indonesia. Several media outlets and socialization platforms are developed and maintained to inform the public about energy conservation and their role in it. Other important metrics that can improve the use of energy in the country are the factors that influence purchasing decisions of electronic goods [3]. Creating a policy that regulates the use of technology regarding environmental and energy conservation that can have a significant impact on the energy conservation of a country is necessary [3, 4].

Companies that distributed electricity and other social amenities to the public had a direct link to the consumption trends in the country. They, therefore, held a critical role in the use and conservation of energy in the country. In analyses of these core factors, the paper should present important niches that may not have been exploited. Minimizing on wastage through phasing out high energy consuming appliances, for instance, can improve the overall sustainability of the country's energy supply [2, 5].

## RESULTS

The power sector in Indonesia is regulated by the Ministry of Energy and Mineral Resources. It has several sub-agencies from which it implements policy and pushes for increased value and investment in the energy sector of the country. Some of the core functions of the company include the creation of a national energy plan. In this plan, 10-year energy use is developed. The Ministry of Energy details issues like capacity needs within the ten-year period, information on resource allocation, and investment options for the company.

The potential for renewable energy is another important concern the government considers. The plan also accounts for the potential sources of renewable energy that can be incorporated into their national grid. These functions are often delegated to private organizations and government agencies. Some agencies include the Directorate General of Electricity and the Directorate General of New and Renewable Energy and Energy Conservation [2]. Through such institutions, companies can improve on their distribution and use of energy.

Some reforms that have been implemented and advocated for in the last three years include, the use of energy saving lamps, reduction of the consumption of electricity, and even regulation of the temperature in buildings. These are critical steps that ought to improve the strides that individual entities in the country can make to safeguard the energy needs of their country [6]. Taking the perspective of both technical and human influences, the conservation of energy in Indonesia can be critiqued. These two dimensions of energy use and distribution are critical as they undermine or improve the public value of environmental conservation within the country.

A survey that sampled ten regions represented in the PLN Surakarta district and the provincial capital, Semarang, was undertaken to find out the efficiency of energy conservation within the country and, more specifically, the perceptions of the people of Indonesia on energy conservation. The respondent's responses were recorded in an Achievement index. The achievement index defined the perceptions of individuals through a gap analysis. Below is the Criteria for the Achievement Index.

**Table 1:** Energy conservation respondent's index

Gap Score	Category
0-1.00	very low
1:01 to 2:00	low
2:01 to 3:00	fair
3:01 to 4:00	high
4:01 to 5:00	very high

The respondent's gap score gives an accurate depiction of the understanding of the respondents on energy conservation. The researchers from this survey employed ordinal logistic regression to define the scope of the outreach programs and their impact on energy conservation in the country.

The study took a sample of 65% Female respondents and 35% Male respondents. Their ages were spread across, 17 -25, 26-35, 36-45, 46-55, 56-65 and Over 66 Years old, whose sample was, 6%, 11%,19%, 38%, 16% and 10%, respectively. Other important statistics that defined the study include the educational background, work background, income and spending background, electrical power use, and use of electricity meters. This information would improve the accuracy of its objectives.

### Level of public awareness

The public awareness level was calculated at 2:00. All categories were included in this analysis. This finding warrants an increase in programs and policy that improve on the conservation of energy in Indonesia. While there have been significant strides that the government has made in terms of television advertisements, radio, and even print media, there is still a significant stride to be made. For instance, social marketing can improve the public interest in matters concerning energy conservation.

## CONCLUSION

Given the result on the Achievement Index, several important conclusions can be derived from the index. For instance, the gap analysis indicated a low achievement index on the public awareness in relation to conservation of energy. This is an important starting point, as it forms the baseline on which the government and private firms must consider when improving energy conservation.

The study also uncovered the discourses in communicating energy conservation to the public. The most effective media outlets proved to be radio, the Internet, and television [7]. Many respondents often relied on these means to get information on important policy and issues affecting their communities. Using this tool can, therefore, be useful in improving awareness in the country.

While advertising on social media, among other forms of multimedia, the critical factors of conservation meant more than awareness had to be implemented. Energy conservation demands the initiative from every consumer and household [8]. Reducing the consumption of electricity through creating a 5pm to 10pm policy on conservation can be an avenue through which change can be effected on the ground [7]. Advocating for the use of energy saving technology and reducing the use of natural gas also improved the sustainability of energy in the country

## RECOMMENDATION

Education is an important and effective avenue through which information can be passed. The study did not cover under 17-year-olds. One institution through which conservation can be taught and incorporated into the culture of the country is through its inclusion in the education system of Indonesia. The increase in the middle-class population implies the country should see an increase in the demand for energy [8]. As the country develops, the government will have to implement tariffs and policies that improve the measures on energy conservation in the country. Price instrument, for instance, can be a powerful tool through which the government improves the strides in the conservation of energy [9, 10, 11]. Socialization is an important part of the process. As more people learn about energy conservation and their role in improving the use of electricity, among other important sources of energy, a culture around conservation of energy can be developed [10,12]. The government should aim to create this culture from the corporate institutions to individual homes. By implementing such a reform, the country should see a significant improvement in energy use and conservation.

### CONFLICT OF INTEREST

There is no conflict of interest.

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## ARTICLE

# A SURVEY ON CLOUD OPTIMIZATION SYSTEMS

R. Divya<sup>1\*</sup>, V. Jayanthi<sup>2</sup>

<sup>1</sup>Department of CSE, NPR College of Engineering and Technology, Dindigul, INDIA

<sup>2</sup>Department of ECE, PSNA College of Engineering and Technology, Dindigul, INDIA

### ABSTRACT

Cloud has become the best revenue generator tool in the business world. The Cloud Service Provider (CSP) gives attention to the enormous data arriving in the cloud. Many techniques are available for solving the problems in cloud. But complete solution is not possible due to the volume, velocity and variety of data arriving in cloud. Modifications in resource utilization, cost pricing, load balancing could be done for the effective utilizations of cloud. The combined optimization of the major factors of the cloud could result in high profit to the CSP. In this paper, an extensive survey of optimization techniques for different factors of cloud is discussed and the results achieved by each factor are tabulated.

### INTRODUCTION

Cloud has become an essential component in daily life for business organizations, educational institutions, hospitals, Industries for gaming servers, file sharing, billing, web hosting, software applications etc., Because of the resource pool visibility and availability, elasticity, self service and pay per use reasons, the Cloud is always being a vital platform. The Cloud service Providers (CSP) are also increasing due to demand of resources. Having resources in hand, CSP make their own ideas on how to efficiently use them, manage them, protect them and make profit of them [1]. Many investors are also investing in research around cloud computing.

Even though cloud was initially invented in the 1960s, it was introduced for industrial purpose in India in 2006. Once it was started practicing by our business people, many problems arose in the trustworthiness of cloud, legal issues and architectures to follow. Research started in cloud from then till now to achieve best approaches and results. Many cloud applications and models solved most of the basic problems of cloud. But the virtualized cloud storage, heterogeneous underlying hardware, self organizing and self optimizing cloud are still under research. The problems of cloud are easy to solve using one crisp solution due to the fact that the issues are interlinked with one another. Increasing the number of servers may result in best speed and throughput but contradicting in resource utilization. Enhancing the performance with the resources available would be the possible way of solving cloud problems. Minimizing the resources available is nothing but optimization. Certain adaptation in the underlying factors and parameters of cloud would produce efficient utilization.

Optimization is a mathematical model based on decision making. The decision has to taken from the user .The cloud user provides the input data, Control variables and decision constraints for optimization. The sample cloud price data, data center, VM can be taken from Amazon web services, Google trace data, planet lab etc., User provides input data in numerical values and the factors of cloud to be optimized as control variables. The type of service and the number of users are used as decision variables. The resources of cloud like bandwidth, memory, storage, No: of servers, processing speed , latency, power, cost, virtual machine down time, migration time are the control variables. Based on the control variables, the cloud environment can be optimized as maximizing or minimizing function with decision constraints and solved for different input data sets [2].

The Cloud Service Providers have numerous of servers with different memory, storage space, CPU speed, and bandwidth. They expect profit in providing service. They have to make their resources completely utilized for better profit. Optimization techniques are used for effective utilization of cloud resources. This in turn also optimizes the cost for the provider. The arriving load on the provider side has to be monitored and balanced to avoid hacking and over utilization of the resources.

The Optimization technique has many challenges. It needs to deal with the varying loads on the cloud. It needs to scale with the increased number of users at a time [3]. In a short period of time, it Should make fast decisions in service allocation, and deal with additional problems like hackers, over utilization, under utilization, deadlocks, distributed database, replication etc.,

Thus Optimization techniques are broadly extended for 3 factors of cloud: Resource based Optimization, Cost based Optimization and Load based Optimization. Resource based Optimization deals with the user side resource and ways of utilizing them at the maximum profit without deadlock in handling multiple users [4]. Cost based Optimization also deals with the techniques in maximizing the profit using different pricing techniques and cost estimation techniques. Load based Optimization deals with the balancing the resources using parameters to prevent hacking and user to be served at a fair manner. The Existing optimization techniques have been elaborated in the [Table 1].

#### KEY WORDS

Deadlock, Virtual Machine Migration, Starvation, Data center cost, cloud service provider, dynamic resource provisioning.

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\*Corresponding Author:  
Department of CSE, NPR  
College of Engineering and  
Technology, Dindigul, INDIA

This paper is organized as follows. Section II introduces the Resource Optimization methods which contribute to the maximum profit in CSP. Proper resource utilization deals with the correct way of scheduling of resources for varying cloud requests. Section III explains the role of cost maximizing in cloud for profit. It deals with the pricing models, power and energy of cloud resources. Load balancing on the CSP side according to the arriving cloud requests and monitoring their running on cloud resources is elaborated in Section IV. In section V, we conclude this paper.

**Table 1:** Optimization methods

No	Methods	Techniques	Author(s), Year	Remarks
1.	Zoutendijk's Feasible direction Method	Karush Kuhn Tucker condition	Bazaara et al., 2013	Properties are difficult to satisfy. Suitable in cases where Objectives don't conflict with each other.
2.	Gradient Projection method	Covergent step size rules are adopted.		
3.	Penalty method	Changing penalty co-efficient in each iteration till convergence.		
4.	Apriori Methods Weighted Global Criteria	Global Criterion $F(x) = \text{Sum of the squares of the relative deviations of the individual objective function from the feasible ideal solutions has to be minimized.}$	Marler and Arora. 2004	Used in cases where user able to specify the constraints, decision variables and goals clearly.
5.	Lexicographic method	Ranking of objectives and constraints is done.	Ching-Lai-Hwang, 2012	
6.	Weighted Min-Max	Backtracking is followed. Solution is obtained by minimizing the function considering the maximal valued parameters in each iteration.	Hazewinkel, Michiel ,2001	
7.	Weighted product	Each parameter is multiplied by weight ratio based on its importance.	Miller, 1969	
8.	Goal Programming	Degree of attainment of the goals has to be determined with the available resources. Goals are associated with priority.	MJschienderjans, 1995	
9.	Bounded Objective	The optima of respective objective function exist and coincide by strong duality condition.	Jeffrey, 2004	
	A posteriori Methods Genetic Algorithm	Evaluation, Selection, Cross over, mutation as a iteration process.	Fleming , 1993	
11.	Normal Boundary Intersection method	Multi-objective optimization is reduced in to beta problem and then solved as weighted single optimization problem	Dennis J.E, 1998	
12.	Normal Constraint method	Pareto filter is used for finding the best optimal points resulting in trade off between the given constraints.	Messac.A, 2003	
13.	Multi-Objective Particle Swarm optimization	Parameters are taken as particles and position and velocity associated with them are iteratively changed to reach the desired solution	Muller-gritschneder, 2009	
14.	Interactive Methods Zionts-Wallenius method	Interactive method where the iteration proceeds with the choice of feasible solution or desire of change in iteration.	Zionts & Wallenius, 1976	Used in the cases where user has no specifications in start and interact as the algorithm runs and finds solution.
15.	Satisfying trade-off Method	Min Max approach is minimized by a local approach using simulated	Nakayama, 1984	

16.	NIMBUS method	Aspiration levels, upper bounds and weighting coefficient are formulated and new alternatives are found in each iteration and most preferred one is selected for next iteration till user is	Miettinen,2006	
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## MATERIALS AND METHODS

### Resource optimization methods

Resource Allocation plays an important role in achieving profit for CSP. It is the process where CSP allocates the existing resources to the requested cloud users over the internet. The process deals with the proper utilization of resources at the provider side and also avoids starvation at the user side [5]. Resource Optimization solves the difficulty by helping the CSP to manage their resources before and during allocation.

Resource Optimization is making the resource allocation easier by setting values for the user requirements before allocation. This makes sure that the resource at the CSP side remains safe and optimal. The cloud request mentions the amount of resource and their duration to the CSP. The CSP has to run their Resource Optimization algorithm to find out the sequence of cloud requests to be served so that starvation and under utilization is not encountered [6]. Resource Optimization should avoid certain situations in Resource Allocation. They are

- i) Resource conflict evolves when two or more users make access to the same amount and type of resource at the same time
- ii) Insufficiency of resources may occur when there are inadequate resources and also when resources not allocated in proper manner.
- iii) Resource splinter situation evolves when the resources are separate in remote servers and not able to allocate together immediately at the time to the cloud request.
- iv) Over provisioning is the process of user being allocated resources in excess to the requested one. This in turn also called over utilization of resources at the CSP point of view.
- v) Under-provisioning is the process of user being allocated resources in smaller amount than his demand. It is called the under utilization of resources at the CSP side.

In the paper "Deadlock detection for resource allocation in Heterogeneous Distributed platform", Ha Huy Cuong et al., presented Parallel Deadlock Detection Algorithm (PDDA) using Resource Allocation Graph (RAG) for IAAS heterogeneity cloud. It avoided starvation of resources using RAG. The time and space complexity of the algorithm held good for the cloud scenario. It was implemented in cloud sim and outperformed better than the optimal time algorithm [7].

In the paper "Decentralized and optimal resource cooperation in geo-distributed mobile cloud computing", Rong Yu et al., suggested coalition based game model for achieving profit at the provider side by utilizing the resources at the maximum. The Profit and Utility factor was measured to be good than the normal schemes on checking it with Normal schemes data [8].

In the paper, "An Online Auction Framework for Dynamic Resource provisioning in cloud computing", Weijie Shi suggested VM auction algorithm for dynamic resource provisioning at the provider side. It resulted in better profit when checked using Google-cluster data with different no of cloud users, different no: of data centers and no: of rounds. The Trace driven simulation was run for 3 data centers and 6 types of VM [9].

In the paper, "Utility Max-Min: An Application oriented Bandwidth Allocation Scheme", Zhiruo cao and Ellen. W.Zegura suggested utility based switch algorithm for effective bandwidth utilization in achieving profit. It resulted in providing better fairness index and Quality of service when checked for different bandwidth in java code. The algorithm outperformed the standard bandwidth allocation schemes but it needs utility function of the arriving functions for its processing [10].

In the paper, "A Power Efficient Genetic Algorithm for Resource Allocation in Cloud computing data centers", Giseppe Portaluri et al., presented genetic algorithm for server scheduling resulting in less power consumption of servers. The algorithm was run in Intel 17 with 8 Gb RAM, Ubuntu OS in IJ Metal framework. The results showed power efficiency with the arriving tasks and completion time. It can be extended to consider the internal communication cost, electricity cost, data center load cost etc., for better efficiency [11].

The Cloud request differs in each type of cloud service. Some request resources in duration for rent. Some users rent resources in storage. In Static resource allocation, the resources are fixed and rented to the users on cost. In dynamic scheduling, the resources are allocated on demand and they are charged based on usage of each resource per hour [12]. The Resource Optimization strategy must assure a deadlock free environment with better speed, bandwidth, throughput, and response time, completion time, profit, VM provisioning and less power consumption. Thus managing and allocating resources in cloud is crucial.



**COST OPTIMIZATION METHODS**

CSP put a lot of investment based on the type of cloud service they provide. They aim at serving the users demand at minimal cost and expect profit in return. Profit at the CSP side can also be achieved by minimizing cost. This can be implemented by using proper pricing models, scheduling based on geographical location of servers, virtual machine migration scheme saving energy [13]etc.,

The pricing models have to done in an efficient manner to satisfy the user demands. The pricing methodology changes for each type of CSP [14]. The static cost provisioning makes the cost fixed for users. Dynamic pricing methodology changes the cost at various hours based on user demand. The scheduling or resources between users plays a major role in achieving profit. The instances of resources to be allocated for better profit have to pre determined. The server selection has to be done considering their geographical location so that speed, transfer rate and thereby throughput can be maximized. Energy saving comes as the next major factor in achieving profit [15]. The cost of electricity, working and cooling power for servers has to be minimized for saving energy [16]. Different cooling and power saving techniques are being adopted to achieve it. The brief overview of the above discussed parameters in cost optimization techniques have been detailed in the [Table 2].

**Table 2:** Cost based Optimization models Summary

Paper ID	Addressed Issues	Algorithm and Datasets	Performance Metrics	Implementation	Result and Remarks
[17]	Task scheduling , Resource allocation and Profit	Multi-Objective Optimization <ul style="list-style-type: none"> <li>Ant colony Optimization</li> <li>Resource Cost Model</li> <li>Make span and budget Cost as constraints</li> </ul> Data sets: 100 hosts, 10 Virtual Machines Compared with <ul style="list-style-type: none"> <li>Original colony algorithm</li> <li>Heuristic Algorithm</li> <li>Min-Min Algorithm</li> <li>FCFS Algorithm</li> </ul>	<ul style="list-style-type: none"> <li>Make span</li> <li>Cost</li> <li>Dead Violation rate</li> <li>Resource Utilization</li> </ul>	Cloud Sim 3.0  Amazon cloud service data [18].	Outperformed the Min-Min Algorithm even at worst case  Better Effectiveness than FCFS algorithm
[19]	Energy consumption  Congestion or Hot Spots	Data center Energy Efficient Network Scheduling Algorithm (DENS ) <ul style="list-style-type: none"> <li>Dynamic Voltage and Frequency Scaling(DVFS)</li> </ul> Data sets: Three Tier Data center topology With <ul style="list-style-type: none"> <li>1536 servers</li> <li>32 racks</li> <li>48 servers//rack</li> <li>1 GE internal Link</li> <li>10 GE topology Link</li> <li>Propagation Delay 10 ns</li> </ul>	<ul style="list-style-type: none"> <li>Power consumption</li> <li>Uplink traffic load</li> </ul>	Green Cloud Simulator	Outperforms the Round robin scheduler and green scheduler in reduced power consumption.  Suitable for three tier architecture and Should be checked for other data center architectures.
[20]	Electricity Cost of Data centers in cloud	Energy efficient Algorithm  Data sets: Internet traffic Archive, CLARKNET-HTTP, NASA –HTTP, UC BERKELEY IP.	<ul style="list-style-type: none"> <li>Normalized cost</li> <li>Maintenance cost</li> <li>Electricity cost</li> </ul>	Simulation of 1024 servers by hybrid cooling with 2.6 GB service rate.  G/G/M model for response time calculation	Outperforms the traditional cooling technique.
[21]	Cost Optimization	Reserved Instances Optimizer with Hill climbing Algorithm based Profit Function Compared with the theoretical values of the inventory model.  Data sets: Industrial data	Demand trace and profit function	Nord Cloud	Outperforms the Heuristic methods, machine learning techniques.  Risk analysis has to be checked.

