

ISSN: 2454-1311



# International Journal of Advanced Engineering Management and Science

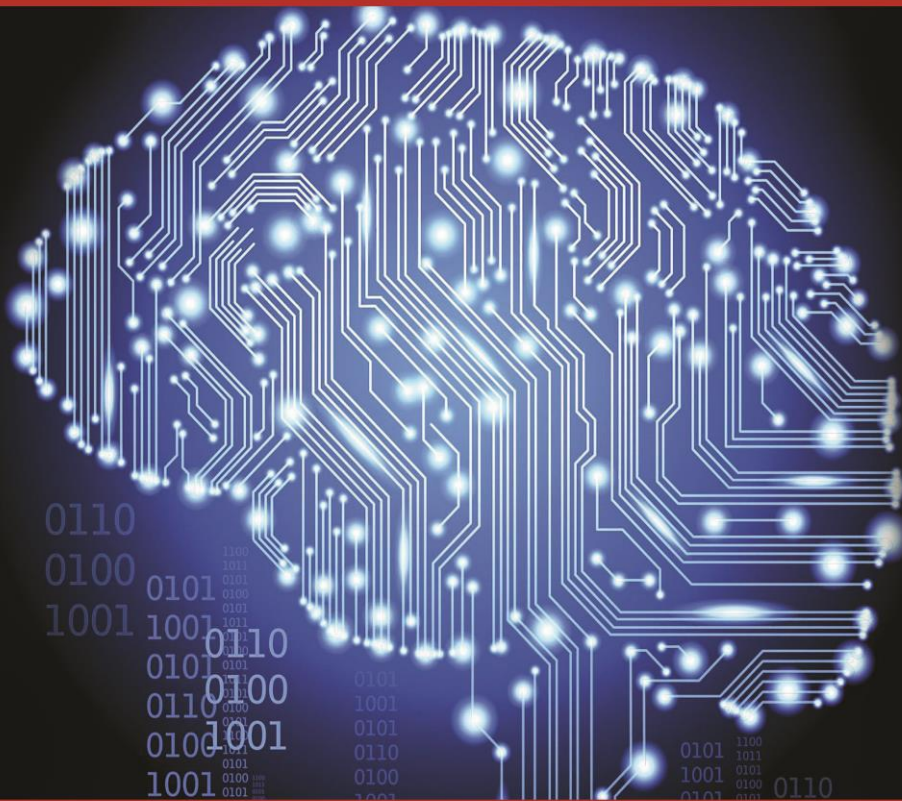
(IJAEMS)

An Open Access Peer Reviewed International Journal

Vol. -4

Issue -5

May, 2018



Journal DOI: 10.24001/ijaems

Issue DOI: 10.24001/ijaems.4.5



<http://www.ijaems.com/> | [editor@ijaems.com](mailto:editor@ijaems.com)

## Editorial Board

**Dr. Zafer Omer Ozdemir**

*Energy Systems Engineering Kirklareli, Kirklareli University, Turkey*

**Dr. H.Saremi**

*Vice- chancellor For Administrative & Finance Affairs, Islamic Azad university of Iran, Quchan branch, Quchan-Iran*

**Dr. Ahmed Kadhim Hussein**

*Department of Mechanical Engineering, College of Engineering, University of Babylon, Republic of Iraq*

**Mohammad Reza Kabaranzad Ghadim**

*Associated Prof., Department of Management, Industrial Management, Central Tehran Branch, Islamic Azad University, Tehran, Iran*

**Prof. Ramel D. Tomaquin**

*Prof. 6 in the College of Business and Management, Surigao del Sur State University (SDSSU), Tandag City, Surigao Del Sur, Philippines*

**Dr. Ram Karan Singh**

*BE.(Civil Engineering), M.Tech.(Hydraulics Engineering), PhD(Hydraulics & Water Resources Engineering), BITS- Pilani, Professor, Department of Civil Engineering, King Khalid University, Saudi Arabia.*

**Dr. Asheesh Kumar Shah**

*IIM Calcutta, Wharton School of Business, DAVV INDORE, SGSITS, Indore  
Country Head at CrafsOL Technology Pvt.Ltd, Country Coordinator at French Embassy, Project Coordinator at IIT Delhi, INDIA*

**Dr. Uma Choudhary**

*Specialization in Software Engineering Associate Professor, Department of Computer Science Mody University, Lakshmangarh, India*

**Dr. Ebrahim Nohani**

*Ph.D.(hydraulic Structures), Department of hydraulic Structures, Islamic Azad University, Dezful, IRAN.*

**Dr.Dinh Tran Ngoc Huy**

*Specialization Banking and Finance, Professor, Department Banking and Finance, Viet Nam*