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[22]	Energy Reduction and Maximizing profit	Profit Driven Online Resource Allocation framework  Data sets: Google data traces.	<ul style="list-style-type: none"> <li>• Profit</li> <li>• Average CPU utilization</li> <li>• Cluster energy</li> </ul>	Run on Google Cloud cluster  Microsoft cloud computation service data used for pricing values	Evaluated results in Google traces for heuristic Max, Min and Random values.  Only CPU utilization is concentrated. Other resources Memory, Bandwidth also to be incorporated.
[23]	Cost Efficiency	Co-Efficient and Reliable Resource Allocation algorithm(CERR)  Data sets: Amazon EC2 Instances	<ul style="list-style-type: none"> <li>• Cost</li> <li>• Reliability</li> <li>• CERR rate</li> </ul>	Matlab simulation	Outperforms the MAX-MIN algorithm, MIN_MIN algorithm and FCFS Algorithm

The parameters of the cost optimization can be prioritized based on its importance in achieving profit. Each parameter contributes in achieving profit in its own way depending on the cloud service [24]. The cloud service provider concentrates on optimizing the parameter based on their network topology and architecture. The literature survey analysis of cost parameters in cloud is depicted via pie chart in [Fig.1].

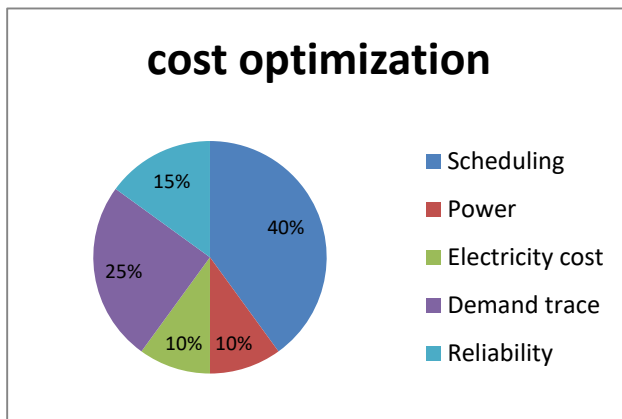


Fig.1: Cost optimization priority factors.

**LOAD OPTIMIZATION METHODS**

Load balancing has to be concentrated by CSP for its efficient run. If not done, it leads to resource over utilization and deadlock. In cloud, the arriving requests are enormous and vary from time to time. Hence some load balancing technique has to be adopted. Virtualization solves these issues and becomes the powerhouse of cloud computing [25]. It is the process of isolating resources, balancing load and system maintenance in order to serve big data applications. Virtual machine migration is the process of transferring OS instances from the existing physical server to the needed server. It is done to balance the incoming enormous load on cloud.

In virtual machine migration scheme, resources are consumed on both host and guest side causing a migration overhead [26]. The distance between them has also to be considered. By Making effective use of virtual machine migration, profit and optimization gets achieved in Cloud, while handling large data [27]. The different virtual machine migration based load balancing technique is discussed in [Table 3].

Even in small load cases, the resources have to be balanced and monitored properly to avoid deadlock and hacking. Many Load balancing techniques have been developed based on the CSP. In 2016, Lei Yu et al., discussed about stochastic load balancing with hot spot migration of virtual machines in his paper [28].The stochastic algorithm outperforms other virtual migration schemes in three tier architecture. The algorithm had run well on Cloud Sim with the VM utilization trace from planed Lab and Google trace data. But the migration schemes have to be checked for all kind of probability distribution and network topology in cloud.

In 2013, Jai Ganesh and Vincent Antony Kumar designed a Fuzzy logic model for Data Center Load Efficiency (DCLE) Monitoring. It was a model for monitoring CPU, Bandwidth, and Memory. It was implemented for physical machine with limited users. The DCLE meter has to be validated for different virtual machine scenario handling big data in cloud [29].

The CSP may serve software applications, Operating systems, Servers etc., Load balancing also becomes an important issue in security point of view. The hackers try to utilize maximum of a particular resource to hack the system. Hence resource utilization has to be monitored to avoid complete system crack. CSP must concentrate on this factor for efficient running of their service.

**Table 3:** Load based optimization techniques

No.	Strategies	Algorithm	Author(s)	Year	Remarks
[30],[31]	Virtual Migration Techniques	Pre-Copy approach	C. Christopher et., all	2005	Pre-Copy Migration Technique is used with less down time but more migration time
		Delta compression	P. Svard, J. Tordsson, B. Hudzia, and E. Elmroth	2011	
		Adaptive Rate Limiting	H. Jin, L. Deng, S. Wu, X. H. Shi, and X. D. Pan	2009	
		Time Series Prediction Technique	B.Hu, Z. Lei, Y. Lei, D. Xu and J. Li	2011	
		Recovering System and CPU Scheduling	L. Weining and F. Tao.	2009	Post copy Migration
		Check pointing/Recovery and Trace/Replay Approach	L. Haikun, J. Hai, L. Xiaofei, H. Liting, and Y. Chen	2009	Technique is used with less down and migration time. But its performance depends on the amount of data to be transferred.
		Memory Re-using mechanism for VM consolidation	Soramichi Akiyama	2012	
		Post -copy Approach	R. H. Michael, D. Umesh, and G. Kartik	2009.	

The profit can be achieved by using Multi objective optimization of resource, cost and load using different parameters for each factor. It can be inferred that the combined Optimization of all the three factors will result in better throughput. Depending upon the type of the cloud service, the number of users and the network topology each factor and its parameters plays its role in providing profit.

## RESULTS AND CONCLUSION

The Optimization technique is the most thriving one in cloud optimization. Many types of optimization techniques have been developed so far. With respect to the Cloud environment, Resource, Cost and Load based optimization techniques have been developed. The resource optimization helps the cloud provider in effective utilization of resources by considering the type of scheduling and the nature of service. The resources can be protected before allocation by putting certain constraints to avoid over and under provisioning and deadlock of resources and requests in case of heterogeneous databases. This leads to the better profit in providers. Cost can be optimized by introducing pricing models and prior estimation of resource allocation factor leading to profit. The load at the provider side has to be balanced by using Virtual migration techniques reducing the down time and the migration time considering the network topology. This way of effective utilization of incoming load leads to the balanced cloud system avoiding hackers and earning high profit. Thus optimization techniques can be evaluated by various factors like profit, resource utilization factor, traffic load speed, transfer rate, down time, deadlock violation rate etc.,

### CONFLICT OF INTEREST

No conflict of interest to declare

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## ARTICLE

# INVESTIGATING THE RELIABILITY OF SMALL-SCALE WIND-POWER CONVERSION SYSTEMS CONNECTED TO THE NETWORK

Sajad Maleki Varnamkhasti\*

Faculty of Engineering, Shahed University, Tehran, IRAN

### ABSTRACT

**Introduction:** Today, increasing the reliability of power systems is one of the important goals in its various planning. In the meantime, reliability testing in terms of production has particular importance. Increasing arrival of renewable energy sources to the energy generation cycle on the one hand and increase energy consumption on the other hand, reliability indicators find particular importance. **Material and method:** Therefore, in the present study, with the aim of investigating the reliability of small-scale wind-power conversion systems connected to the network, a possible method was developed to evaluate the contribution of wind turbines to the overall reliability of the entire system. In the initial model, transmission lines have been used to connect the wind farm to the real network. **Result and discussion:** The basic model used in this research is the 220kV system, 56km. In this paper, the classic model of the production system is expanded in combination with the transmission system. The average power output (mean-COPT) table has also been used to increase the computational velocity which allows for the compilation of LOLE and EUE reliability indices simultaneously. Wind velocity is predicted using the ARMA time series for wind power modeling, and then the power is estimated using wind turbine curve. An appropriate method for reducing model modes is also used and a 5-mode model is proposed. With regard to the constraints of transmission lines in the production of wind power models, the model obtained has between 2 and 5 modes. **Conclusion:** Using wind power, on the other hand, saves fuel consumption, improves system reliability and enhances environmental issues. It is also very effective in determining the best transmission capacity with regard to the risk and cost of the system.

### INTRODUCTION

Today, increasing the reliability of power systems is one of the important goals in its various planning. In the meantime, reliability testing in terms of production has particular importance. Increasing arrival of renewable energy sources to the energy generation cycle on the one hand and increase energy consumption on the other hand, reliability indicators find particular importance.

Meanwhile, using wind farms has become more important because of higher energy production and cheaper energy production. For each system and in each project, the first step in the field of reliability engineering is to identify the capabilities of its agents. Reliability engineering must meet the requirements of the tasks that are performed in order to ensure the reliability of the systems of the system, documentation of the design and development of the system, tests, production and performance. Reliability tasks include analyzes schedules, and failures reports. Choosing the type of tasks and the level of work required depends entirely on the importance of the system, its type of function and the defined costs. Major systems required formal reports to fail in the next stages of development while less important systems can conclude with the final test reports [1]

The production system involves many power plants that convert mechanical power into electrical power using energy sources such as coal, gas and water. In most cases, these power plants are in a very large fraction of the load [2]. It provides the required power to the power network and consists of several large power plants. For each system and in each project, the first step in the field of reliability engineering is to identify the capabilities of its agents. Reliability engineering must meet the requirements of the tasks that are performed in order to ensure the reliability of the systems of the system, documentation of the design and development of the system, tests, production and performance. Reliability tasks include analyzes schedules, and failures reports. Choosing the type of tasks and the level of work required depends entirely on the importance of the system, its type of function and the defined costs. Major systems required formal reports to fail in the next stages of development while less important systems can conclude with the final test reports. In general, the most important tasks and routines of reliability have been documented in the standards of the different domains [3].

The distribution network is the last part of the power system that is in direct communication with consumers. This section has many challenges, especially high power losses and low reliability. In this part of the network, the consumption current is at the highest possible, and after that the high network losses are high which leads to the destruction of the voltage profile and increase network cost. Distribution network has the most equipment in terms of diversity and multiplicity compared to other parts of the network. Hence, its reliability level is very low. In this article, due to the random nature of the output of the production units, a probabilistic method for assessing the reliability of a power system of a wind system is presented. The primary model involves connecting the transmission line of a large remote wind farm to a typical network system. Using this method, the risk probability model which is a combination of production model and load model, is constructed and according to that, the important indicators of system reliability such as LOLE and LOEE obtained. In this study, the average capacity abandonment possibility is used. Meanwhile, using wind farms has become more important because of higher energy production and cheaper energy production. In aim of this study is evaluate the reliability of the studied system with the presence of wind farms, in addition to selecting the appropriate model for forecasting wind velocity and

#### KEY WORDS

wind power, wind turbine systems, reliability, renewable energy

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#### \*Corresponding Author

Email:  
sm7088@yahoo.com  
Tel.: +989368421572

wind farm, reliability indicators of the system are also calculated. The simulation experiment was performed on the sample network and the obtained values were analyzed.

## LITERATURE REVIEW

Wind turbines with permanent magnetism synchronous generators (PMSG) has efficient configuration for applications with variable velocity. Advantages of using these settings include eliminating dc stimulation, less need for repair and high power over weight. These compositions require a full-fledged transducer to connect to the network, which makes it possible to obtain power from the wind in a range of wind velocity. Different control methods are used to obtain maximum power and maximum power point tracking (MPPT) at the variable velocity of wind turbine [4].

Reference [5] has controlled the optimized performance of a variable velocity winding turbine connected to a DFIG-equipped network with a non-linear control system with two separate targets. In the outer ring, a maximum power point tracking algorithm (MPPT) based on fuzzy logic theory is designed to extract continuous optimal aerodynamic energy. The simulation results indicate the permanent tracking of the MPP point regardless of the turbine velocity, in addition, the proposed slider mode control strategy has interesting features in comparison to the original first-grade slider technique.

Reference (Voldgade) provides an effective plan to improve the DFIG-based turbine capacity under unbalanced voltage drop conditions with the reliability of wind energy conversion systems. This means that the above idea applied during unbalanced voltage drop, SDR resistors only in low voltage phases. Then, the rotor current is controlled in such a way that no unbalance voltage occurs on the stator voltage. An analysis of the reliability of a small size wind system with a permanent magnet synchronous generator is presented in [6]. Such a system is largely influenced by many dependent variables. In this reference, the magnitude of the effect of each variation on the reliability of the system has been investigated.

Reference [7]. applied a DFIG variable velocity based on WECS to generate simultaneous power with harmonic filtering and network reliability. An improved harmonic splitter in the field of time has been used based on a new selector signal detector. The technique for offsetting the entire network stream harmonic components is selected. Simulation for a three-megawatt WECS with DFIG at two different velocity (8 and 12 m/s) has been implemented. The results showed that, in addition to the power, the network flow harmonic filtering was achieved using WECS and 4% total harmonic reduced.

A reference [8] has proposed the DFIG without brush (BDFIG) as a variable alternator in wind turbines. The BDFIG benefits from the DFIG, that is operation in variable velocity, but does not include brushes and slider loops that increase its reliability. The analytical results are presented by simulating the time domain for small wind turbine generators, as well as the experimental results of voltage drop for BDFIG with a power of 250 kW presented. In, the effects of voltage drops due to DFIG error to overcome network errors and improve reliability are studied. A wide range of duration and loss depths are considered. It has been observed that the effect of the duration of the drop is changed periodically. The effect of drop depends on duration and depth, as well as the process of eliminating the error. Two methods have been used to analyze this: a distinct drop and a sudden drop. The voltage range of the converter of the rotor is intended to show the rotor current status in this analysis.

Mohanti et al [9] proposed a new method for compensating reactive power in a micro-network by having a DFIG based on a wind-diesel system to enhance the paradigm of the hybrid system voltage and increase reliability indices. UPFC is used as one of the FACTS devices to improve the control of reactive power failure and system stability. The small signal system of the wind-diesel system, the DFIG-based wind turbine system, UPFC, and controllers for this analysis are designed. In addition, voltage change and reactive power compensation are investigated by combining the proposed ANFIS with the UPFC controller. Reference [10] focuses on the stability analysis of the oscillation and reliability of a wind turbine. The exact mathematical analysis of the wind turbine has been expanded with the controller loops. Also, the Huff branching is considered as a key parameter. They are used to guide the regulating of DFIG parameters to ensure sustainable operation. The results of the dynamic stability analysis of an 80 MW coastal wind turbine connected to the power network by a high voltage direct current (HVDC) line are presented in [11].

The wind turbine studied has been simulated using an excited wind turbine equivalent. The systematic analysis was carried out using the frequency domain method based on the calculation of special values and time domain design based on nonlinear model simulations. Modeling the DFIG system for wind turbine use is the main challenge of reference [12]. The PSCAD / EMTDC software has been used for the superiority of the proposed-model and the dynamic response to the voltage drop is discussed with the behavior. An analysis for wind generator DFIG for operation in unbalanced voltages is presented in [13].

The DFIG system is modeled by the positive synchronous reference framework. The behavior and operation of the generator system and the network side converter are shown under unequal conditions with the definition of oscillatory power expressions in the synchronous reference framework. This model allows active and reactive power control using the direct power control technique. It is shown that by considering the DFIG model in the synchronous reference, exchange of power has been simplified. In addition, using the proposed model, the oscillation of the stator output power is facilitated using the GSC.

**Modeling the system and evaluating the method**

**Wind velocity modeling**

The wind power productive has a direct relation with the cubic of the wind velocity. This means that it is necessary to study the effect of wind power on the reliability and cost of a system for accurate modeling of wind velocity. By changing the time and geography location, wind velocity changes continuously. Therefore, simulating a wind model, simulates the wind velocity for a specific region in a given time interval. To simulate the hourly wind velocity, an ARMA time series selected for the wind farm was formulated as math:

$$y_t = \varepsilon_t + \sum_{i=1}^p \phi_i y_{t-i} + \sum_{j=1}^q \theta_j \varepsilon_{t-j} \tag{1}$$

In this regard,  $y_t$  is the amount of time series at time  $t$ , and  $\phi_i$  and  $\theta_j$  are recursive and motor parameters.  $\varepsilon_t$  is normal white noise with average zero. The simulated SWT wind velocity at  $t$  can be calculated according to equation (2) using the mean velocity  $\mu_t$  and standard deviation  $\sigma_t$  and the value at time series  $y_t$  calculated as follows:

$$SW_t = \mu_t + \sigma_t \times y_t \tag{2}$$

The average hourly wind velocity and standard deviation of data for the Zafarana area were collected by the NREA and a computer program written to use wind velocity data, determine the exact ARMA model ( $p$ ,  $q$ ) to be used to simulate wind velocity. This model represents the first step in modeling the wind system.

**Modeling the WTG system**

The Zafarna wind farm is made up of three types of units and has an installed capacity of 425.82 MW. Modeling WTG system requires the combination of the wind velocity model described above with the WTG generation capability for all types of WTGs.

**Productive wind power**

The main features affecting the amount of power produced by WTG are cut-off velocity  $V_{ci}$ , high cut-off velocity  $V_{co}$ , nominal velocity  $V_r$ , and nominal power  $P_r$ . The generated wind power varies nonlinearly with variations in wind velocity and can be determined by the WTG power curve, which is formulated mathematically as follows:

$$P_t = \begin{cases} 0 & 0 \leq SW_t \leq V_{ci} \\ A + B \times SW_t + C \times SW_t^2 & V_{ci} \leq SW_t \leq V_r \\ P_r & V_r \leq SW_t \leq V_{co} \\ 0 & V_{co} \leq SW_t \end{cases} \tag{3}$$

In this case,  $P_t$  is the output power at  $t$  and the coefficients  $A$ ,  $B$ ,  $C$  are determined from the upper and lower cutoff rates.

**Productive wind power model**

Wind farm production capacity consists of a number of different modes of production power and the corresponding probabilities of each of them. The probability of the availability of a  $P_{wi}$  simulated wind speed  $SW_i$  is calculated by the following equation:

$$P_{wi} = \frac{N_i}{(N \times 8760)} \tag{4}$$

In this case,  $N$  is the number of simulated years and  $N_i$  is the number of wind speeds in the range ( $SW_j$ ,  $SW_{j+1}$ ), which:

$$SW_i = \frac{(SW_j + SW_{j+1})}{2} \tag{5}$$

The  $P_i$  power generated by each WTG in the wind farm is calculated by Eq (3) and then summed together to determine the wind farm production potential, which is based on the amount of wind power generated by the  $W_{Pi}$  wind farm and the probability of occurrence of the  $P_i$ . The amount of  $W_{Pi}$  corresponding to the  $SW_i$  wind speed is calculated from equation (6):

$$WP_i = \sum_n P_i \tag{6}$$

In this case,  $n$  is the number of wind turbines (WTGs) in the wind farm.

EPO is defined as the average long-term output power and it is an indicator for assessing the usefulness of the wind farm. This index is calculated from the following equation:

$$EPO = \sum_{i=1}^m WP_i \times p_i \tag{7}$$

In this case, m is the number of states of production.

The number of model states obtained is high. Therefore, an appropriate method has been used to provide a reduced equivalent model of wind farm. The average wind speed for this geographic region is between 9 and 9.7 m/s, and the standard deviation is the hour within the range of 3.5 to 3.6 m/s.

The amount of cut-off velocity, nominal velocity and cut-off velocity of each wind turbine (WTG) are in the range of 2.5, 4 and 4 m/s, 13, 13 and 17 m/s, 25, 19 and 25 m/s. The 5-state model obtained for the wind farm is shown in [Table 1].

**Table 1:** Productive wind power model

The probability of each mode	Productive wind power mode $WP_t$ (%)
0.070210	0
0.059460	25
0.116850	50
0.244460	75
0.509020	100

**Wind turbine system model**

The next step in the evaluation process is to determine the model of wind farm productive power at the network connection point. In this model, the transmission line model is considered, which includes the power transmission power and the possibility of out-of-service lines, which are included in the wind farm productive power model. As stated in equation (8), the available wind power at the network connection point (WPGi) is limited by the capacity of the transmission lines Tcap:

$$\begin{aligned}
 WP_{Gi} &= WP_i, & \text{for } WP_i < T_{cap} \\
 WP_{Gi} &= T_{cap}, & \text{for } WP_i \geq T_{cap}
 \end{aligned} \tag{1}$$

Also, the probability pGi for producing the WPGi mode is calculated from Equation (9):

$$\begin{aligned}
 p_{Gi} &= U_T + (1 - U_T) \times p_i & \text{for } WP_{Gi} = 0 \\
 &= (1 - U_T) \times p_i & \text{for } WP_{Gi} < T_{cap} \\
 &= (1 - U_T) \times \sum_{j=1}^s p_j & \text{for } WP_{Gi} = T_{cap}
 \end{aligned} \tag{2}$$

In this connection,  $U_T$  is the probability of the exit of the transmission line from the network, and s is the total number j of the productive mode limited by the capacity of the transmission lines.

In this research, the failures of the transmission system ( $\lambda$ ) and the average repair time (r) from the Egyptian electricity company have been extracted. The probability of unavailability of the transmission system is calculated 0.066. The combined wind power model combines with the unavailability of a transmission system of 2 to 5 modes depending on the capacity of the transmission lines and the capacity of the wind farm. These models, which are computed from computer running, are shown in [Table 2].

**Table 2:** Suspended model of productive wind power

Productive wind power mode $WP_t$ (%) (MW)	The probability of each mode
<b>Two modes model</b>	
0	0.1843
100	0.8057
<b>Three modes model</b>	
0	0.1943
130	0.4554
250	0.3503
<b>Four modes model</b>	
0	0.1943
130	0.4554
260	0.3117
350	0.0386
<b>Five modes model</b>	
0	0.1943
130	0.4554
260	0.3117
390	0.0375
520	0.0012



Thus, equations (6) to (9) are used to determine the different modes of productive wind power and the probability of occurrence of each mode. This model is used to calculate EPO according to equation (10).

$$EPO = \sum_{i=1}^m WP_{Gi} \times p_{Gi} \tag{10}$$

### System risk modeling

The overall model of the productive system, comprised of the combination of traditional production units and wind power, is ultimately blended with the load model to determine the system risk and energy indicators. The load on the Egyptian electricity system varies with time change, and these changes can be modeled by the load model. [Fig. 1] shows the load curve model.

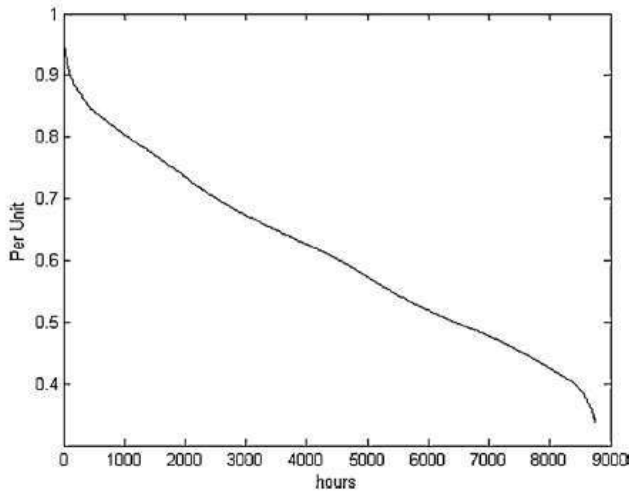


Fig. 1: Egyptian annual load variation curve

### Integration adequacy assessment and Risk Indicators

[Fig. 2] shows the overall software process used to assess the system's adequacy. This program calculates system reliability indicators, including the expected unprotected burden (LOLE), as well as energy indicators such as the amount of expected unloaded load (LOEE) and the amount of energy indicators including expected energy levels (EES) for each productive unit calculated. These indicators are used to assess the reliability and cost of community units of wind units with traditional productive units and transmission systems.

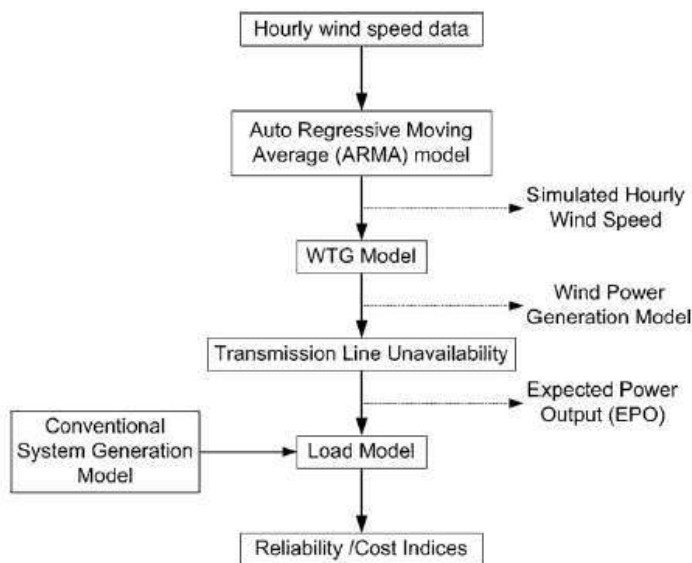


Fig. 2: Flowchart of the evaluation process used

**Evaluation of reliability and cost**

The use of wind power in a traditional power system has advantages such as the following:

**Saving wind turbines for fuel consumption**

The amount of fuel savings is calculated by determining the energy deviation. The energy deviation is equal to the amount of energy expected by wind resources. The energy provided by the wind farm changes the cost of fuel needed and is calculated from Equation (11):

$$FOW = EES_w \times FC \tag{3}$$

In this equation, FOW is the fuel saving rate by wind turbine,  $EES_w$  the amount of energy supplied by WTG in MWh and FD is the average fuel cost per \$/MWh.

**Environmental benefits caused by the use of wind turbines**

Wind power technology and wind power costs are much more cost effective than generating power by traditional sources. The Wind Power Productivity Index (WPPI) has been used to calculate the environmental benefit of wind power, which is estimated at 1 \$/kWh.

The monetary value of environmental benefits is calculated using equation (12) as follows:

$$BOI = EES_w \times WPPI \tag{4}$$

In this equation, the BOI is profit index, which is in dollar.

**3-2-1 Reliability**

In addition, the wind power in the traditional system can be beneficial by providing additional energy to the system and reducing the cost of payments to definite subscribers (ECOST). The easiest way to estimate ECOST is given in Equation (13) [14]:

$$ECOST = IEAR \times LOEE \tag{5}$$

The IEAR show the evaluation of the cut-off energy and 3.63 \$ /kWh is non-energized power. LOEE is also defined as the amount of energy not provided by the sources of production (EENS). Adding wind power to the power system improves overall system performance and increase system reliability. This sentence can be numerically calculated by reducing the LOEE value obtained from Eq. (14):

$$\Delta LOEE = EENS - EENS_w$$

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In this equation,  $\Delta LOEE$  is the reduction in LOEE of the system as a result of wind use, EENS is the amount of energy not provided before adding wind and  $EENS_w$  is the amount of energy not provided after adding wind power. The reduction in cost for subscribers or the amount of available profits from ECOST savings can be calculated according to equation (15):

$$BOC = IEAR \times \Delta LOEE$$

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BOC is the amount of profit earned by saving ECOST in dollar. Thus, the total benefit ( $B_w$ ) of wind power is calculated using Equation (16) as follows:

$$B_w = EES_w (FC + WPPI) + IEAR \times \Delta LOEE$$

(Error! No text of specified style in document.8)

**RESULTS**

The Egyptian power system consists of 165 manufacturing unit with a production capacity of 21516 MW. The annual peak charge for this country is 19700 MW. System information and information about the reliability of the system's units are given in [Table 3]. The Zafarana wind farm makes up 1,979% of this power. According to the method presented in [Fig. 2], this section of the reliability assessment is used to find the best transmission system capacity. For this study, EPO, LOLE, LOEE and EES indicators were used to study reliability.

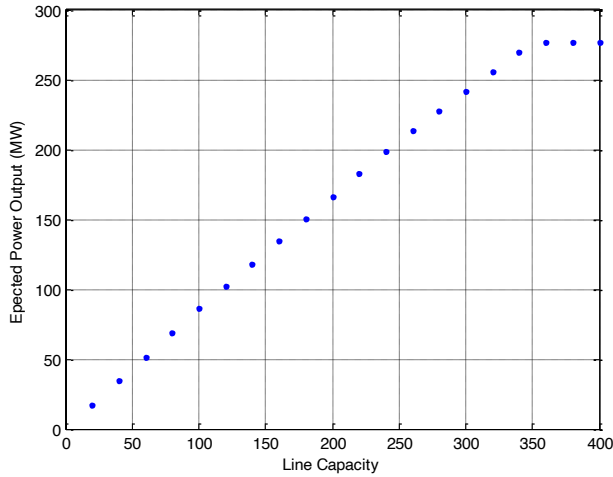
**Investigating the effect of the transmission line capacity**

By increasing the Zafarana wind farm, the reliability of the system has increased. But the reliability of the wind system depends on the communication line that connects it to the system. [Fig. 3] shows the increase in reliability of the system by increasing the capacity of this communication line. But reliability increases with increasing line capacity. This figure indicates that the EPO for a 150 MW line is approximately 127.848 MW, and for a 600 MW line capacity is equal to 304.642 MW.

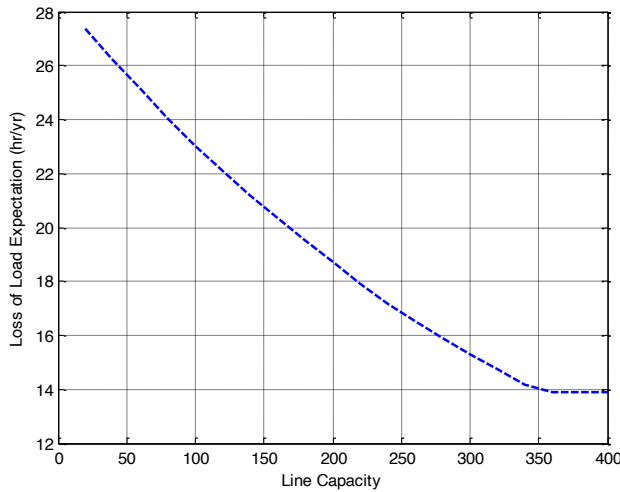
In this figure, the capacity of the zero line indicates that there is no connection between the wind farm and the system. Also, the LOLE value of the main power system of Egypt without wind power is 28.98813 h/yr. [Fig. 4] shows that increasing the line capacity is more than 450 MW that has not affected the reliability of the system.

**Table 3:** Information on the production units of the Egyptian power system

Unit (MW)	Capacity	Unit type	Number of units	FOR	MTTF(h)	MTTR(h)
	11.30	G	1	0.78384	126.14400	457.42616
	11.60	G	1	0.78395	126.14400	457.42616
	14.28	H	6	0.05633	5135.11200	306.54618
	16.00	H	4	0.05633	5135.11200	306.54618
	23.96	G	2	0.60355	183.96000	280.05672
	24.50	C	12	0.06941	3836.00400	286.12865
	24.60	G	1	0.60371	183.96000	280.24123
	24.72	C	8	0.06666	3836.00400	273.98078
	26.50	S	1	0.09369	4239.84000	273.98078
	30.00	S	5	0.09369	4239.84000	438.29941
	32.30	G	5	0.60371	183.96000	280.24123
	33.00	S	2	0.09369	4239.84000	438.29941
	33.30	G	4	0.60371	183.96000	280.24123
	33.50	G	3	0.60371	183.96000	280.24123
	45.92	C	1	0.09381	4239.84000	438.91242
	45.94	C	1	0.06666	3836.00400	273.98078
	46.00	H	7	0.04728	4920.49200	244.19637
	50.00	G	1	0.32611	400.33200	193.72776
	55.00	C	1	0.06666	3836.00400	273.98078
	58.55	C	3	0.06666	3836.00400	273.98078
	60.00	S	4	0.09369	4239.84000	438.29941
	65.00	S	3	0.09369	4239.84000	438.29941
	67.50	H	4	0.04728	4920.49200	244.19637
	87.50	S	4	0.09369	4239.84000	438.29941
	110.00	G	3	0.32586	400.33200	193.72776
	110.00	C	1	0.06666	3836.00400	273.98078
	110.00	S	4	0.07624	5745.68400	474.21369
	132.00	C	6	0.06666	5745.68400	273.98078
	136.00	C	3	0.06666	3836.00400	273.98078
	150.00	S	10	0.07624	5745.68400	474.21369
	175.00	H	12	0.04728	4920.49200	244.19637
	210.00	S	2	0.09066	6547.22400	652.71720
	250.00	C	16	0.06666	3836.00400	273.98078
	300.00	S	3	0.05929	6230.98800	392.72067
	311.00	S	1	0.05929	6230.98800	392.72067
	312.00	S	2	0.05929	6230.98800	392.72067
	315.00	S	4	0.05929	6230.98800	392.72067
	320.00	S	6	0.05929	6230.98800	392.72067
	330.00	S	2	0.02917	6230.98800	391.84406
	341.25	S	4	0.05929	6230.98800	392.72067
	627.00	S	2	0.06649	6806.52000	484.80407



**Fig. 3:** Expected Output Power (MW)



**Fig. 4:** Expected deadline load by increasing line capacity

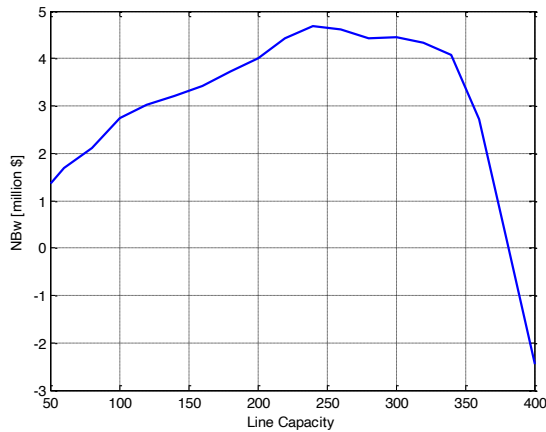
### Economic review of the wind power transmission system

Making the final decision about the best transmission system requires a comparison between cost and system reliability. In order to determine the best transmission capacity, the benefit from wind power transmission is compared with the cost of investment in the transmission system for different transmission capacities. Investment in the transmission line generally increases linearly with the increase in transmission capacity. The cost of investing in the 220 kV and 300 MW system is equal to 0.69 million dollars \$/km.

A linear relationship has been used to estimate the cost per kilometer of transmission line for different capacities. Also, the annual amount of the investment is based on the average life expectancy of 45 years. Assuming that after the traditional large production units, wind resources are used to supply the load, the amount of fuel saved is calculated. The average value of 3.75 \$/MWh in this study is considered for fuel costs and the wind power producing revenue is assumed to be 0.01 \$/kWh. The IEAR value is 3.63 \$/kWh and the profit value using (16) is calculated.

### Investigating the effect of the transmission line development

The net profit resulting from the development of the transmission line above 50 MW is shown in [Fig. 5]. The benefit of connecting wind power through the transmission line is calculated by equation (16). The difference between the total cost of the investment and the total net profit, net profit is calculated. The profit in the capacity of the 350 MW line has reached its highest level. [Fig. 5] shows that by increasing the line capacity, the net profit rate is reduced rapidly. [Fig. 4] also showed that there was no reliability in capacities greater than 450 MW. Also, in order to determine the future conditions of the system, the decision should be made for the best capacity of the transmission line.



**Fig. 5:** Net profit with the development of the transmission line

The use of the n-1 method, considering the random nature of the generated wind power, is not a prime means for planning the transmission system, and therefore this method cannot be used to plan a power system with wind power. In this section, a feasible method is proposed based on reliability assessment methods and cost to assess the impact of wind power transmission on system reliability. The system model and methods for using the limited transmission line in the HL-I study system are presented. The wind power model has been gathered at the network connection point with the traditional Egyptian power system model. A computer program has been written to evaluate the reliability of the system using numerical results. The main indicators that can be calculated from this program are EPO, LOLE, LOEE and EES indicators. By adding wind power to the traditional power system, the reliability indicators of the transmission capacity increased [15]. However, increasing the capacity of the lines will reduce the benefits of increasing reliability. Wind power reduces fuel consumption, reduces system shutdown time and reduces environmental degradation. Economic analysis of reliability indicates that these benefits are limited to a certain range of transmission line capacity. Also, from a specific range, there is no more wind power can be used in the system, and thus, with increasing wind power usage in the system, these relative benefits are reduced [16].

### CONCLUSION

Energy savings and the use of renewable energy have become more important given the increasing need for energy and the completion of fossil fuels and the concern for greenhouse gas emissions. Production through new energies like the sun and wind is the main solution to the energy crisis. The total installed solar capacity in 2012 was 100 GW. This amount for wind power has reached 283 gigawatts at the same time. The growing use of new energies has led to widespread use of electronic power, in which electronic power converters play an important role in extracting power from renewable sources. Power electronics equipment can generate raw energy from new energies to an arbitrary power supply; controllable voltage and frequency is converted to usable energy in the power network.

For wind systems, the electronic converter is the intermediate power between the wind turbine and the power network, and it can convert the raw power generated by the power turbine compatible with network and along with this conversion, tasks such as improving network power quality, extracting maximum power from the network, and active and reactive power control.

For solar systems, the power electronic converter also has the power to convert the dc power output of the panels to the optimal network ac power. Of course, along with those tasks, there is also a maximum power output. Given the expansion of renewable resources in the network, the reliability of these resources has great importance and because the exits of these resources, which are usually installed near loading centers, will shut down the network's reliability.

Proper design of these systems will have a direct impact on the reliability of these systems, from the point of view of the proper selection of active and inactive elements and the proper design of the ventilation system. Also, it is also important to study the methods that can be used to eliminate the power of the converter output after the failure of the electronic converters. This property is referred to as fault-tolerant converters.

In the article, a review on reliability and important indicators on this field was carried out. Then, the method of assessing the reliability of electronic power converters was presented. In addition, the power extraction methods from wind turbines were investigated. In order to inject PMSG from the active power to the three-phase network, a diode rectifier with an augment converter and inverter should be used. The duty of the inverter is to adjust the DC bus voltage and the duty of the converter to adjust the output voltage of the rectifier in an amount in which the maximum power of the PMSG is extracted. This system was simulated. Then, the reliability of each single converter, including incremental converter, rectifier and

inverter was investigated. Incremental converter to improve the reliability of the converter and Interleaved Boost converter to reduce the flow was used. Simulation results showed the effect of wind speed on power and losses, as well as reliability, and the accuracy of the calculations was confirmed.

#### CONFLICT OF INTEREST

There is no conflict of interest.