**Dr. Shuai Li**

*Computer Science and Engineering, University of Cambridge, England, Great Britain*

**Dr. Ahmadad Nabih ZakiRashed**

*Specialization Optical Communication System, Professor, Department of Electronic Engineering, Menoufia University*

***Dr.Alok Kumar Bharadwaj***

*BE(AMU), ME(IIT, Roorkee), Ph.D (AMU),Professor, Department of Electrical Engineering, INDIA*

***Dr. M. Kannan***

*Specialization in Software Engineering and Data mining, Ph.D, Professor, Computer Science,SCSVMV University, Kanchipuram, India*

***Dr.Sambit Kumar Mishra***

*Specialization Database Management Systems, BE, ME, Ph.D,Professor, Computer Science Engineering Gandhi Institute for Education and Technology, Baniatangi, Khordha, India*

***Dr. M. Venkata Ramana***

*Specialization in Nano Crystal Technology, Ph.D,Professor, Physics,Andhara Pradesh, INDIA*

***Dr.Swapnesh Taterh***

*Ph.d with Specialization in Information System Security, Associate Professor, Department of Computer Science Engineering Amity University, INDIA*

***Dr. Rabindra Kayastha***

*Associate Professor, Department of Natural Sciences, School of Science, Kathmandu University, Nepal*

***Amir Azizi***

*Assistant Professor, Department of Industrial Engineering, Science and Research Branch-Islamic Azad University, Tehran, Iran*

***Dr. A. Heidari***

*Faculty of Chemistry, California South University (CSU), Irvine, California, USA*

***DR. C. M. Velu***

*Prof.& HOD, CSE, Datta Kala Group of Institutions, Pune, India*

***Dr. Sameh El-Sayed Mohamed Yehia***

*Assistant Professor, Civil Engineering(Structural), Higher Institute of Engineering -El-Shorouk Academy, Cairo, Egypt*

***Dr. Hou, Cheng-I***

*Specialization in Software Engineering, Artificial Intelligence, Wisdom Tourism, Leisure Agriculture and Farm Planning, Associate Professor, Department of Tourism and MICE, Chung Hua University, Hsinchu Taiwan*

***Branga Adrian Nicolae***

*Associate Professor, Teaching and research work in Numerical Analysis, Approximation Theory and Splines Functions, Lucian Blaga University of Sibiu, Romania*

***Dr. Amit Rathi***

*Department of ECE, SEEC, Manipal University Jaipur, Rajasthan, India*

***Dr. Elsanosy M. Elamin***

*Dept. of Electrical Engineering, Faculty of Engineering. University of Kordofan, P.O. Box: 160, Elobeid, Sudan*

# FOREWORD

I am pleased to put into the hands of readers Volume-4; Issue-5: May, 2018 of “**International Journal of Advanced Engineering, Management and Science (IJAEMS)** (ISSN: 2354-1311)”, an international journal which publishes peer reviewed quality research papers on a wide variety of topics related to Science, Technology, Management and Humanities. Looking to the keen interest shown by the authors and readers, the editorial board has decided to release print issue also, but this decision the journal issue will be available in various library also in print and online version. This will motivate authors for quick publication of their research papers. Even with these changes our objective remains the same, that is, to encourage young researchers and academicians to think innovatively and share their research findings with others for the betterment of mankind. This journal has DOI (Digital Object Identifier) also, this will improve citation of research papers.

I thank all the authors of the research papers for contributing their scholarly articles. Despite many challenges, the entire editorial board has worked tirelessly and helped me to bring out this issue of the journal well in time. They all deserve my heartfelt thanks.

Finally, I hope the readers will make good use of this valuable research material and continue to contribute their research finding for publication in this journal. Constructive comments and suggestions from our readers are welcome for further improvement of the quality and usefulness of the journal.

With warm regards.