#### ACKNOWLEDGEMENTS

None

#### FINANCIAL DISCLOSURE

None

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## ARTICLE

# A COMPREHENSIVE BIDIRECTIONAL CONVERTER CONTROLLING ALGORITHM FOR ENERGY MANAGEMENT OF BUILDING PV SYSTEM APPLICATIONS

Sajad Maleki Varnamkhasti\*, Mohammad Yasinzadeh

Faculty of Engineering, Shahed University, Tehran, IRAN

### ABSTRACT

The main purpose of a smart energy management system as a high level controller is to provide an adequate coordination between battery, solar system and power grid. Taking maximum power from solar panels, minimizing the energy received from the network and the reduction of battery charging and discharging cycles are the other purposes of utilizing this controller. In this paper, a novel and comprehensive control algorithm for bi-directional converter has been proposed to provide the solar system of a building with predictive energy management. Despite the existing management methods, the proposed algorithm considers the Tariff variant dynamic besides load and generation changes and launches a predictive approach for a solar system of a residential building. The main aims of the proposed algorithm are to increase energy storage life time, reduce electricity invoices and protect batteries against overcharging. The proposed algorithm has been implemented on some real data obtained from a solar system of an inhabited building and the results have been illustrated in the paper. Having achieved all the objectives, the simulations assure the effectiveness of the proposed management system.

### INTRODUCTION

Renewable energy systems have gained a lot of support from some governments and intermittency of PV power generation is the challenging issue for widespread public acceptance [1]. In order to improve intermittency problem, energy storage systems can be placed to store excess energy and provide it at times of deficiency [2] and improve stability of the micro grid [3]. In order to properly supply the load with a PV installation an energy storage system is required, such as a battery bank, and consequently a bidirectional power converter should be used as an interface between the DC link and battery storage. Such battery-based power converter should have high efficiency and provide smooth charging and discharging to extend the life-time of the battery bank. In addition to the power converter, a smart-energy management system is required to coordinate the power transfer from PV as well as the charging and discharging of the battery bank according to the demand and the grid state as well as energy cost. Energy storage systems have proven to be a vital part of any renewable energy system [2-3]. Batteries have been distinguished from other storage systems because of their unique features like high energy density and less volume and weight [4]. The lithium-ion batteries have more benefits in comparison to other batteries; hence, the largest volume of battery production in the world belongs to the production of the mentioned batteries [5]. One of the disadvantages of the lithium-ion batteries is low resistance against overcharging and full discharging; therefore one of the factors which should be considered in the energy management control algorithm of the system is to protect the battery against full charging and full discharging.

### Energy management control systems

Having chosen the best converter fitting a residential application, a management system should be designed to make the power flow more efficient maximizing the PV power dispatch. The energy management system basically coordinates between three parts of the system, the PV converter, the battery converter, and the grid connected inverter. In the literature, there are basically two main approaches to manage and optimize energy of renewable energy resources.

#### The first approach

The first approach employs the use of a predictive control model to manage the system. It utilizes generation and demand forecast as well as market price prediction through statistical models and neuro-fuzzy networks. Such management systems can be found in [6-8], and [9]. These algorithms present many advantages for large scale integration of PV systems where optimization and response time are essential. However, these data may not be available for a small scale PV system. Therefore, the role of an energy management system in small scale PV systems is more concerned with maximizing PV power, minimizing grid power, extending the life of the energy storage system, providing backup using energy storage during islanded mode.

#### The second approach

The second approach is a direct approach that evaluates the state of the system instantaneously, decides the operation mode, and generates control signals to the converters in the system. Typical tasks of such a management system include maximum power tracking, state-of-charge (SOC) estimation, battery dispatch optimization, and inverter control. Typical systems can be found in [10-14]. These systems share a common management structure which consists of a higher level controller that decides the mode of operation and generates reference signals to lower level controllers of power converters. In [Fig. 1(b)], the

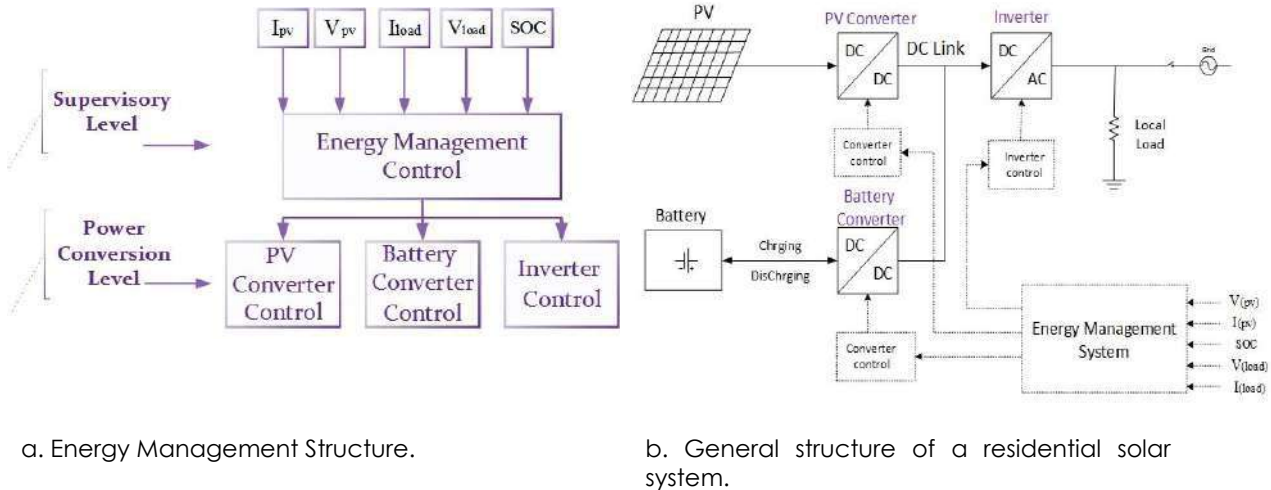
#### KEY WORDS

Energy Management System; Bidirectional Converter; Controlling Algorithm; Building PV System Applications; Battery Charge and Discharge.

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\*Corresponding Author  
Email:  
s.maleki@shahed.ac.ir

general structure of a residential solar system is displayed, as it can be observed in the structure of the energy management system in [Fig. 1(a)], the low level control is made up of three parts in which the PV inverter controller has the task of performing the MPPT algorithm in order to use the maximum power. The battery inverter controller has the task of controlling the charge and discharge of the battery by performing two functional modes of buck and boost on the inverter. And the inverter controller has the task of controlling the voltage and also controlling the active and reactive power. In this paper, it has been supposed that there are three distinct converters. However, they can be packed in one device if required. Also, authors want to clarify that the proposed algorithm is launch on the battery converter with is in charge of charging and discharging the battery. When it attempts to charge the battery, it will work in buck mode and when it attempts to discharge the battery it will work in boost mode.



a. Energy Management Structure.

b. General structure of a residential solar system.

Fig. 1: General structure

### PROPOSED ENERGY MANAGEMENT CONTROL SYSTEM

The proposed management system is similar to the previously mentioned systems. However, the existing predictive algorithms don't have the simplicity required for a residential application and on the other hand, the existing instantaneous algorithms don't have the estimation focus. Therefore, the proposed algorithm will combine simplicity of application and apply estimation that suits the residential application. The proposed system will not discuss island detection techniques and will assume the state of the point of common coupling (PCC) will be given by a binary integer (one/zero). The proposed energy management algorithm is similar to the one in [13]; however, power limitations and economic considerations are added. The energy management algorithm presented in [13] is shown in [Fig.2(a)]. The three main purposes of the energy management control system are consisted of reducing electricity bills, observing the charge and discharge modes (SOC) of the battery and reducing the number of charging and discharging cycles. The second and third cases increase the battery life. In [Fig. 2(b)], power functions of each part of the system are shown in which P(pv) is the productive power of the photovoltaic system, P(bat) is the transitional power of the battery, P(inv) is the transitional power of the inverter, P(load) is the power consumed by the load and P(grid) is the transitional power of the network. In this paper, grid characteristics is as follows: 220AC, 50Hz, Single phase.

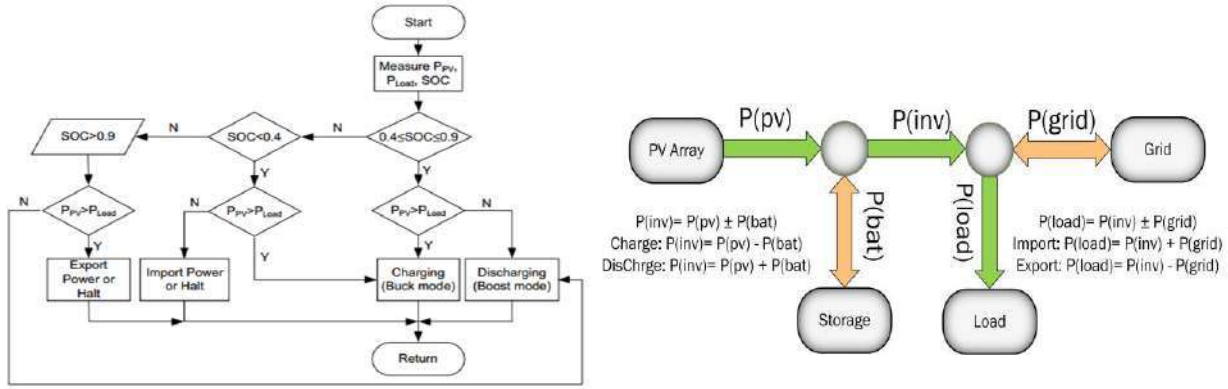
Transitional power of inverter is obtained from equation 1 in which the P(bat) sign is distinguished by the charge and discharge of the battery. As it is obvious in [Fig. 2(b)], when the battery power is finished or the so-called battery is discharged, positive sign is chosen in equation 1 and P(bat) is added to p(pv). And when the battery is charged, negative sign has been chosen and P(bat) is subtracted from P(pv).

$$P(inv)=P(pv)\pm P(bat) \tag{1}$$

The transitional power of the network is also obtained from equation 2 and as shown in the [Fig.2(b)], the power sign taken from the network is positive and the power sign given to the network is negative.

$$P(grid)=P(inv)-P(load) \tag{2}$$





a. Proposed Energy Management Algorithm in [13]      b. Power functions of each part of the system.  
**Fig. 2:** Proposed system.

The two main objectives of this Energy management control system are to reduce the electricity bill and reduce number of charging / discharging cycles off the battery. The number of charging and discharging cycles will in fact effect the life time of batteries. Lithium-ion batteries for example, are typically used and have got high price, having decreased the charging and discharging cycles, it will save the costs. When PV generation, for example, excels the local load and when it is possible to charge the battery, the algorithm decides whether to charge the battery or not. Having analyzed PV generation, loads' energy consumption and Tariff values, the algorithm might conclude that no charging shall happen at instant. This will reduce the unnecessary charging cycles. In this system, charging and discharging decisions will be made every three hours based on averaged measurements for one hour. The energy function of this system is expressed as follows:

$$E_{grid}(t) = E_{load}(t) - E_{pv}(t) - E_{bat}(t) \tag{3}$$

And the price of electricity can be expressed as follows:

$$price(t) = E_{grid}(t) \cdot C(t) \tag{4}$$

$$price(t) = (E_{load}(t) - E_{pv}(t) - E_{bat}(t)) \cdot C(t) \tag{5}$$

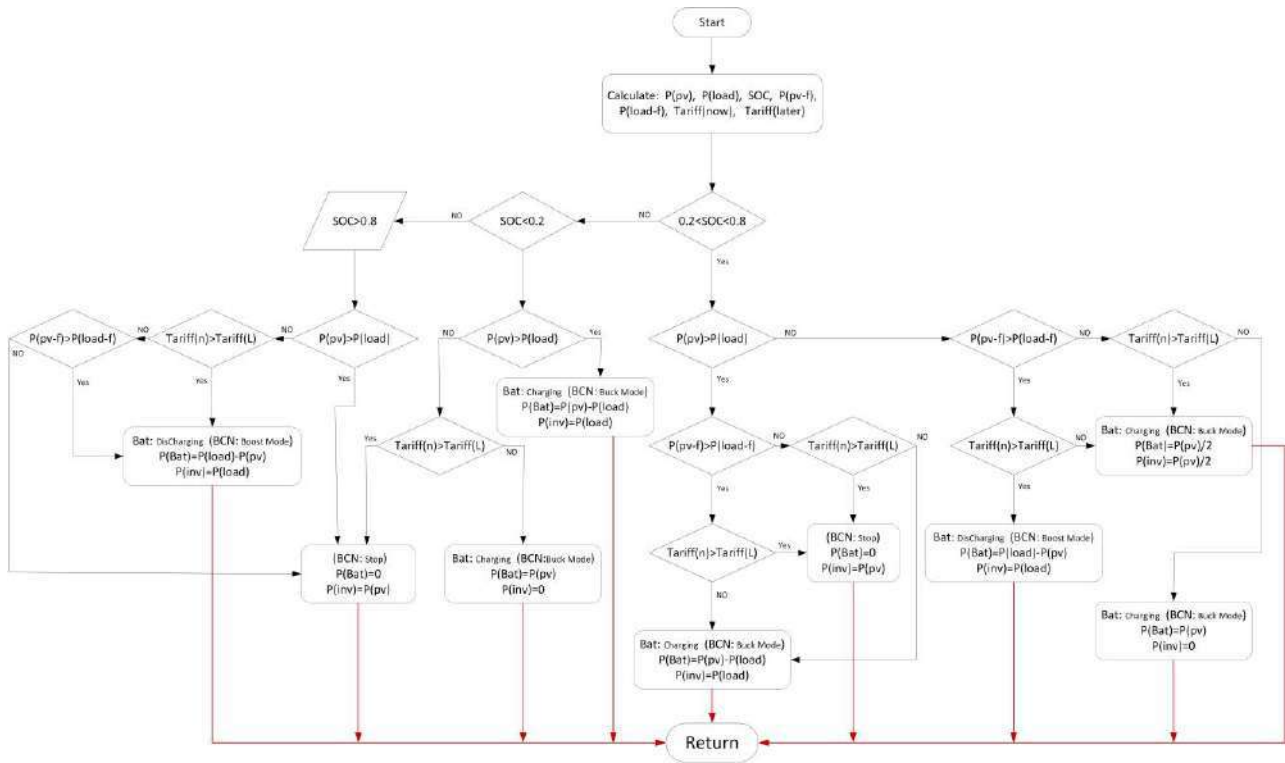
And  $c(t)$  is the cost for electricity function. From this equation it can be observed that the load cannot be changed and the only way to control PV energy is to apply MPPT algorithm. Therefore, optimizing this function relies on optimizing the battery energy with respect to the cost. Since battery can give or receive energy, price function should be reduced at charging the battery and increased at discharging the battery. Maximizing the battery life has many parameters but in this system only the number of charging and discharging cycles is included. According to [5], the lithium-ion batteries have low resistance in front of overcharging and full discharging, therefore it is important to observe the charging mode for these batteries, providing charging mode (SOC) and minimizing the number of charging and discharging cycles have been considered in this algorithm. According to the mentioned items, for designing the algorithm, supply priorities should be distinguished and these priorities are given in [Table 1].

**Table 1:** Priority organization

Priority step	Priority
Priority 1	Energy will be obtained from PV
Priority 2	Energy will be obtained from grid if ( Tariff(now) < Tariff(later) )
Priority 3	Energy will be obtained from battery if ( Tariff(now) > Tariff(later) )

According to the priorities of the mentioned [Table 1], battery charging and discharging algorithm by bidirectional dc-dc converter in the energy management control system was designed as [Fig. 3]. In which  $P(pv)$  is the productive power of the photovoltaic system,  $P(bat)$  is the transitional power of the battery,  $P(inv)$  is the transitional power of the inverter,  $P(load)$  is the power consumed by the load and  $P(grid)$  is the

transitional power of the network. In the following algorithm, SOC, BCN, P (PV-f) and P (load-f) stand respectively for state of charge, bidirectional converter, PV energy generation prediction and load prediction. For tariff, two other concepts have been defined. Tariff (n) reports the tariff at the existing time and Tariff (later) reports the tariff at the later time.



**Fig. 3:** Proposed battery charging and discharging algorithm by bidirectional dc-dc converter in the energy management control system

### LOAD PREDICTIVE MODEL

There are many load predictive models in the different literatures. The simplest forecast models are linear regression models such as [15]. Linear regression models are simple to implement and have many forms. However, they are known to have consistent, over-estimating or under-estimating, errors. Nonetheless, the amplitude of error is considered acceptable in a residential energy management application especially when its main function is to determine the state of the battery. The Chosen model for this system is a linear model that predicts a residential load based on its past history for the last four days. The model is expressed as [15]:

$$d(t) = [d(t - 1) \ d(t - 2) \ d(t - 3) \ d(t - 4)] \times \begin{bmatrix} a_1 \\ a_2 \\ a_3 \\ a_4 \end{bmatrix} \tag{6}$$

To find the (a) parameters, a set of at least 8 days of load data is needed and parameters a1 to a4 can be found as follows:

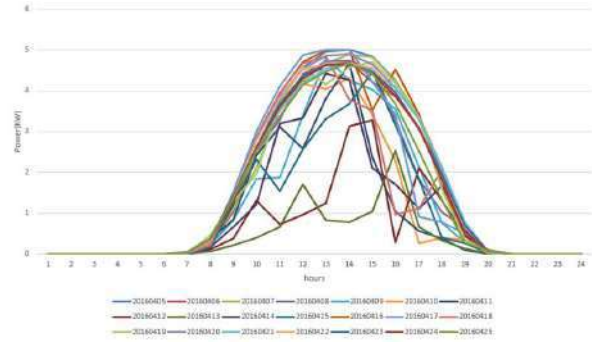
$$\begin{bmatrix} a_1 \\ a_2 \\ a_3 \\ a_4 \end{bmatrix} = \begin{bmatrix} d(4) & d(3) & d(2) & d(1) \\ d(5) & d(4) & d(3) & d(2) \\ d(6) & d(5) & d(4) & d(3) \\ d(7) & d(6) & d(5) & d(4) \end{bmatrix}^{-1} \cdot \begin{bmatrix} d(5) \\ d(6) \\ d(7) \\ d(8) \end{bmatrix} \tag{7}$$

After finding these parameters, the load can be predicted by simply providing load consumption for the last four days.

### PRODUCTIVE POWER OF THE PHOTOVOLTAIC SYSTEM

Depending on the weather conditions, temperature and radiation, it is different in various days; for testing the proposed algorithm, the data of a 5-kW inverter of the SMA Company (Sunni boy 5000 TL) which was installed in a residential building, was used. For the forecast model of the production, the linear regression method which was mentioned in the load forecast model section has been used. In [Fig.4(a)] and

[Fig.4(b)], general production diagrams of a solar system in one day and system production at different hours of the day in a 21 day period of the year are presented, respectively.



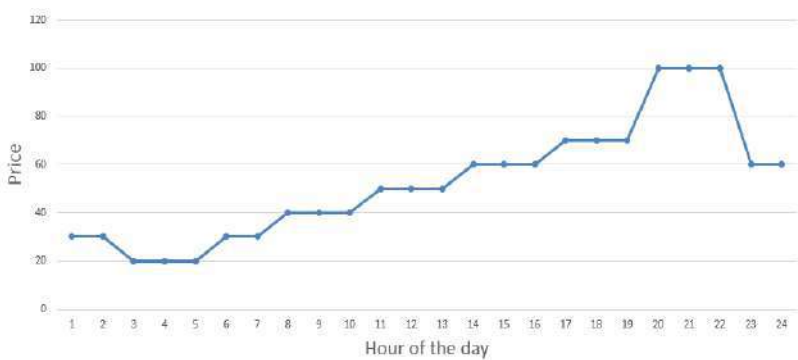
a. Daily production diagram of the photovoltaic system in a 21-day period

b. Production diagram of the PV system at different hours in different 21 days.

**Fig. 4:** Productive power of the photovoltaic system.

### Tariff Model

As previously pointed out one of the main aims of the proposed control algorithm is to reduce the consumed electricity bill of a residential building equipped with solar system and storage system; in this system, dynamic pricing is applied to the energy management algorithm. The price of electricity varies during the day and the highest price is related to the highest demand or the peak consumption. Electricity pricing varies in different parts of the world, but by checking several sites that included electricity prices during different hours of the day, an electricity tariff model based on prices at different hours was extracted without considering any specific currency. The extracted model is shown in [Fig. 5].



**Fig. 5:** The electricity tariff model based on different hours of the day

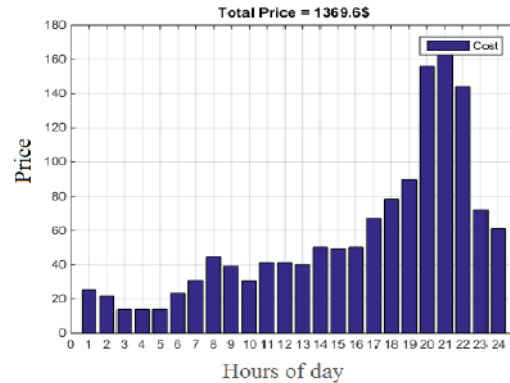
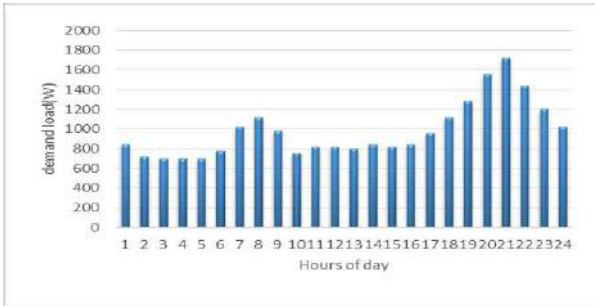
### CAPACITY OF THE PHOTOVOLTAIC SYSTEM AND THE STORAGE SYSTEM

For testing the proposed algorithm for the bidirectional converter in the energy management control system, the capacity and size of the photovoltaic system and the storage system should be specified. It should also be notified that the proposed algorithm can work with any size and capacity and can provide the desired items such as reducing the electricity bill and increasing the battery life time. In [16], a general analysis about the optimum capacity of these systems is presented for several scenarios and in different years. In 2017, the capacity of the photovoltaic system in the optimal mode is 3.75 kW and the capacity of the storage system is 5 kWh.

### RESULTS OF EVALUATING THE PROPOSED ALGORITHM

In this section, the proposed algorithm for the bidirectional converter in the energy management control system is evaluated. For this reason, the results are compared with the results of the algorithm in [13]. The bidirectional converter was considered as a 1 kW converter. To make the comparison simple in different situations, evaluation was used for a sample of load profile in a day. In [Fig. 6(a)], the diagram of a sample load consumed for a residential building at different hours of the day has been represented. According to

the presented sample tariffs [Fig. 5], the electricity bill without the solar system is 1369.6 dollars and the bill is also calculated and represented in [Fig.6(b)] according to the tariff per hour. Two evaluations of two samples have also been provided in two different days which are as follows:



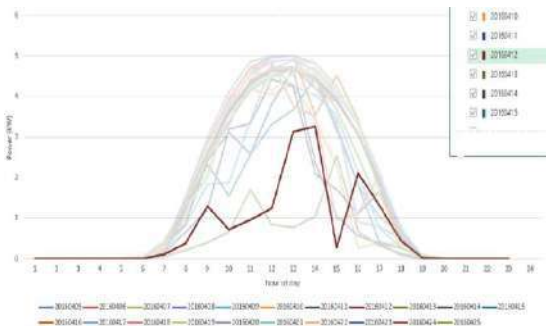
a. The diagram of the load sample consumed for a residential building at different hours

b. The diagram of the electricity price based on the diagram of the load sample consumed at different hours without the solar system

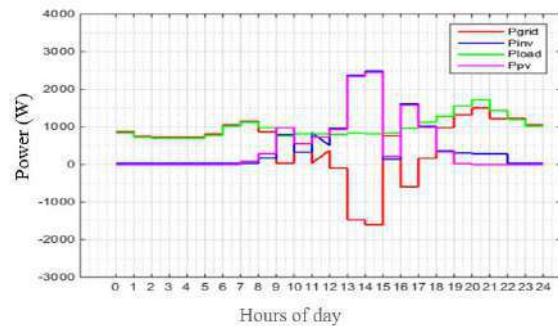
**Fig. 6:** The diagram of the load sample consumed and the diagram of the electricity price

### The first sample

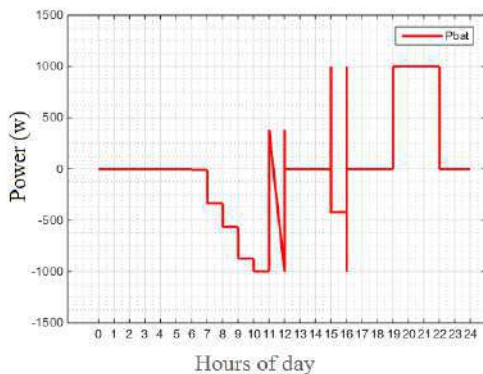
In [Fig.7(a), (b), (c), (d), (e)] the production diagram of the photovoltaic system on 12.04.2017 and general values of the system parameters, the amount of battery charging and discharging, battery charging mode and the electricity bill will be represented. In [Fig. 7(e)], positive values express the scenario in which energy is obtained from grid. Also, negative values express the scenario in which energy is exported to grid.



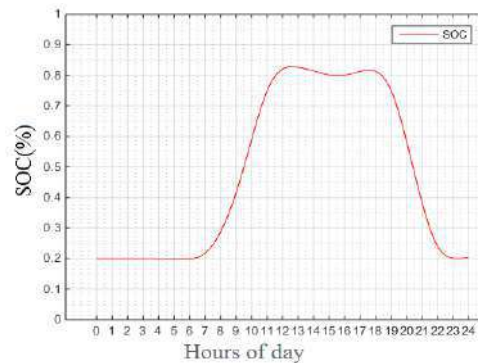
(a) The production diagram of the photovoltaic system on 12.04.2017.



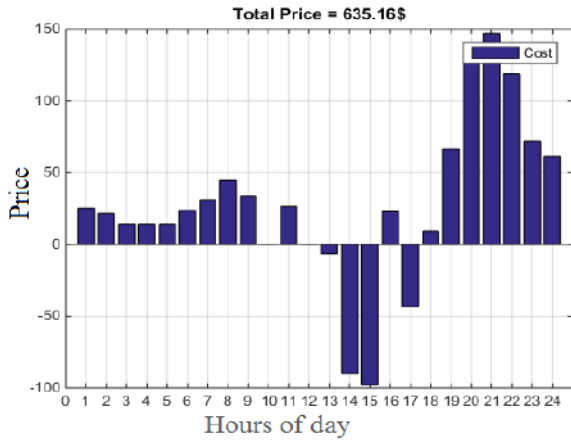
(b) The changes diagram of the network power, inverter, load and PV by implementing the proposed algorithm for the first sample.



(c) Battery charging and discharging diagram using the proposed algorithm for the first sample.



(d) The (SOC) diagram using the proposed algorithm for the first sample.



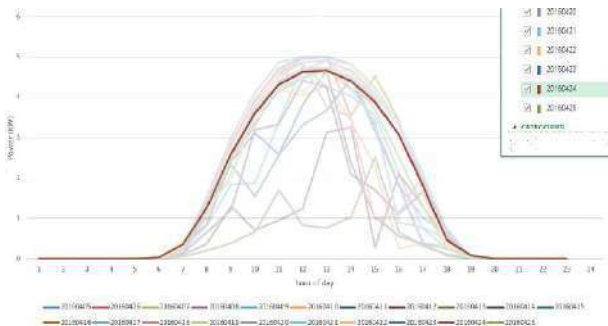
(e) The cost of electricity per hour and the electricity bill using the proposed algorithm for the first sample.

**Fig. 7:** The first sample

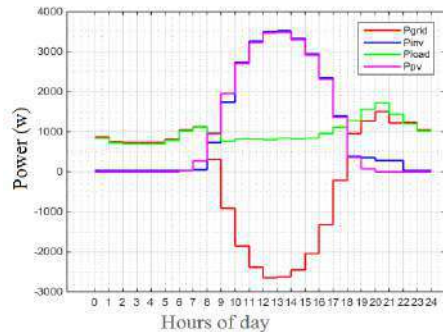
The electricity bill in the indicated day is equal to 737 by implementing the algorithm in [13] and it is equal to 635 by implementing the proposed algorithm and for this day, considering the production of the PV system, the bill is decreased by 14 percent compared to the algorithm [13] using the proposed algorithm. Also, the parameters of maximizing the battery life can be seen in the algorithm in which (SOC) is about 20 to 80 percent in all the process of charging and discharging the battery and the number of charging and discharging cycles is minimal.

**THE SECOND SAMPLE**

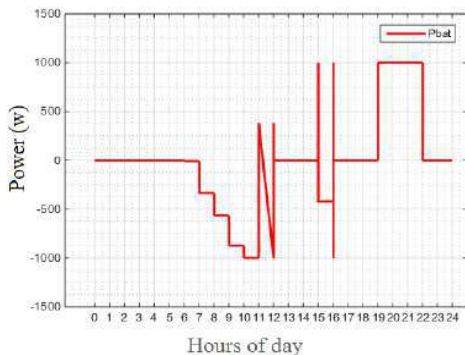
In [Fig. 8(a),(b),(c), (d), (e)], the production diagram of the photovoltaic system on 14.04.2017 and general values of the system parameters, the amount of battery charging and discharging, battery charging mode and the electricity bill will be represented.



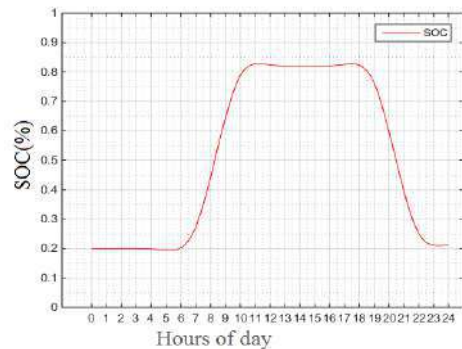
(a) The production diagram of the photovoltaic system on 24.04.2017



(b) The changes diagram of the network power, inverter, load and PV by implementing the proposed algorithm for the second sample

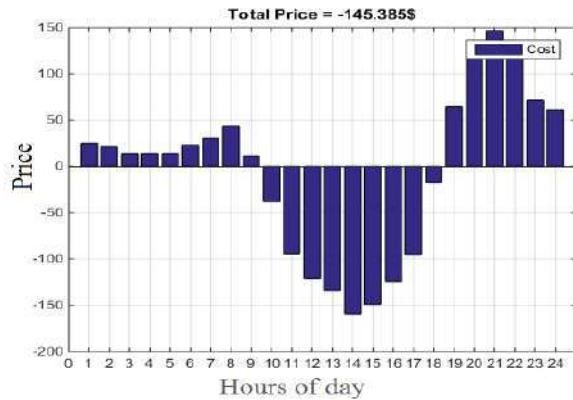


(c) Battery charging and discharging diagram using the proposed algorithm for the second sample



(d)The (SOC) diagram using the proposed algorithm for the first sample

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(e)The cost of electricity per hour and the electricity bill using the proposed algorithm for the first sample

Fig. 8: The second sample

The electricity bill in the specified day in the energy management control system is equal to the negative 108 by implementing the algorithm in [13]. In fact, the amount of 108 units has been sold to the electricity network. And it is equal to the negative 145 by implementing the proposed algorithm that for this day, considering the production of the PV system, the sold electricity to the network is increased by 34 percent compared to the algorithm [13] using the proposed algorithm. By evaluating the proposed algorithm for the 21-day data from the production of the photovoltaic system and comparing the results with the algorithm [13], the proposed algorithm will have in an average of 23 percent profitability, while in this algorithm, the desired parameters for increasing the battery life are also considered.

### CONCLUSION

In this paper, a control algorithm was proposed for a bidirectional dc-dc converter in the energy management system of a residential building equipped with solar and storage systems. The algorithm is in fact a predictive algorithm and its main purposes are to increase energy storage life time, reduce electricity bills and protect batteries against overcharging. The decision maker algorithm pays a serious attention to state of the charge (SOC) to minimize the charging and discharging cycles which subsequently increases the life time of storage system. Having used the real data of a residential building solar system, the simulations assure the effectiveness of the algorithm as all the desired purposes can be achieved. Having analyzed the results, it has been concluded that the proposed algorithm would be beneficial for all the residential building equipped with solar and storage systems.

**CONFLICT OF INTEREST**  
There is no conflict of interest.

**ACKNOWLEDGEMENTS**  
None

**FINANCIAL DISCLOSURE**  
None

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# INTRODUCTION OF CHANNEL LINEAR CODING TECHNIQUE IN MOBILE SATELLITE COMMUNICATIONS

Dimov Stojce Ilcev\*

*Postgraduate Studies in Space Science, Durban University of Technology (DUT), Durban, SOUTH AFRICA*

## ABSTRACT

This paper describes introduction of channel linear coding techniques used in Mobile Satellite Communications (MSC) for maritime, land (road and rail) and aeronautical applications. The design of modern channel coding structure includes both encoder and decoder part that can be used in a communication system for encoding a message at the transmitter and decoding it, detecting error and correcting it on the receiver part. As is known, MSC systems are generally limited by the available power and bandwidth. Thus, it is of interest if the signal power can be reduced while maintaining the same grade of service for Bit Error Rate (BER). This sequence can be achieved by adding extra or redundant bits to the information content by using a channel coder. The complete transmission loop requires any type of encoder followed by modulation in transmitter via transmission channel to receiver, namely to demodulator and decoder. In coding theory, a linear code is an error-correcting code for which any linear combination of codewords is also a codeword. Linear codes are traditionally partitioned into block and convolutional codes, although turbo codes can be seen as a hybrid of these two types. Linear codes allow for more efficient encoding and decoding algorithms than other existing codes. Among the total channel schemes implemented in MSC, only two most widely used block or cyclic and convolutional encoders are described. Here will be not discussed decoding techniques as the reverse method of coding and every type of decoding on the transmit side needs the convenient decoding method on the receive side.

## INTRODUCTION

Linear codes are used in forward error correction and are applied in methods for transmitting symbols (bits) on a communications channel so that, if errors occur into the links, some errors can be corrected or detected by the recipient of a message block. The codewords in a linear block code are blocks of symbols that are encoded using more symbols than the original value to be sent. In fact, a linear code of length  $n$  transmits blocks containing  $n$  symbols.

The matter of a MSC system depends on how it deals with the noise that may interfere with the Voice, Data and Video (VDV) to be transmitted. Noise generally is encountered in the channel phase of a different communication system, which could be transmission lines, optical fibers, space, air etc. The coding theory is an important tool for encoding a given message, decoding and correcting the received message. As is known, MSC systems are generally limited by the available power and bandwidth. Thus, it is of interest if the signal power can be reduced while maintaining the same grade of service for BER. This can be achieved by adding extra or redundant bits to the information content by using a channel coder. Excepting several main classes of channel coder, the most widely used in MSC are block, cyclic and convolutional encoders. These coding techniques are one such tool that can be used both for encoding and decoding of the information represented in the form of binary numbers.

The complete transmission loop requires any type of encoder scheme followed by modulation and transmitter via transmission channel to receiver, namely to demodulator and decoder. In such a manner, decoding is the reverse method of coding and every type of decoding on the transmit side needs the same convenient decoding method on the receive side.

The VDV or telex information used in MSC is transmitted in digital form through a channel that can cause degradation of these transmission signals. The noise, interference, fading and other obstacle factors experienced during transmission could increase the probability of bit error at the receiver of Mobile Earth Station (MES). Anyway, the coding process uses redundant bits, which contain no information to assist in the detection and correction of errors. The subject of coding emerged following the fundamental concepts of information theory laid down by the US scientist Claude Elwood Shannon in 1948, which is the relationship between communication channel and the rate at which information can be transmitted over it. Basically, the theorems laying down the fundamental limits on the amount of information flow through a channel are given [1, 2, 3].

## Block Codes

Block coding was the first type of channel coding implemented in early mobile communication systems. There are many types of block coding, but among the most used the most important is Reed-Solomon (RS) code, which is

**Key words:** MSC, VDV, MES, Coding, BER, Block Codes, Cyclic Codes, Convolutional Codes

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\*Corresponding Author  
Email: ilcev@dut.ac.za



highly used in MSC applications. In addition, Hamming, Golay, Hadamard, Expander, Multidimensional Parity, Bose, Chaudhuri and Hocquenghemand (BCH) codes are other well-known examples of classical block coding.

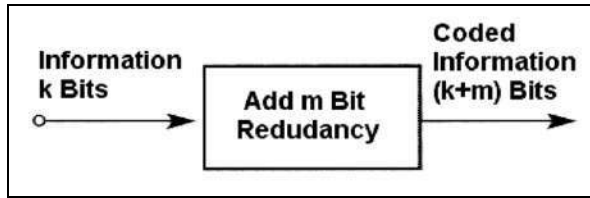


Fig.1: Block Coders - Courtesy of Book: by Richharia [2]

Binary linear block codes are expressed in the  $(n, k)$  form, where  $(k)$  is the information bits number that is converted into  $(n)$  code word bits. There are  $(n, k)$  party bits in each encoded block, where the difference between  $(n)$  and  $(k)$  bits are added by the coder as a number of redundancy bits  $(r)$ . In the other words, a coded block comprising  $(n)$  bits consists in  $(k)$  information and  $(r)$  redundant bits expressed as follows:

$$n = k + r \tag{1}$$

Such a code is designated as a  $(n, k)$  code, where the code rate or code efficiency is given by the ratio of  $(k/n)$ . Mapping between message sequences and code words can be achieved using look-up tables; although as the size of the code block increases such an approach becomes impractical. This is not such a problem as linear code words can be generated using some form of linear transformation of the message sequence. Thus, a code sequence  $(c)$  comprising of the row vector elements  $(c_1, c_2, \dots, c_n)$  is generated from a message sequence  $(m)$ , comprising the row vector elements  $(m_1, m_2, \dots, m_k)$  by a linear operation:

$$c = m G \tag{2}$$

where  $G$  = generator matrix. At this point, in general, all  $(c)$  code bits are generated from linear combinations of the  $(k)$  message bits.

A special category known as a systematic code occurs when the first  $(k)$  digits of the code are the same as the first  $(k)$  message bits, namely if input message bits appear as part of the output code bits. The remaining  $n-k$  code bits are then generated from the  $(k)$  message bits using a form of linear combination, and they are termed the party data bits.

The generator matrix for a linear block code is one of the bases of the vector space of valid codewords. The generator matrix defines the length of each codeword  $(n)$ , the number of information bits  $(k)$  in each codeword and the type of redundancy that is added; the code is completely defined by its generator matrix. The generator matrix is a  $(k \cdot n)$  matrix that is the row space of  $V_k$ . Thus, one possible generator matrix for a typical  $(7, 4)$  linear block code has to be presented in four rows as blocks:

$G = 1101000/0110100/1110010/1010001$ . Thus, the distance between two coded words (for example, first 2 and second 2 digits) in a block is defined as the number of bits in which the words differ and is called the Hamming distance  $(d_h)$ . The Hamming distance has the capability to detect all coded words having errors  $(e_d)$ , where  $e_d < (d_h - 1)$ ; to detect and correct  $(e_{dc})$  bits, where  $e_{dc} = (d_h - 1)/2$  and to correct  $t$  and detect  $(e)$  errors, where the Hamming distance as a minimum space between two coded blocks is given by:

$$d_h = t + e + 1 \tag{3}$$

Basically, in the detection process, two coded words separated by  $(d_h)$  are most likely to be mistaken for each other. The extended Golay code offers superior performance to Hamming codes but at a cost of increased receiver complexity. In practice, code words are conveniently generated using a series of simple shift registers and modulo-2 adders.