**Dr. Uma Choudhary**

Editor-in-Chief

Date: June, 2018

## Vol-4, Issue-5, June, 2018

Sr No.	Title
1	<p><a href="#"><u>The Application of Bruner's Learning Theory on Teaching Geometric at Smp Negeri 2 Sipahutar in Academic Year 2017/2018</u></a>            Author: Taruly Tampubolon   DOI: <a href="https://doi.org/10.22161/ijaems.4.5.1">10.22161/ijaems.4.5.1</a>            Page No: 351-356</p>
2	<p><a href="#"><u>Improve the extraction efficiency of a tandem sugarcane mil</u></a>            Author: Verónica Flores Sánchez, Laura Cocotl Xocua, Marco Tulio Cerón López   DOI: <a href="https://doi.org/10.22161/ijaems.4.5.2">10.22161/ijaems.4.5.2</a>            Page No: 357-359</p>
3	<p><a href="#"><u>Application of ICT and Electronic Technology in Election Management: Challenges in Rural Areas in South-Eastern Nigeria</u></a>            Author: Njoku O. Donatus, Amaefule I. A, Nwandu C. Ikenna, Jibiri Ebere Janefrances   DOI: <a href="https://doi.org/10.22161/ijaems.4.5.3">10.22161/ijaems.4.5.3</a>            Page No: 360-365</p>
4	<p><a href="#"><u>Buckling behavior of straight slot tubes under oblique loading – A comparative study</u></a>            Author: Belal Ahamad, Anand Singh, Masihullah, Afaq Umer, Mohd. Reyaz Ur Rahim   DOI: <a href="https://doi.org/10.22161/ijaems.4.5.4">10.22161/ijaems.4.5.4</a>            Page No: 366-368</p>
5	<p><a href="#"><u>Knowledge and Attitude of Dental Students and Staffs towards Basic life Support(BLS)</u></a>            Author: Dr Abdul Saheer P, Shabna V Basheer, Shabna M, Shahanas Hakkim, Sneha Sanjeev, Sanisha Sadanandan, Dr Shanila Abdul Majid   DOI: <a href="https://doi.org/10.22161/ijaems.4.5.5">10.22161/ijaems.4.5.5</a>            Page No: 369-374</p>
6	<p><a href="#"><u>Integration of TTF, UTAUT, and ITM for mobile Banking Adoption</u></a>            Author: Sayyed Khawar Abbas, Hafiz Ali Hassan, Jawad Asif, Bilal Ahmed, Fahad Hassan, Syed Salman Haider   DOI: <a href="https://doi.org/10.22161/ijaems.4.5.6">10.22161/ijaems.4.5.6</a>            Page No: 375-379</p>
7	<p><a href="#"><u>Senti-Lexicon and Analysis for Restaurant Reviews of Myanmar Text</u></a>            Author: Yu Mon Aye, Sint Sint Aung   DOI: <a href="https://doi.org/10.22161/ijaems.4.5.7">10.22161/ijaems.4.5.7</a>            Page No: 380-385</p>
8	<p><a href="#"><u>Applying Soft Computing Techniques in Information Retrieval</u></a>            Author: Namrata Nagpal   DOI: <a href="https://doi.org/10.22161/ijaems.4.5.8">10.22161/ijaems.4.5.8</a>            Page No: 386-388</p>

9	<u><a href="#">The Effect of Service Quality on Loyalty using Satisfaction as an Intervening Variable (Study on Entrepreneurs in Bekasi Bonded Zone)</a></u> Author: Jumawan  DOI: <a href="#">10.22161/ijaems.4.5.9</a>	Page No: 389-394
10	<u><a href="#">Security Issues &amp; Threats in IoT Infrastructure</a></u> Author: Archana Sahai  DOI: <a href="#">10.22161/ijaems.4.5.10</a>	Page No: 395-399
11	<u><a href="#">Practicality and Effectiveness of Student' Worksheets Based on Ethno science to Improve Conceptual Understanding in Rigid Body</a></u> Author: Agnes Amila W, Abdurrahman, Agus Suyatna, I Wayan Distrik, Kartini Herlina  DOI: <a href="#">10.22161/ijaems.4.5.11</a>	Page No: 400-407
12	<u><a href="#">Transient Stability Assessment of Hybrid Distributed Generation and its Impact on Critical Clearing Time and Oscillation Duration Considering its Complementary Nature</a></u> Author: P. K Olulope  DOI: <a href="#">10.22161/ijaems.4.5.12</a>	Page No: 408-423
13	<u><a href="#">Comparing the Dynamic Impact of Hybrid Distributed Generation with Single Source DG</a></u> Author: P. K Olulope  DOI: <a href="#">10.22161/ijaems.4.5.13</a>	Page No: 424-435

# The Application of Bruner's Learning Theory on Teaching Geometric at Smp Negeri 2 Sipahutar in Academic Year 2017/2018

Taruly Tampubolon

Kopertis Lecturer of Region I Medan, at FKIP - UNITA

**Abstract**— This study aimed to find out the activity and learning outcomes of the eight grade mathematics students at SMP N.2 Sipahutar in academic year 2017/2018 on the application of Bruner's theory on the subject of parallel lines. The subject of this research was the eight grade students of SMP N.2 Sipahutar in academic year 2017/2018, while the object of research was the result of learning and students' activity while learning with the application of Bruner's theory on the subject of parallel line. This research was a descriptive research, and the instrument of data collection used was the test in the form of description and students' activity observation sheet. Based on the result of data analysis, the results of the research are: (1) The average score of learning result obtained by students is 24.64 with the average grade 77.02 or with the percentage of mastery level of 77.02%. It shows that the students' level of mastery is still classified as moderate. (2) Student's learning completeness: a) Persuasion ability, many students who completed the study were 27 students, while the unfinished study was 4 students, b) Classical absorption, from 31 students there are 27 students or 93.55% completed the study, while the unfinished study is 4 students from 31 students or 6.45%. It shows that classically, the students' learning completeness is achieved; (3) Achievement of specific learning objectives was over 65.0%. (4) Students' activity, activity level on first learning is equal to 75,71 and the mean of students' activity reliability level is equal to 82,62%; students' activity level on the second learning is equal to 88,82 and the mean of students' activity reliability level is equal to 84,61%, it concluded that there is increase of students' activity during learning.

**Keywords**— Bruner's Learning Theory, Geometric.

## I. INTRODUCTION

The issue of educational quality came to the fore of a national issue. The quality of education is questioned as the consequence of the students' unsatisfactory learning outcomes. Improving the quality of education can only be achieved through improving the quality of education processes that leads to the improvements in the quality of educator products. According to R. Soedjadi, the education

process can run well when there is a harmonious interaction between the elements, namely: (1) education participants (2) educators (3) means (4) curriculum in the broad sense, and evaluation of learning outcomes (Soejadi, 1991: 5). To know the quality of education, one indicator can be the result of student learning. Therefore, one way to improve the quality of education is to improve the achievement of students' learning outcomes.

The low achievement of students can occur, because the elements in teaching and learning process have not been handled optimally and proportionally.

According to R Soejadi (1989), no matter how precise and well mathematics teaching material set, not guarantee the achievement of the desired mathematics education goals. One of the important factors to achieve the goal of education is the learning process that is implemented. The process of learning to teach math needs to emphasize the optimal involvement of the learners consciously. In order for the teaching-learning process that students can engage optimally, the teacher's role is clearly a key factor. According to Ron Brandt in Mariani (1994) almost all reforms in education such as curriculum renewal and the adoption of new teaching methods ultimately depend on teachers. One effort that can help teachers to improve student engagement in the teaching-learning process is that teachers must be consciously able to apply relevant learning theories. Deliberately geometry is selected, because many facts show that students have difficulty in the field of geometry. Difficulties in the field of geometry have been experienced by students since the elementary school. This is supported by the findings of R Soejadi (1991: 4), namely: In the last few years, both in mass media and in certain meetings, informed and even lead to concerns about elementary school math subjects, or even the level of junior and high school. Unit of geometry appears to be a unit of mathematics in elementary school that is classified as a difficult unit. The statement which is in line with the statement once made by Del Grande (1983) in Ronald (1995: 4) states: "Educators of the work ask this question: why is it that so many students who master the most subjects, get nowhere in their study of geometry? From the description above indicates the vulnerability of



mastery of teaching materials geometry which leads to the low mastery of students of facts and concepts of geometry. Many factors can be the cause of the low mastery of facts and geometric concepts. To see the students' intellectual involved in learning geometry, the teachers need to track students' intellectual development. Therefore, the teacher is also required to be able to apply the theory of learning in the process of teaching and learning. Based on the above description, the authors conducted a research in a junior high school entitled: "The Application of Bruner's Learning Theory on teaching geometry in SMP N.2 Sipahutar in academic year 2017/2018"

### The Research Problem

In accordance with the back ground of the study, the formulation of the problem in this study is: "How are the students' learning outcomes of the eight grade students at SMP N.2 Sipahutar in academic year 2017/2018 with the application of Bruner's learning theory on the subject of parallel lines?"

### The Research Objective

This study aims to determine: the students' learning outcomes of the eight grade students at SMP N.2 Sipahutar in academic year 2017/2018 with the application of Bruner's learning theory on the subject of parallel lines.

## II. REVIEW OF LITERATURE

### Teaching Geometry in Junior High School

In teaching geometry, according to Soemadi (1994), there are known global methods and methods of unity. The global method is inductive and begins with the observation of the whole thing, followed by observation and recognition of its parts. The method of unanimity begins by introducing elements, then, the elements are compiled. In this method, the two and three dimensional spaces are separated and the concepts are axially deductive. To prove some theorems axioms, postulates and previous theorems are used. In teaching geometry of unity, there is a strict sequence to the understanding and its theorems. Based GBPP (Indonesian Curriculum) 1994 for junior mathematics subjects, it can be observed that there is a new approach, which introduced the deductive approach. It is said to be a new approach for junior high school students, because the previous curriculum of the 1984 curriculum, teaching geometry using an inductive approach. In the introduction to the mathematics text book 2a for the second grade of junior students, R Soejadi said: *"Satu hal baru dalam unit geometri kelas 2 SLTP ini terdapat pada bahasan garis sejajar. Unit ini disusun secara khusus. Ini disengaja agar para siswa, setelah tujuh tahun belajar matematika, dapat mengenal lebih baik bagaimana sebenarnya matematika itu disusun. Dalam unit ini dikenalkan beberapa kesepakatan yang mendasari susunan khusus geometri yang harus dipegang teguh dalam mempelajari matematika selanjutnya"* "One