In [Fig. 1] is illustrated the concept diagram of block codes and rate, which operate on groups of bits organized as blocks, namely information bits for transmission are assembled as blocks before coding.

1. **Cyclic Codes** – Cyclic Codes were first studied in 1957 by Prange. After that they became an important part of the coding theory. Cyclic codes are easy to study and implement because: 1) Encoding and syndrome computation can be done easily using shift registers with feedback connections. 2) Due to the inherent algebraic structure, they are easy to decode.
2. In coding theory, a cyclic code is a block code, where the circular shifts of each codeword gives another word that belongs to the code. They are error-correcting codes that have algebraic properties that are convenient for efficient error detection and correction. These code methods are a subclass of linear codes, where a code word is generated simply by performing a cyclic shift of its predecessor. In other words, each bit in a code sequence generation is shifted by one place to the right and the end bit is fed back to the start of the sequence, hence the term cyclic. Both the linear Hamming and extended Golay codes have equivalent cyclic code generators.

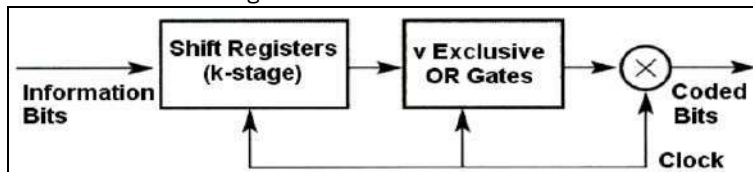


Fig.2: Convolutional Coders – Courtesy of Book: by Richharia. [4]

**BCH Codes** – The BCH codes are the most powerful of all cyclic codes with a large range of block length, code rate, then alphabets and error correction capability. These codes are superior in performance to all other codes of similar block length and code rate. Most commonly used BCH codes have a code word block length as  $n = 2^m - 1$ , where ( $m = 3, 4 \dots$ ). For instance, Inmarsat-A MES onboard ships uses 57 bits plus 6 parity bits encoded with BCH (63, 57 code in TDM channels and for the return request channel burst employs Aloha BPSK (BCH) 4800 b/s.

**RS Codes** – The RS codes are a subset of the BCH codes specially suited for correcting the effect of the burst errors. The latter consideration is particularly important in the context of the MSC channels and hence, RS codes are usually incorporated into the system design. This set of codes has the largest possible code minimum distance of any linear code with the same encoder input and output block length. Thus, the RS codes are specified using the convention RS ( $n, k$ ), where  $n$  = number of code symbols word length per block;  $k$  = data symbols encoded and the difference between ( $n$ ) and ( $k$ ) is the number of parity symbols added to the data [2, 4, 5, 6].

## CONVOLUTIONAL CODES

The second family of commonly used codes is known as convolution codes, which in MSC are a type of error-correcting code that generates parity symbols via the sliding application of a Boolean polynomial function to a data stream. The sliding application represents the so-called convolution of the encoder over the data, which gives rise to the term convolutional coding. The sliding nature of the convolutional codes facilitates trellis decoding using a time invariant trellis. Time invariant trellis decoding allows convolutional codes to be maximum likelihood soft decision decoded with reasonable complexity. The ability to perform economical maximum likelihood soft decision decoding is one of the major benefits of convolutional codes. This is in contrast to classic block codes which are generally represented by a time variant trellis and therefore are typically hard decision decoded.

Convolutional codes are simply often described as continuous. However, it may also be said that convolutional codes have arbitrary block length, rather than that they are continuous, since most real world convolutional encoding is performed on blocks of data. Convolutionally encoded block codes typically employ termination. The arbitrary block length of convolutional codes can also be contrasted to classic block codes, which generally have fixed block lengths that are determined by algebraic properties. The ability to perform economical soft decision decoding on convolutional codes, as well as the block length and code rate flexibility of convolutional codes, makes them very popular for MSC systems.

However, convolutional codes are generally more complicated than linear block codes, more difficult to implement, and have lower code rates (usually below 0.90), but have powerful error correcting capabilities. They are popular in satellite and deep space communications, where bandwidth is essentially unlimited, but the BER is much higher and retransmissions are infeasible.

Convolutional codes are more difficult to decode because they are encoded by finite state machines that have branching paths for encoding each bit in the data sequence. Decoding of convolutional codes is performed very quickly by the Viterbi Algorithm. The Viterbi algorithm is a maximum likelihood decoder, meaning that the output code word from decoding a transmission is always the one with the highest probability of being the correct word transmitted from the source.

Unlike block codes, which operate on each block independently, convolution codes retain several previous bits in memory, which are all used in the coding process. They are generated by a typed-shift register and two or more modulo-2 adders connected to particular stage of the register. The number of bits stored in the shift register is termed the constraint length ( $K$ ). Bits within the register are shifted by ( $k$ ) input bits. Each new input generates ( $n$ ) output bits, which are obtained by sampling the outputs of the modulo-2 adders. The ratio of ( $k$ ) to ( $n$ ) is known as the code rate. These codes are usually classified according to the following convention: ( $n, k, K$ ), for example ( $2, 1, 7$ ), refers to a half-rate encoder of constraint length 7. It is important to know what sequence of output code bits will be generated for a particular input stream. There are several techniques available to assist with this question, the most popular being connection pictorial, state diagram, tree diagram and trellis diagram [2, 4, 7].

However, to illustrate how these methods are applied, the simple example of half-rate ( $1/2$ ) encoder will be considered with constraint length  $k = 3$ . The system has two modulo-2 adders, so that the code rate is  $1/2$ . The input bit ( $m$ ) placed into the first of the shift register causes the bits in the register to be moved one place to the right. The output switch samples the output of each modulo-2 adder, one after the other, to form a bit pair for the bit just entered. Thus, the connections from the register to the adders could be one, two or three interfaces for either adder. The choice depends on the requirement to produce a code with good distance properties. A similar encoder used by the Inmarsat-A and aero standards is a half-rate convolutional encoder. At this point, in terms of connections to the modulo-2, adders can be defined using generator polynomials in the encoder configuration.

Thus, convolutional codes are formed in convolutional coder by convolving information bits  $R$  with the impulse response of a shift register encoder, which block diagram is shown in [Fig. 2]. These types of codes use previous information bits in memory ( $v$ ) and continuously produce coded bits. The constraint length of convolutional code defines the number of information bits, which influence the encoder output. In such a way, the constraint length is decided by the number of shift registers or code memory. The error correcting property of the convolutional code depends on the constraint length and its value improves as code memory is increased, and in such a way decoding complexity increases. The polynomial for the generating arm ( $n$ ) of the encoder  $g_n(p)$  and the generator polynomials representing encoder  $g_1(p)$  can have the following relations:

$$g_n(p) = g_0(p) + g_1p^1 + \dots + g_np^n \quad (4)$$

$$g_1(p) = 1 + p + p^2 = 1 + p^2 \quad (5)$$

where the value of  $g_1$  takes on the value of 0 or 1 and a 1 is used to indicate that there is a connection between a particular element of the shift register and the modulo-2 adder. Thus, to provide a simple representation of the encoder, generator polynomials are used to predict the output coded message sequences for a given input sequences. For instance, the input sequence 10110 can be represented by the polynomial relation:

$$m(p) = 1 + p^2 + p^3 \quad (6)$$

The Inmarsat-A analog MES onboard ships uses a HSD channel encoding configuration for the information data stream at 56 Kb/s.

The scrambling sequence on the input data stream shall be provided by the scrambler before the convolutional encoder described in CCITT Recommendation V.35 scheme. The data stream then passes differential encoder state stage 1 followed by  $1/2$  (half) convolutional encoding with constant length  $k = 7$ . The half ( $1/2$ ) rate convolutional encoder can provide two data streams to the QPSK modulator using two generator polynomials rates as follows:  $G_1 = 1 + x^2 + x^3 + x^5 + x^6$  and  $G_2 = 1 + x + x^2 + x^3 + x^6$ . The encoder provides two parallel data streams to the modulator: I and Q, while (Q) should lag (I) by  $90^\circ$  in the modulator. The Inmarsat-B digital MES and aero standards onboard aircraft for transmission and out-of-band signaling channels uses digital modulation and FEC in order to efficiently utilize satellite power and bandwidth.

The basic modulation and coding techniques are filtered by 60% roll-off O-QPSK and 40% roll-off BPSK, both with convolutional coding at either rate: 1/2 or 3/4 FEC and 8-level soft decision Viterbi decoding (constraint length = 7) [2, 4, 8].

## CONCLUSION

In this paper have been reviewed basic and state-of-art coding, decoding and error correction techniques for MSC. Those techniques have been used extensively in digital MSC, because they are providing cost effective solutions in achieving efficient and reliable digital transmissions. Coding now plays an important role in the design of modern MSC and forthcoming generations of technology are expected to continue this trend with development more complicated, but more economic coding schemes.

Linear block codes are so named because each code word in the set is a linear combination of a set of generator code words. They are very easy to implement in hardware of MES terminals, and since they are algebraically determined, they can be decoded in constant time. They have very high code rates, usually above 0.95. They have low coding overhead, but they have limited error correction capabilities. They are very useful in situations where the BER of the channel is relatively low, bandwidth availability is limited in the transmission, and it is easy to retransmit data.

In this innovative age of ICT it is becoming essential to provide reliable communications of information to people on the move at sea, on the ground (road and Rail) and in the air, having sometimes difficulties to locate some of them precisely. Therefore, the deployment of channel coding and interleaving will enhance the bit-error performance of MSC links addressed for digital speech and data transmissions.

### CONFLICT OF INTEREST

There is no conflict of interest.

### ACKNOWLEDGEMENTS

None

### FINANCIAL DISCLOSURE

None

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# ANALYSES OF VHF-BAND MULTIFUNCTIONAL AIS ANTENNA

Dimov Stojce Ilcev\*

Postgraduate Studies in Space Science, Durban University of Technology (DUT), Durban,  
SOUTH AFRICA

## ABSTRACT

This paper is introducing analyses of new design of the Automatic Identification System (AIS) ships antenna that will serve for both VHF-band Radio and Satellite tracking and identification system for maritime applications. The current AIS network is an automatic tracking system used by ships of Vessel Traffic Service (VTS) for identification and location of vessels by electronically exchanging data between nearby ships and on-shore base station. In the AIS system for the electronic data exchange, the Very High Frequency (VHF) range is used. Utilizing of the VHF range makes the AIS as short-range communication, identification and collision avoidance system between AIS equipped ships and base station is possible in the antennas Line-of-Sight (LOS). In order to widen the range of the AIS from short range up to long or global range should be used AIS communication via a satellite. In order to provide communication via satellite as well should be designed multifunctional antenna for both Radio AIS (R-AIS) and Satellite AIS (S-AIS) communication antenna. The analyses and design of a new multifunctional antenna, calculation and development, including implementation and testing of helical VHF antenna for R-AIS and S-AIS equipment are discussed.

## INTRODUCTION

### Key words

AIS, VHF, VTS, R-AIS, S-AIS, LOS,  
Helical VHF Antenna Transfer  
Ellipse, Satellite Orbit, Launching

The VHF Radio AIS (R-AIS) or Radio VHF Data Link (R-VDL) is a most attractive system at present for short range tracking and detecting of ships in coastal navigation. Because of limited R-AIS range recently is proposed Satellite AIS (S-AIS) for global coverage via Inmarsat, Iridium or Orbcomm satellite constellation. Regulation 19 of the SOLAS Chapter V provided requirements for shipborne navigational systems and equipment and sets out navigational equipment to be carried onboard ships, according to ship type. In 2000, IMO adopted a new requirement, as part of a revised new chapter V, for all ships to carry AIS transponders capable of providing information about the ship to other ships and to coastal authorities automatically.

The R-AIS is a maritime surveillance system using the VHF band to exchange information between ships and shore stations, including positions, identification, course and speed, which network is shown in [Fig. 1]. It mainly aims at avoiding collisions between ships.

The link budgets allow receiving transmitted AIS signals from space, and consequently a global maritime surveillance can be considered. However, some challenges arise, especially message collisions due to the use of a Self Organized Time Division Multiple Access (SOTDMA) protocol (not designed for satellite detecting). Thus, advanced signal processing for separation of received signals is needed. According to IMO regulations by 31 December 2004 each oceangoing vessel has to install AIS transponder devices onboard, which automatically broadcast regularly to the coast station ships name, call sign and navigation data. This data is programmed when the equipment is installing onboard ships and also all this information is transmitted regularly.

The signals are received by R-AIS transponders fitted on other ships or on land based systems, such as Vessel Monitoring System (VMS). The received information can be displayed on a screen or chart plotter, showing the other nearby vessel's positions in much the same manner as a radar display [1, 2, 3].

## ANALYSES OF VHF-BAND AIS ANTENNA FOR SATELLITE TRACKING

Classical dipole antenna for the VHF-band has quite simple construction suitable for many applications and in particular for radio and satellite AIS systems. The conventional dipole antenna has some disadvantages for AIS usage. The main aspects of VHF radio antenna analyzes concerning to VHF AIS are: Polarization, which is particular the same for VHF AIS; Radiation pattern of radio VHF antenna and antenna gain; Severe influence of different and extreme weather conditions on communication between ground and mobile AIS antenna units with different VHF radiation pattern and various antenna gains; and Ability of ship R-AIS antenna to communicate with VHF S-AIS Orbcomm satellite.

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\*Corresponding Author  
Email: ilcev@dut.ac.za



antenna directivity. The equation for radiation intensity is radiated power per solid angle. The dipole antenna radiation pattern (case antenna gain is 3 dB) is shown in [Fig. 3] [1, 2, 4].

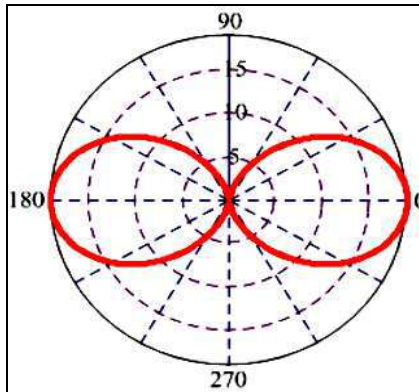


Fig. 3: Dipole antenna radiation pattern.

– Courtesy of Manual: by Ilcev [4]

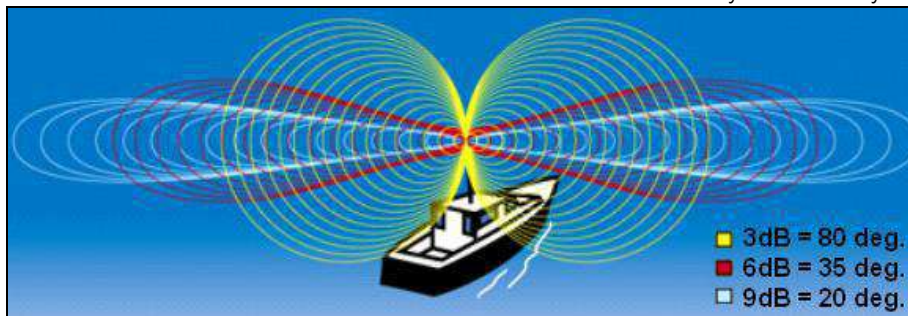


Fig. 4: Dipole radiation pattern at different antenna gains – courtesy of article: by West Marine [5].

In the far field radiation intensity is following:

$$P_{rad} = \int_0^{2\pi} \int_0^\pi U(\theta, \phi) \sin\theta \, d\theta \, d\phi = \int_0^{2\pi} \int_0^\pi U(\theta, \phi) \, d\Omega \quad (1)$$

where  $d\Omega = \sin(\theta)d\theta \, d\phi$  is differential solid angle.

The average radiation intensity is defined by dividing the radiation intensity (1) with the area of the unit sphere ( $4\pi$ ), which relation gives:

$$U_{avg} = \int_0^{2\pi} \int_0^\pi U(\theta, \phi) \, d\Omega / 4\pi = P_{rad} / 4\pi \quad (2)$$

The directivity antenna equation is the ratio of the radiation intensity (1) in a given direction from the antenna to the average radiation intensity (2) over all directions. Hence, formula for antenna directivity is as follows:

$$D(\theta, \phi) = U(\theta, \phi) / U_{avg} = 4\pi U(\theta, \phi) / P_{rad} \quad (3)$$

Inserting the  $P_{rad}$  expression into the directivity is:

$$D(\theta, \phi) = 4\pi F(\theta, \phi) / \int_0^{2\pi} \int_0^\pi F(\theta, \phi) \sin(\theta) \, d\theta \, d\phi \quad (4)$$

where value  $F(\theta, \phi) =$  function of radiation pattern intensity. To plot radiation pattern, radiated pattern function of dipole antenna is needed, which mutual relation is presented by:

$$F(\theta) = 0.64 \cos^2(\theta) \quad (5)$$

Inserting formula (5) into (4) and with the help of software “MathCAD”, dipole antenna radiation pattern diagram is plotted with a vertical cross-cut. In [Fig. 3] can be seen two lobes of radiation pattern known as

main lobes of radiation pattern.

Radiation patterns of VHF dipole antenna for AIS system at different antenna gains (Yellow is 3 dB, red is 6 dB and blue is 9 dB) shown in [Fig. 4]. Thus, the higher antenna gain the better radiating energy concentration is in space, which reduces the amount of radiated energy above or below the antenna perpendicular line toward antenna axis. In fact, should be considered communication of AIS equipped ships with the VHF high and low gain antenna providing 3 and 9 dB, respectively. This consideration is vital to analyze and define necessary antenna gain for AIS.

The radiation pattern of ship High Gain Antenna (HGA) concentrates radiating energy in narrow lobes along the horizontal line. The HGA array is suitable for long-range communication, owing to high concentration of radiation energy. However, this case is advantage only in normal navigation and weather/sea conditions without extremely pitching and rolling of a ship.

In contrary, ships radio communication becomes significantly worse when the ship begins pitching or rolling due to agitated sea, hence the radiation pattern of VHF AIS antenna becomes inclined relatively to horizon line, what is shows in [Fig. 5] (Left). This figure shows a ship equipped with the VHF HGA.

In case when VHF Low Gain Antenna (LGA) is used, main lobes of radiation pattern become significantly wider. The radiated energy by LGA quickly is spreading out, what significantly reduces communication range. But in case of very high sea agitation, when ship is pitching and rolling, the transmitting or receiving VHF antenna of nearby ships is still capable to receive or transmit signal as shown in [Fig. 5] (Right).

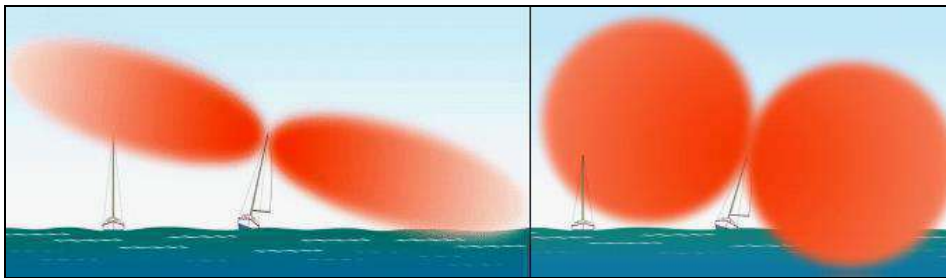


Fig. 5: Ship equipped with HGA and Transmission with LGA – Courtesy of Presentation: by NMEA [6]

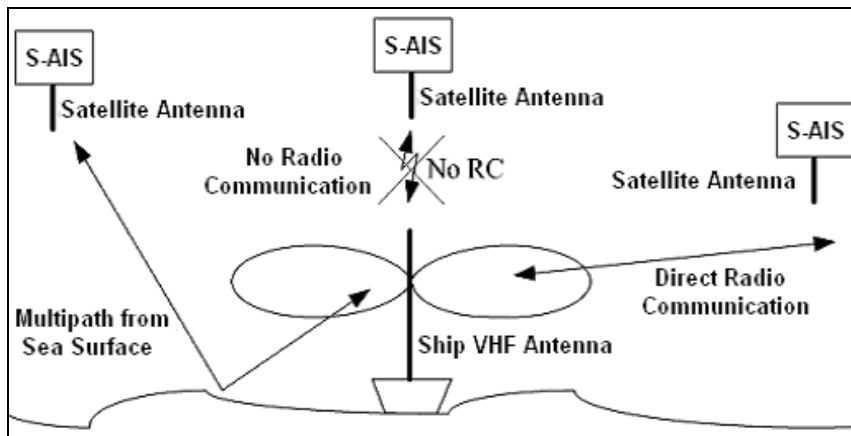


Fig. 6: Graphic of Possible S-AIS via VHF Antenna – Courtesy of Manual: by Ilcev [4]

**Third aspect** - It presents reliable satellite communication with standard AIS VHF antenna, which deserves special consideration. To provide link between AIS Orbcomm (S-AIS) satellite and AIS ship-borne terminal (R-AIS) should be used the same low gain VHF antenna as for R-AIS. According to the graphic analyses shown in [Fig. 6], satellite communication with the VHF antenna is possible in two following cases:

- Radio wave reflection from sea water surface; &
- Radiation pattern of ship-borne VHF antenna fully matches its radiation pattern with satellite's antenna in LOS.



To improve radiation pattern, should be selected another type of maritime antenna for S-AIS, such as spiral or helical antenna, which radiates circular polarized signal [1, 4, 5, 6].

**Calculation and design of Helical Antenna**

In order to choose necessary construction of VHF helical antenna array should be considered environmental conditions where this antenna is going to be used. According to the current and latest research analyses, the most suitable antenna for S-AIS is Quadrifilar Helical Antenna (QHA). Consequently, it will be necessary precisely to select needed radiation pattern of QHA with open circuit, which can be plotted by the known radiation pattern formula for helical antenna:

$$F(\theta) = \cos(\theta)\sin(N\psi/2)/\sin(\psi/2) \tag{6}$$

where value  $N$  = number of turns for every given helix; and  $\psi = k\cos\theta + \alpha$  = summarized variable determined by the type of circulation  $k$  and pitch angle of helix  $\alpha$ , which equation is:

$$\alpha = s/\pi d; \tag{7}$$

where value  $s$  = space between turns of helix; and  $d$  = diameter of helix turns. Executing several simple conversions of equation provides the QHA formula and inserting converted equation (6) of QHA radiation pattern into equation (4) can be plotted chart by the "MathCAD" software.

The QHA radiation pattern is illustrated in [Fig. 7] (Left) and model of QHA resonant for R-AIS system is shown in [Fig.7] (Right).

Considering presented radiation pattern can be seen that radiation pattern has hemispherical shape, therefore, such radiation pattern is suitable for satellite communication and tracking (S-AIS) and including for (R-AIS) intercommunication between ships (ship-to-ship) due to the significant broad radiation pattern within horizontal plane.

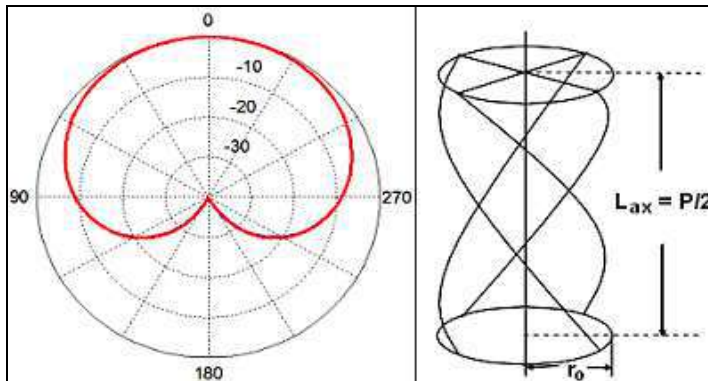


Fig. 7: QHA Radiation Pattern and Model – Courtesy of Manual: by Ilcev [4]

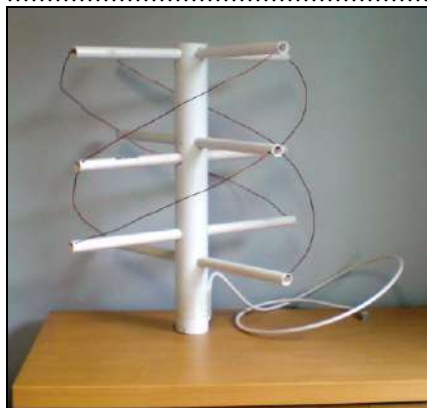


Fig. 8: Experimental Sample of the QHA . Antenna – Courtesy of Manual: by Ilcev [4]

This resonant QHA antenna consists of four spiral arms separately fed by currents, which have equal amplitude and 90° difference between two orthogonal. The resonant QHA antenna can be divided into two types, open and shorted circuit at non-feed end, which main parameters for implementation onboard ships are following:  $r_o$  = spiral radius;  $P$  = thread pitch;  $N$  = turns numbers;  $L_{ele}$  = helix length; and  $L_{ax}$  = axial length. All these variables are included in equation:

$$P = \sqrt{(1/N^2(L_{ele} - Ar_o)^2 - 4\pi^2 r_o^2)} \quad (8)$$

where values  $L_{ele} = (2n+1)\lambda/4$  (opened at non-feed);  $n = n\lambda/2$  (shorted at non-feed) both values are considered with  $n = 0,1,2, \dots$ ;  $A = 1$  (if open at non-feed) and  $A = 2$  (if shorted at non-feed). Also important aspect of the QHA antenna is auto-phase shifting structure that produces 90° differences through its antenna arms, so the length of two bifilar helices is different. The longer arm can produce a capacitive input impedance with negative 45° phase shift different to resonance, while the shorter gives resonant length that produces an inductive input impedance with positive 45° phase shift different to resonance. Therefore, two bifilar helices can produce 90° phase shift difference without any auxiliary structure used to produce phase shift.

Also important aspect of the QHA antenna is auto-phase shifting structure that produces 90° differences through its antenna arms. The principle is that the length of two bifilar helices is different. This, one slightly longer than resonant length that can produce a capacitive input impedance with negative 45° phase shift different to resonance; another arm is slightly shorter than resonant length that produces an inductive input impedance with positive 45° phase shift different to resonance. Therefore, two bifilar helices can produce 90° phase shift difference without any auxiliary structure used to produce phase shift.

In addition, main parameter of the QHA antenna that determines size depends on central operation frequency, so R-AIS system uses two radio channels at frequencies of 161.975 and 162.025 MHz and with spectrum width at 25 kHz. The resonant QHA antenna is a broadband device, hence its central frequency should be selected as  $f_{cnt} = 162$  MHz.

Knowing central frequency value it makes simple to calculate wavelength for this central frequency, what is presented by formula:

$$\lambda = c/f_{cnt} = 3 \times 1.8 / 162 \times 10^6 = 1.8 \quad [m] \quad (9)$$

Using  $\lambda = 1.8$  [m] can be calculated necessary wire length  $L_{ele}$  for open and shorted circuit of the QHA antenna. Other dimensions and parameters of the QHA array should be selected empirically during experiment to achieve desirable radiation pattern [1, 2, 4, 7].

### IMPLEMENTATION AND TESTING OF HELICAL VHF ANTENNA

According to provided design and calculations for the QHA antenna in previous subsection, the QHA antenna was designed. The resonant QHA antenna has been implemented as “turn, quarter lambda” type. Two twisted wire frames are placed upon each other at right angles and connected to the antenna cable at the top (feeding provided at the top) with part of QHA-cylinder equals to approximately 0.4 m. The photo of experimental sample of QHA antenna done at Durban University of Technology that can be used onboard ships simultaneously for both R-AIS and S-AIS is shown in [Fig. 8]. For the measuring of radiation pattern of QHA was used special laboratory equipment which provides rotation of antenna with fixed steps of degrees in two plans what necessary to obtain measuring of radiation pattern antenna in two cross-sections:

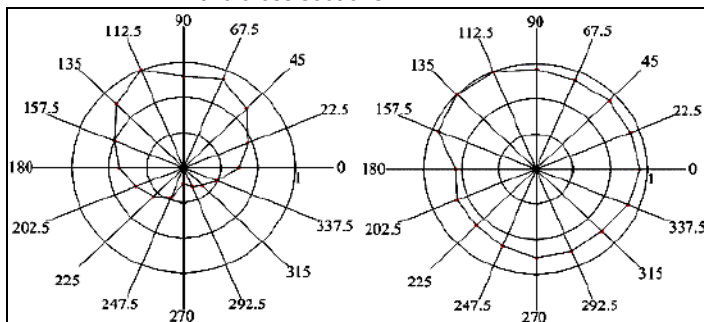


Fig.9: Radiation Pattern of QHA Antenna – Courtesy of Manual: by Ilcev. [4]

The structure of fully equipped laboratory stands for measuring radiation pattern of the both QHA antennas can be done by connecting transmitting (TX) antenna to VHF generator for producing sinusoidal signal at 162 MHz that corresponds to R-AIS central frequency. The receiving (Rx) antenna is simple half-wave dipole connected to VHF detector that can show the level of receiving signal in relative units. The theoretical far-field region is 0.9 meter, which means that taken 5 meters of distance between Rx and Tx antenna for measuring of radiation pattern is sufficient for correct measurements. With help of the laboratory stand was also provided measurements of both vertical and horizontal cross-sections of antenna radiation pattern. Measurements were provided with steps in  $22.5^\circ$  to achieve smooth curvatures. The measurement of the radiation patterns done in relative units is maximum magnitude in achieved radiation pattern of left or right unit shown in the [Fig.8]. In order to convert relative units into dB, logarithmic equation should be used. In such a way, it will be necessary to take into account that measurements provided by the detector connected to antenna. Such detector provides measuring of antenna voltage, hence should be used logarithmic equation as follows:

$$dB = 10\log(U_1^2/U_0^2) \quad (10)$$

where  $U_1$  = magnitude value of voltage given by detector;  $U_0$  = is threshold magnitude of voltage; and dB = antenna gain. Therefore, in the left side of [Fig. 9 ] is shown radiation pattern with vertical cross-section and in the right side is shown radiation pattern with horizontal cross-section. Simple calculation with the help of the equation (8) is showing that the QHA antenna produces radiation pattern with gain higher than 3 dB within confined angle  $10^\circ$  and  $175^\circ$ , the vertical-cross section radiation pattern diagram is shown in [Fig.11]. This is sufficient for reliable S-AIS. In the left side of the same figure is shown horizontal-section of radiation pattern diagram, where antenna gain is lower than 3 dB, but also still enough for communication with nearby ships [1, 4, 7, 8].

## CONCLUSION

Designed and assembled sample of the resonant QHA antenna clearly shows that the resonant QHA antenna can be used for both the radio-based (R-AIS) and satellite-based (S-AIS). Such antenna should be improved by adding ground shield plane, which will prevent harmful back radiation being reflected from the sea surface. The next stage is to provide test of this antenna in real environment at sea. This antenna doesn't require any changes in the AIS equipment to be coupled. Also the resonant QHA antenna easily matches with input impedance of AIS transmitter, since resonant antenna has only resistive impedance.

### CONFLICT OF INTEREST

There is no conflict of interest.

### ACKNOWLEDGEMENTS

None

### FINANCIAL DISCLOSURE

None

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## ARTICLE

# DEVELOPMENT OF NEW SATELLITE SOLUTIONS FOR MILITARY APPLICATIONS

Dimov Stojce Ilcev\*

*Postgraduate Studies in Space Science, Durban University of Technology (DUT), Durban, SOUTH AFRICA*

### ABSTRACT

This paper introduces new projects of military satellite solutions for global tracking and Communication, Navigation and Surveillance (CNS) of mobile assets and personnel at sea, on the ground and in the air. Implementing new CNS systems military mobiles and personnel will be controlled, tracked and managed in more tactical and safe ways. The new satellite communication and navigation transponders are able to provide connections, monitoring and detection of all military mobile vehicles and personnel, to enhance traffic control and management, improve safety and security of movements and augment collision avoidance, especially for navy and air forces assets. Tracking transponders dedicated for civilian application discreetly installed onboard ships or aircraft can provide to military forces reliable anti piracy or hijacking solutions, respectively. Separately, the communication, navigation and surveillance solutions for navy, ground and air forces with their advantages and disadvantages are discussed.

### INTRODUCTION

The satellite communication and navigation era began when the Soviet Union shocked the globe with the launch of the first ever artificial satellite, Sputnik 1, on 4 October 1957. Sputnik contained two radio transmitters, which sent back the “beep-beep-beep” signals heard round the globe as a first Satellite Communication link with the Control Centre on the ground. In the following years were developed fixed and mobile satellite systems via Geostationary (GEO), Medium (MEO) and Low Earth Orbits (LEO), including Highly Elliptical Orbits (HEO) and other satellite networks including combination of these constellations in Hybrid Satellite Orbits (HSO). After that, it was deployed new Digital Video Broadcasting-Return Channel via Satellite (DVB-RCS) network.

Global Navigation Satellite Systems (GNSS) are represented by fundamental solutions for Position, Velocity and Time (PVT) of the US GPS and Russian GLONAS military systems, which suffer from particular weaknesses that render them unsuitable for use in modern transportation state affairs as sole solutions for positioning, tracking and detecting of military and civilian mobile asserts. A major goal of the near-universal use of GNSS systems is their integration with satellite communication systems, which very small units will be able to improve tracking and positioning facilities of military personnel and mobile assets, such as ships, ground vehicles and aircraft.

As a result of these efforts, modern satellite technologies have been projected and developed to utilize CNS solutions and services for enhanced traffic control and management of military mobile assets and personnel staff. Received tracking data by GPS/GLONASS Receiver (Rx) of military personnel or mobile assets can be sent via adequate Geostationary Earth Orbit (GEO) or Non-GEO spacecraft. All mobiles and personnel require far more sophistication of new Satellite Asset Tracking (SAT) than standalone GPS or GLONAS GNSS positioning systems. Thus, it is proposed Global Mobile Tracking (GMT) system as integrated configuration in one SAT device containing small GPS or GLONASS receivers and mini GEO and Non-GEO satellite transceivers with omnidirectional antennas.

On the other hand, besides on existing military satellite systems, new satellite communication systems are offering many networks for civilian application also useful for tactical and defense solutions. For instance, Inmarsat, Intelsat and other existing satellite systems and networks provide sophisticated communication, navigation and other transponders, offering both CNS and DVB-RCS interactive networks for civilian and military applications.

### DEVELOPMENT OF SATELLITE ASSET TRACKING (SAT) EQUIPMENT AND NETWORKS

The scenario of military SAT is system employing the GNSS subsystem of US GPS and Russian GLONASS to provide free of charge position data to different military or civilian assets. This PTV data can receive ships,

#### Key words

CNS, GEO, MEO, LEO,  
HEO, DVB-RCS, GNSS,  
GPS, GLONASS, VDVoiP,  
SCS, SNS, SSS

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\*Corresponding Author  
Email: ilcev@dut.ac.za

land vehicles and aircrafts via onboard GPS/GLONASS Rx integrated with satellite transceiver. Then the Satellite transceiver (Rx/Tx) is providing frequently transmissions of PTV/ID data via GEO or Non-GEO spacecraft through Ground Erath Station (GES) and Internet to the Control and Operations Centres.

Because of many incidents in past time, without successful search and tracing of ships or aircraft disappeared in some disasters caused by collision or grounding, were proposed new tracking and detecting solutions via GMT system. For instance, if GMT transponder was fixed in Air France or Malaysian aircraft crashed in 2009 and 2014, respectively, Search and Rescue (SAR) forces should find the wreck in 1-2 days and in area of maximum 100-200 Nm. The GMT system will provide solutions for the global identification and tracking of mobiles and personnel [1, 2, 3].

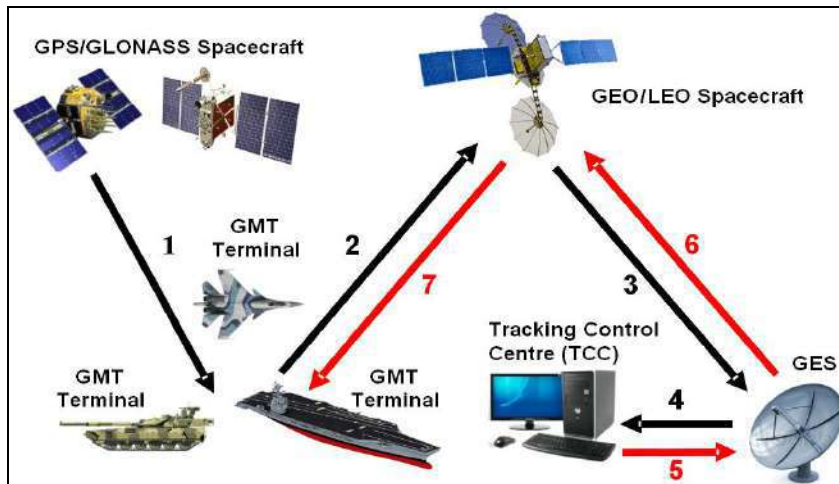


Fig. 1: Configuration of GMT via GNSS and Spacecraft – Courtesy of Manual: by Ilcev [2]

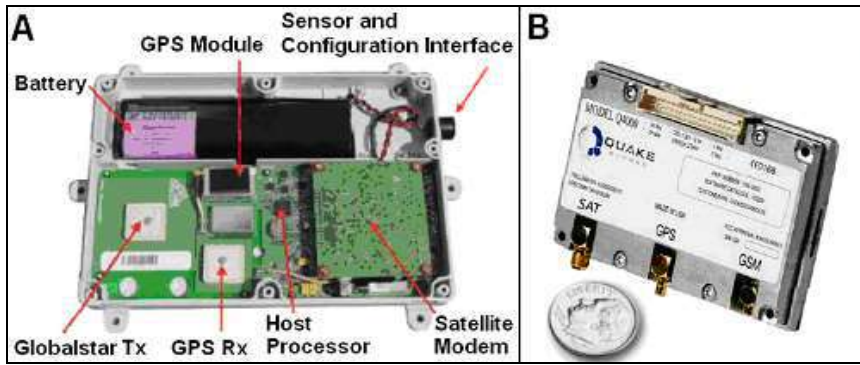
The GMT equipment receives GNSS signals from GPS/GLONASS spacecraft (1) and sends PTV tracking messages of position (2) via GEO satellite to GES (3) of Satellite Communication and Application Service Providers (Internet) to the TCC processor (4), shown in [Fig. 1]. All lines highlighted in red are indicating GMT receiving process, namely, the receiver in GMT terminal is receiving PVT data from TCC useful for collision avoidance and showing it on receiver display. Here will be introduced only two types of GMT that can be used for tracking of military mobile assets and personnel.