new thing in this junior second class of geometry unit is the parallel line. This unit is specially structured. This is intentional for students, after seven years of math learning, to get to know better how mathematics is actually structured. This unit introduced several agreements underlying a special arrangement of geometry that must be adhered to in learning the next math" The deductive approach is specifically introduced to the topic of parallel lines. This topic was given in the 2nd grade students of SMP Catur Wulan 1. The sub-topics of the parallel lines according to the GBPP are:

- To know the meaning of parallel lines through the repetition of the congruent rectangular intercepts.
- To know the nature of parallel lines are:
  - o Through a point outside the line can be drawn exactly a line parallel to the line.
  - o If a line cuts one of two parallel lines, then it will also cut the second line.
  - o If a line parallel with two lines, then the two lines are also parallel to each other.
- To know the angles that occurs if two parallel lines are cut by a line, e.g., angle to the inside, inside opposite, outside opposite, unilaterally and unilaterally.
- To recognize the angle relationships on two parallel lines cut by a line, e.g., the same angle to the same extent, the opposite outer angle as large, the unilateral inner angle of 1800, and the unilateral outer angle of 1800.

### Bruner's Learning Theory and Its Application

Jerome Bruner is a developmental psychologist and cognitive psychologist from the United States. In his work, he combines psychological research and classroom practice. He conducted research to revive human interest in the "cognitive process" that is to receive, store and convey information ". Bruner has promoted a laboratory studies of the problem of "cognitive processes" that involve thinking and learning abilities. The main center of his work is the concept of development. Bruner did not develop systematic learning theories. What matters to him is how to choose, maintain and transform information actively, and this is what he thinks as the essence of learning. The Bruner approach to learning is based on two assumptions. The first assumption is that the acquisition of knowledge as an interactive process, meaning that students learn to interact with the environment actively and the changes that occur not only in the environment but also in itself. The second assumption is that students construct their knowledge by connecting incoming information with previously stored information. Bruner is only interested in the results of the interaction stages that are revealed in the minds of children. He argues: "If we are of benefit from contact with recurrent regulars in the environment, we must represent them in some manner. To dismiss this

problem as "mere memory" is to misunderstand it. For the most important thing about memory is not the storage of past experience, but rather the retrieval of what is relevant in some usable form. This depends so that it may be relevant and usable in them present when needed. The end product of a system of coding and processing is what we may speak of as a representation ". (Bruner in Rensick, 1964: 112) Bruner argues that learning involves three simultaneous processes. The three processes are: (1) obtaining new information (2) transforming information and (3) testing the relevance and determination of knowledge. According to Bruner, children develop through three stages: enactive, iconic and symbolic stages. The sequence of stages proposed by Bruner does not relate the stage of thinking to the age of the child. In the enactive stage, children learn by using / manipulating objects directly. In the iconic stage, children's activities develop and lead to things that are more abstract. At this stage there is a process of mental imagination about an object, but does not manipulate it directly. In the third stage symbolic, the child directly manipulate the symbol without any referent with the objects. In developing his work for classroom teaching Bruner argues, if enactive, iconic and symbolic develops, it is possible to teach new concepts. Nevertheless, Bruner in Resnick cautioned that: "and even though some students may be quite" ready "for a purely symbolic presentation, it seems that wise, nevertheless, to present at least the iconic modes as well to fall back on in their case symbolic manipulation failed "(Bruner, 1996: 114). Bruner's suggestion implies that the development of ideas in the subject matter must be balanced with the development of the intellect. Bruner formulates four theories about learning, namely construction, notation, contrast and variation and connectivity (Bell, 1978: 78).

**Construction:** This theory states that the best way for a student to start learning concepts and principles in mathematics is to construct that concept or principle. To construct a concept or principle is to simplify the concept or principle by considering the parts that make up the concept or principle. In relation, Bruner argues that "Any idea or problem or body of knowledge can be presented in a form that is simple enough so that any particular learner can understand it in a recognizable form." (Bruner, 1996: 113). According to Bruner in Bell (1978) the notion of a concept in the early stages of students learning the concept, is dependent on activities that use concrete objects. The implications of that theory in the teaching of mathematics are that new concepts are inappropriate when they are presented deductively. This is reasonable, if using indicator stages as proposed by Bruner, namely enactive, iconic and symbolic. Another implication is that students' activities to construct concepts or principles can be generated by rewriting the questions of understanding or illustration that form the concept or principle.

### Application 1

Topics	: Parallel lines
Sub topics	: Know the meaning of parallel lines
Class	: VIII
Prerequisites	: Students already know about tiling
Presentation model	: To explain the concept of parallel lines, the teacher can begin by showing some images containing parallel lines, as well as objects around the student. After that the students are also taken to the material that has been received, namely the problem of tiling. Finally, the teacher can explicitly explain when two straight lines are said to be parallel. To be more convinced that the student has indeed mastered the notion of alignment of two straight lines, the teacher should prepare some drawings of both parallel and non-parallel lines and the students are told to show which ones are aligned and which are not.

**Notation:** The Notation theory states that the initial construction is made simpler cognitively and better understood by the students if the construction is according to a notation that matches the intellectual development level of the student.

The implication of this theory on the teaching of mathematics is that in the use of notation both for concepts or principles adapted to the level of student development. A notation for a concept should at least point to one notion and not another. The use of notation that is not in accordance with the level of intellectual development of students obviously will disrupt the students understanding.

### Application 2

The alignment notation of two lines such as  $//$ , and the  $\perp$  angle notation must always be kept consistent, as well as the naming of points, line naming, right angle notation and so on.

### Contrast and variation

The theory of contradiction and variation suggests that the procedure of learning mathematical ideas running from concrete to abstract must be included in the contradictions and variations (Bell, 1978: 144). According to Herman Hudoyo a mathematical concept would be meaningful if the concept is compared with other concepts (Herman Hudoyo, 1995). This theory is in line with the opinion of Skemp, which states that the concept is the result of abstraction, therefore to form a concept requires a number of experiences that have similarities (Skemp, 1982: 32). Thus, when students learn mathematical concepts, the examples must vary so that students' understanding will be deeper. The application of this theory to the teaching of mathematics is that in teaching a concept must be given counter concept. In addition, examples and non examples

given to a concept or principle must vary. The results of Cohen's study (1980) of 54 students who received lessons through video tape showed that presenting examples rather than counter example resulted in better concept mastery than just providing examples. The results support the research by experts such as Markie and Treman, Shumaway and Tennyson, Steve and Bratwel who conclude that "not an example" is very effective in learning concepts (Cohen: 1980)

### Application 3

Teachers can show students a variety of geometry builds, and ask which lines are parallel and which are not and why so.

### Connectivity

The connectivity theory states that in math, every concept, structure and skill is connected with other concepts, structures and skills. Although the explanation of the concept or principle needs to be linked to the previous concept or principle, it does not need to be associated with previous concepts that are too far away. The application of this theory to the teaching of mathematics is that in the explanation of a new concept or principle, is by firstly given illustration of the previous concept or principle. Furthermore, the definition or proof of the concept or principle is given. The illustration of the concept or principle can be through both examples and non-examples.

### Application 4

Topics : Parallel lines  
Sub topics : Recognize the angles that occur if two parallel lines are cut off another line  
Class : VIII (Eight Grade)  
Prerequisites : Students already understand about the angles that are mutually parallels, angle, contrary and the characteristics of parallel lines.  
Presentation Model : Before the teacher explains the properties found if two straight lines are cut by another line, the teacher needs to bring back the students' memory of angles, angular relationships, opposite angles and so on. In broad outline, the model of instruction directed by Bruner in accordance with the principles of learning that it proposes should include: (1) optimal experience of

students to want and can learn (2) structuring knowledge for optimal understanding (3) details of the order of presentation of the material optimally by taking into account learning factors before, the level of student development, the nature of subject matter and individual differences and (4) the form and the provision of reinforcement (Ratna Wilis, 1988: 133).

## III. RESEARCH METHODS

### The Research Sites/location

This research was conducted in SMP Negeri 2 Sipahutar. The reason for the selection of this research location is that the same research has not been done, and the learning that has been done so far is still focused on the teacher.

### The Subject and Object Research

The Subjects of this study were students of class VIII SMP Negeri 2 Sipahutar in academic year 2013/2014, while the object in this study is the activity and learning outcomes on learning with the application of Bruner's theory of learning on the material of parallel lines

### The Types of Research

In accordance with the research objectives that have been mentioned in Chapter I, this research was a descriptive study that described the actual condition / result of learning.