**2. Axonn 4000 Mini Tracker** – The Axonn SAT terminal is proposed as possible solution for GMT applications using Globalstar Big Low Earth Orbit (LEO) global satellite network, which diagram with electronic components is presented in [Fig. 2 (A)]. This equipment contains low power GPS engine, sensor and configuration interface, satellite modem, host processor, GPS receiver (Rx), Globalstar satellite transmitter (Tx), which is using Globalstar network powered by hybrid lithium thionyl chloride batteries. This SAT unit provides simplex (one-way) satellite transmission of PTV data, but it has not possibility to receive back PTV data from TCC of other mobiles for collision avoidance or any other information to onboard operator. For that reason can be used duplex (two-way) SAT via GEO Inmarsat or Big LEO Iridium satellite networks.

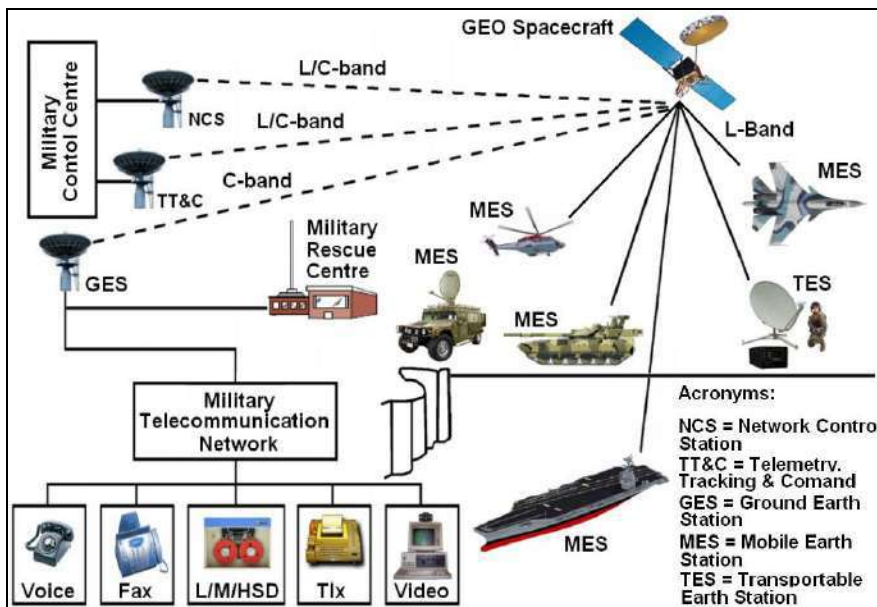
**2. Quake 4000 Mini Tracker** – The Q4000 tracker is a Short Burst Data (SBD) satellite GPS receiver and satellite transceiver designed by the US company Quake for use as a basic unit via different satellite constellations, illustrated in [ Fig.2 (B)]. Though the Q4000 is small enough to fit in the hand, but on other hand it is a rugged industrial grade modem operational over multiple satellite constellations, such as Inmarsat, Iridium, Globalstar and Orbcomm, and some models can be integrated with GSM terrestrial networks all-in-one remote asset tracking solution. This very tiny, 99.3x64x15.9 mm and 170 grams, two-way transceiver is perfect for use for all mobiles and personal, including aircraft and for fixed remote asset tracking and M2M monitoring solutions.

Except dedicated military systems, Inmarsat and Iridium SAT transponders are the best solutions for GMT of military assets and personnel, because are providing full global coverage and the following service:

1. The SAT terminals can be installed in each mobile using onboard power supply or in emergency may use own batteries, and can be also employed for tracking of military personnel.



**Fig. 2:** GPS/Satellite Trackers – Courtesy of Brochure: by Globalstar/Iridium [3]



**Fig. 3:** Military Satellite Communication Network – Courtesy of Manual: by Ilcev [4]

2. The SAT unit can be pre-programmed for different requirements and to send GPS location and other data on pre-defined intervals. Messages are transmitted via the Inmarsat or Iridium duplex satellite networks through a message routing infrastructure and then sent to host (TCC) or can be integrated with a hosted mapping application.

It is important to state that Globalstar is also providing duplex SAT satellite transmissions. The fourth mobile operator for SAT solutions is Little LEO Orbcomm, which network is providing both simplex and duplex service [2, 3, 4, 5].

### SATELLITE COMMUNICATION SYSTEM (SCS)

Most current communications between mobiles and traffic controllers are conducted via radio VHF, UHF and HF RF-bands, which in some busy portions of the world is reaching its limit. Thus, the RF-bands are congested and additional frequencies are not available.

Thus, to improve the communication and traffic control facilities of all mobiles more than 30 years ago was implemented civilian Mobile Satellite Communication (MSC) system, which takes less time and can handle more information than radio system alone. Before that, the World's first military maritime MSC system was

unveiled in 1976 by the US Comsat General with only three satellites and networks in the Atlantic, Pacific and Indian oceans. In [Fig. 3] is illustrated modern military mobile satellite communication network for navy, ground and air forces using L/C-band. However, military satellite communications can use UHF, S, X, Ka and Ka-band between Mobile earth Stations (MES) and Military Control Centre. The MSC systems are not designed only to provide more cost effective, reliable, redundant and fastest communication links between mobiles and traffic controllers, but also to integrate GNSS data for implementing new service for enhanced navigation and surveillance solutions.

The convergence of MSC and Internet technique has opened many opportunities to deliver new multimedia service over hybrid satellite systems to MES terminals. With the need for increased bandwidth capability, the deployed numbers and sophistication facilities of GEO and Non-GEO communication satellites are every year increasing dramatically.

The size of the Earth shape requires multiple satellites to be placed in orbit in a constellation to cover uncovered areas of interest typically need a minimum of 3 to 4 satellites to provide adequate communications coverage. Secondly, for existing users, upgrading satellites is not feasible, which means new capabilities are required and new satellites means new launches. Thirdly, more developed countries are recognizing the huge advantages of Military Satellite Communication (MILSATCOM) capabilities and are looking to implement or expand their networks.

The commercial and military SCS networks are very important for the following reasons:

1. To provide communication links between mobiles and ground infrastructures and between mobiles alone;
2. To transfer augmented and not-augmented navigation PVT data from mobiles to traffic control centres via GEO satellite communication transponder; and
2. To transfer augmented surveillance PVT data from traffic control centres to all mobiles via GEO satellite GNSS transponder, which will be used for enhanced navigation data and collision avoidance.

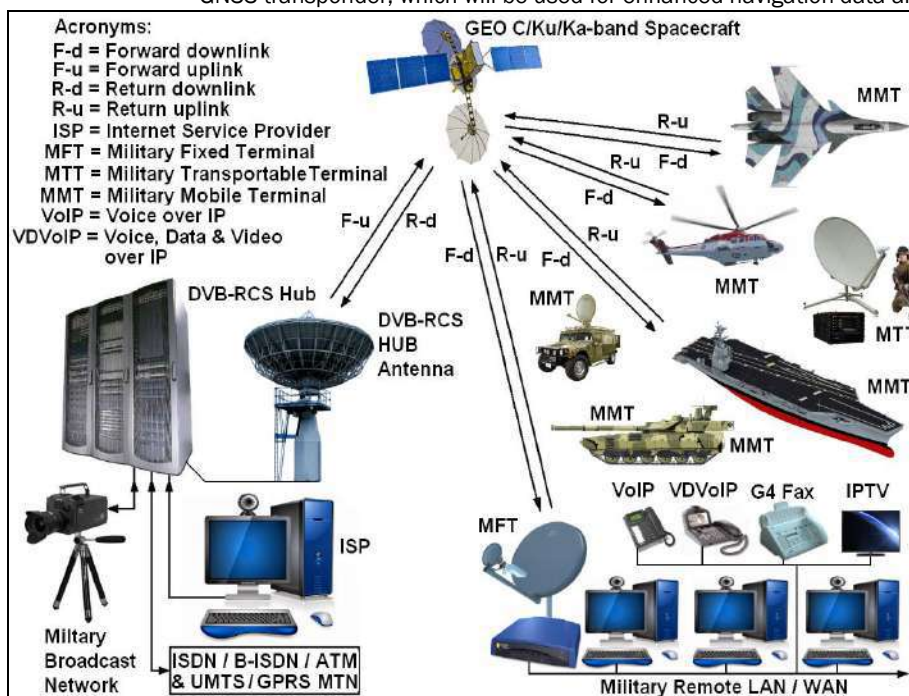


Fig. 4: Military DVB-RCS Communication Network – Courtesy of Manual: by Ilcev. [4]

New mobile DVB-RCS system illustrated in [Fig.4] is derived from current fixed DVB-RCS sometimes in 2000/01. The DVB-RCS mobile network includes a HUB as a GES (Gateway) with C, Ku or Ka-band antenna to interface the Terrestrial Telecommunication Network (TTN) or DVB-T cell via corresponding satellite connections at C, Ku or Ka-band GEO to the MES and TES terminals or Remotes (DVB-S) cells for the following services: Navy, Ground Vehicles and Aircraft. This new infrastructure is the best solution for establishment a network for connection of all military communications at sea, on the ground and in the air.

New mobile DVB-RCS networks are very suitable for mobile-to-ground and ground-to-mobile solutions. Both systems are providing sophisticated Voice, Data and Video over IP (VDVoIP) for corporate, private, military, traffic control and management, meteorological and navigation information, training and medical service, technical and maintenance data, Search and Rescue (SAR), Satellite Augmentation Data (SAD) of GNSS

signals for surveillance and Inter Mobile Links (IML). The problem of current satellite fixed and mobile operators is that they are providing service via GEO satellite constellations and in this case are not able to cover both polar areas, such as Inmarsat, Eutelsat and Intelsat. To realize real global coverage will be necessary to implement hybrid GEO and LEO, MEO or other satellite constellations or to use existing LEO satellite constellations of Globalstar, Iridium and Orbcomm networks [2, 4, 6, 7].

### SATELLITE NAVIGATION SYSTEM (SNS)

As stated before, the US has its own Navstar GPS and Russians have GLONASS as parts of GNSS1 system. Europeans will eventually have Galileo and China is implementing its Beidou system, both as part of new GNSS2 system. Thus, a future development in US GPS capability is the United States Air Force (USAF) GPS-2F constellation of 12 satellites that will provide around-the-clock, ultra precise navigation and timing services for military and civilian users.

New generation of GPS satellite provides better accuracy through advanced atomic clocks, a more jam-resistant military signal and a longer design life than earlier satellites. The GPS 2F will also increase precision navigation and timing to combat forces, increase the signal power, precision and capacity of the system and form the core of the GPS constellation for years to come.

The GPS and GLONASS space segment consists of 24 GNSS1 spacecraft each including ground segment, which contains Ground Control Station (GCS) and Users Segment, shown in [Fig.5]. The GNSS1 network is providing service for ships, land vehicles and aircraft, which are receiving PVT signals by onboard installed mobile GPS or GLONASS receivers. The GNSS1 systems and accuracy are upgraded by VHF or Satellite augmentation of GPS or GLONASS solutions. In such a way, there is Differential GPS (DGPS) developed by the US Coast Guard, which modern nomination is Local VHF Augmentation System (LVAS).

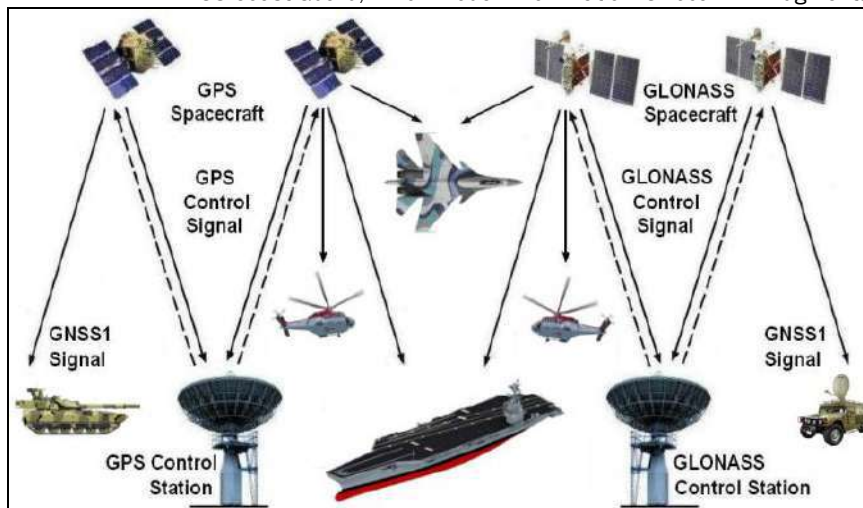


Fig. 5: Military GNSS Network – Courtesy of Manual: by Ilcev [2]

On the other hand, there is modern Regional Satellite Augmentation System (RSAS) or Satellite-Based Augmentation System (SBAS), WAAS developed by the USA, EGNOS by Europe, Chinese SNAS, Russian SCDN and Indian GAGAN. The new project African Satellite Augmentation System (ASAS) is proposed by Research Group in Space Science at Durban University of Technology (DUT) [2, 4, 7, 8].

### SATELLITE SURVEILLANCE SYSTEM (SSS)

The new SSS network will integrate SCS and SNS solutions with Wide Area Multilateration (WAM). The traditional surveillance radar with Automatic Dependent Surveillance (ADS) facilities can be also included in this integration or can be even used as back up. The SSS solutions are set up for the traffic control systems to know where the mobile is and where it is heading. The current surveillance is achieved through the use of long-range and terminal radars, which sometimes cannot work properly caused by very bad weather condition or other natural influence, like dust coming from volcanoes and so on.

The SSS system for satellite SADS-B is working in the way that all mobiles can derive their GNSS data from not-augmented or augmented GNSS receiver and send PVT surveillance data via satellite GEO GNSS satellite



transponder to the traffic control system for computer processing and displaying of surveillance information to the ground controllers on the like radar screen, which diagram is shown in [Fig. 6].

Many research centres worried are working with the aeronautical agencies, institutions and other stakeholders on design of more sophisticated Satellite Automatic Dependent Surveillance - Broadcast (SADS-B) capability that periodically broadcasts an aircraft's position and supporting information, heading, altitude including aircraft identification (ID or name) and short-term intent, more accurately and reliable than the current radar capabilities.

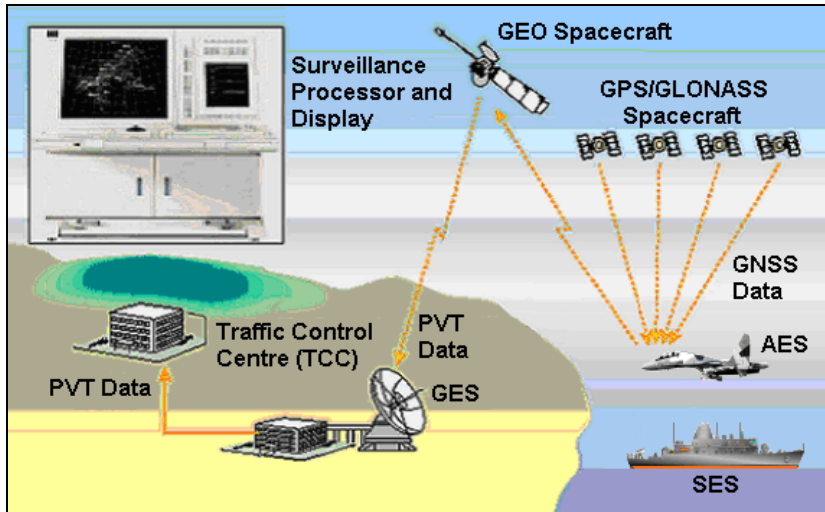


Fig. 6: Military Satellite Surveillance Network – Courtesy of Manual: by Ilcev .[2]

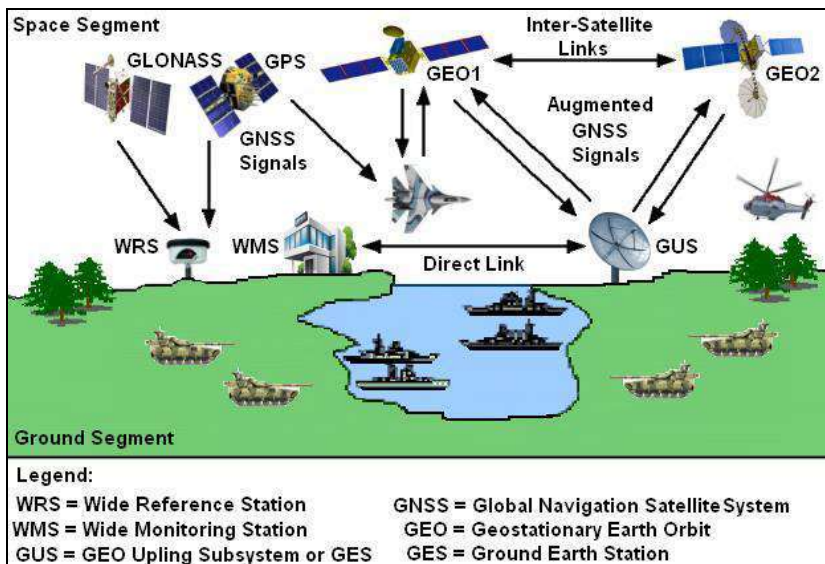


Fig. 7: Military Geospatial Augmentation System – Courtesy of Manual: by Ilcev [4]

In this instance, SADS-B system can be used to increase a pilot's onboard situational awareness, particularly important in not familiar places like where aviation is vital with minimum ground infrastructure, because of the extreme harsh conditions and weather changes quickly and in unpredictable fashions. In the similar way satellite ADS is going to be implemented for maritime and land applications and for all military applications as well.

The RSAS network will be the core of the future development of military GNSS augmentation system for navy, ground and air forces via multipurpose GEO spacecraft for both mobiles to support the TCC facilities and meteorological mission for weather observations, which Space and Ground Segments are presented in [Fig. 7]. The Military Geospatial Augmentation System (MGAS) is working in the same way as RSAS. Namely, WRS and mobiles are getting GNSS signals, while WRS is determining difference of the GNSS signal and WMS provides its augmentation and sending via GUS to mobiles at GNSS frequency bands. The main part of MGAS is that TCC is receiving GNSS augmentation positions from all mobiles, processing positions and show onto like radar display. Then TCC is sending via satellite to certain aircraft position data of all aircraft in its vicinity for collision avoidance and awareness [2, 3, 8, 9].

## CONCLUSION

The development of modern civilian and military CNS depends on the design, deployment and improvement of contemporary satellite systems, networks and ground infrastructures. While early satellite communications systems had a life span of days or weeks, today's systems have design lives extending to 20 years and beyond, with a typical mean mission duration of 15 years. Thus, this is necessary to justify system effort and cost of development and operations. Another change over time is that satellite communication and navigation terminals for fixed and mobile applications have become smaller and more numerous. These terminals have evolved from a few large fixed terminals to thousands of small mobile terminals. On the other hand, satellites have also become bigger, from early 50-kilograms satellites to modern 10-ton structures with solar panels spanning several tenths of meters. Finally, satellites have become greatly capable, having ranged over the years from simple state machines to computers with millions of lines of code.

### CONFLICT OF INTEREST

There is no conflict of interest.

### ACKNOWLEDGEMENTS

None

### FINANCIAL DISCLOSURE

None

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