### The Research Procedures

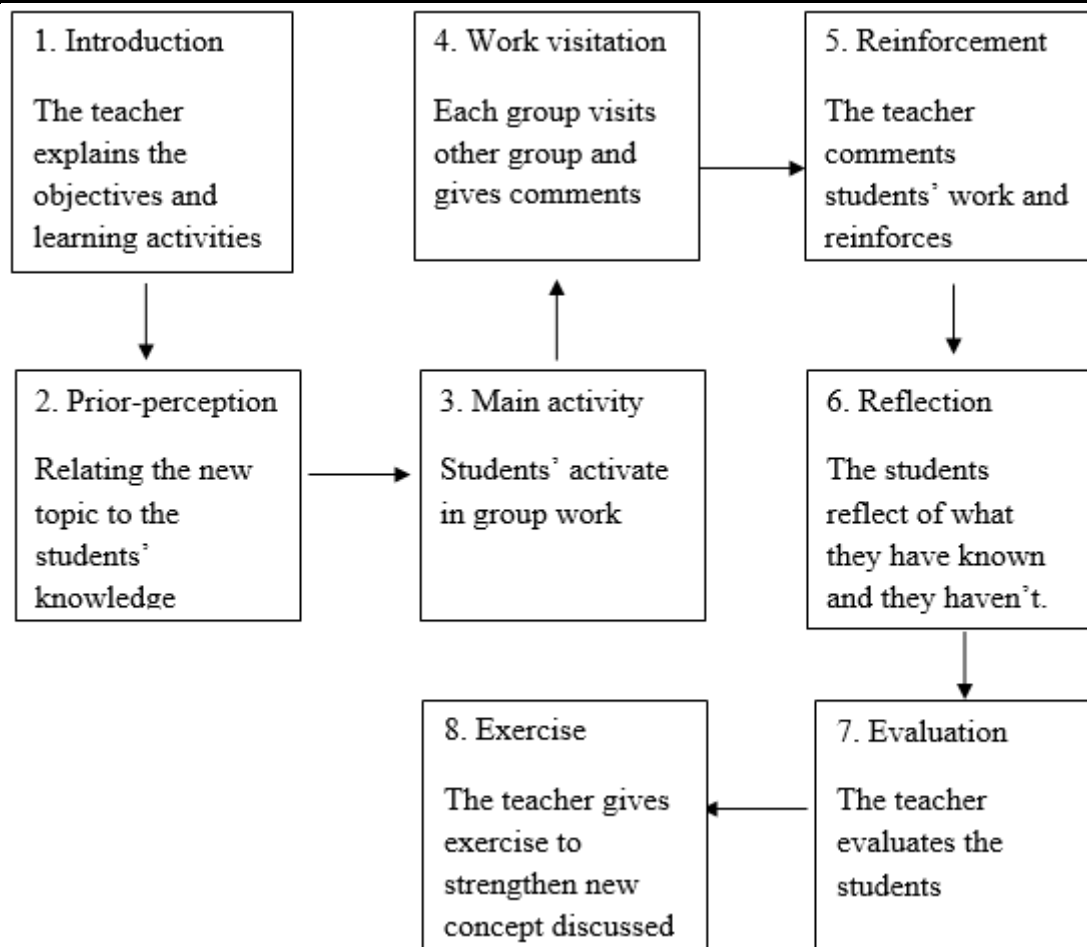
The steps taken in this research were as follows:

#### a. Preparation phase

At this stage the author analyzed the material of parallel lines in class VIII of SMP (Junior Students). Then make a lesson plan. In accordance with the material, make props as an example that was made by the students at the time of learning.

#### b. Implementation phase

- Before the learning was done, on the previous day, the writer told the students to bring scissors, cartons, ruler, plastic bags, printed paper/graph, and glue.
- Learning process. As the following diagram:



Source: Junior High School Mathematics Learning at LPTK, USAID PRIORITY

- At the next meeting, a test was conducted to determine the level of students' mastery of the material that has been studied.

#### IV. RESULTS AND DISCUSSION

Based on the calculation results and research analysis results of data obtained:

1. The average score of learning outcomes obtained by students is 24.64 with the average grade is 77.02 or with the percentage of mastery level of 77.02%. This shows that the level of students' mastery is still classified as classical.
2. Student learning completeness
  - a) Individual absorption  
The total number of students who completed the study is 27 students, while the unfinished study is 4 students.
  - b) Classical absorbency  
From the 31 students there are 27 students or 93.55% of the total subjects who have completed the study, while the unfinished study is 4 students from 31 students or 6.45% of the total subjects. This indicates that the

classical completeness of student learning has been achieved.

3. Achievement of specific learning objectives (TPK)  
The achievement of specific learning goals is all above 65.0%. Thus learning has reached the thoroughness of TPK.
4. Students' activity  
From observations made by two observers to the students' activity during learning, the result shows that the students play an active role during the learning, in which the activity level in the first learning is 75.71 and the average of student activity reliability level is 82.62%; student activity level on second learning is equal to 88,82 and the mean of student activity reliability level is equal to 84,61%. It concluded that there is increase of students' activity during learning.

#### V. CONCLUSIONS

Based on the discussion of data analysis, it's concluded that:

- a. Level of students' activity at the first learning is equal to 75,71 (active) with the mean of students' activity reliability level is equal to 82,62% (high),

and students' activity level on second learning is equal to 88,62 (active) with the mean of students' activity reliability level is equal to 84 , 61% (high).

- b. Learning with the application of Bruner's theory on the material of parallel lines in SMP Negeri 2 Sipahutar in academic year 2017/2018, the achievement has been completed with the following details:

Classical student mastery level of 77.02% is moderate.

1. Absorption of individual students obtained from 31 students, 29 students or 93.55% of the total subjects have completed learning, means have been completed and classically achieved.
2. Achievement of specific learning objectives is all thoroughly achieved

### REFERENCES

- [1] Bell, F.H. (1978). Using Learning and Instructions Theories in Teaching Mathematics. USA: Teaching and Learning Mathematics.
- [2] Cohen,et al. (1981). The effect of nonexamples in Geometrical concepts Acquisition. Investigation in Mathematics Education. Vol 14 No 4. USA.
- [3] Dahar, R.W. (1988). Teori – teori belajar. Jakarta: Dirjen Dikti Depdikbud.
- [4] Hudoyo, H. (1995). Catatan Kuliah. Surabaya: S2 PPS IKIP.
- [5] Rensick. (1996). The Psychology of Mathematics for Introduction. USA.
- [6] Ronald. (1995). Proposal Penelitian. Surabaya: PPS IKIP.
- [7] Skemp, R.R. (1982). The Psychology of Learning Mathematics. New York. USA: Penguin Books.
- [8] Soejono. (1983). Diagnosis Kesulitan Belajar dan Pengajaran Remedial Matematika. Jakarta: P2LPTK.



# Improve the extraction efficiency of a tandem sugarcane mil

Verónica Flores Sánchez<sup>1</sup>, Laura Cocotl Xocua<sup>2</sup>, Marco Tulio Cerón López<sup>3</sup>

<sup>1</sup>Department of IMI, Universidad Tecnológica del Centro de Veracruz, Veracruz, México  
Email: [calidad.utcv@gmail.com](mailto:calidad.utcv@gmail.com)

<sup>2</sup>Department of IMI, Universidad Tecnológica del Centro de Veracruz, Veracruz, México  
Email: [9652@utcv.edu.mx](mailto:9652@utcv.edu.mx)

<sup>3</sup>PhD Student in Strategic Planning and Management of Technology, México

**Abstract**— This project was implemented in Sugar Mill San José de Abajo S.A de C.V., in which there were problems due to sugar losses (Pol), this process is located in the department of mills (extraction). Through the investigation, important data were obtained on the losses of Pol in bagasse, which is very significant for the company. Through the literature we were able to document the adjustments, values, parameters, among other factors that influence good extraction, in order to reduce losses and generate improvements to the process for the benefit of all. The results of the 2016-2017 harvest were analyzed in order to seek improvements, which with hard work and effort were proposed and considered by the technical staff, and which could be used for the sugar industry.

**Keywords**— Pol, efficiently, sugar production.

## I. INTRODUCTION

In the sugar mill object of this study, it shows production losses in the extraction area and in the crystallization process. The capacity installed in the area of mills is up to 800,000 tons of cane per harvest, which lasts approximately six months.

It is important to clarify that the mill area is limited to extract the juice of the sugarcane, however the sugar also known as POL or Sucrose, must be extracted from the fibrous cells, this leads to devise strategies for the maximum extraction of POL.

In the 2016-2017 harvest season, 609,826,704 tonnes of cane with average percentage of 0.890% lost of POL in the bagasse. The above represents the grinding of 1,256,243 tons of sugar and a cost of \$ 12,000.00 per ton.

## OBJECTIVES

Increase the efficiency of a mill tandem by adjusting the operating parameters to the extraction area, according to the standard indicators.

## Specific objectives

To achieve the POL index in bagasse and adequate humidity, the following actions will be carried out:

- Adjust the dimensions of the clubs.
- Adjust hydraulic pressures appropriately.
- Improve the sanitization (disinfection) of the mills.
- Improve the training of workers.
- Correct the flow and temperature of the imbibition water.

The current situation of the company was investigated through surveys carried out with engineers and workers from different areas, and the results obtained by the company's laboratory were analyzed.

To determine the possible causes of the current POL losses, quality tools were used. Below is the diagram of the possible causes:

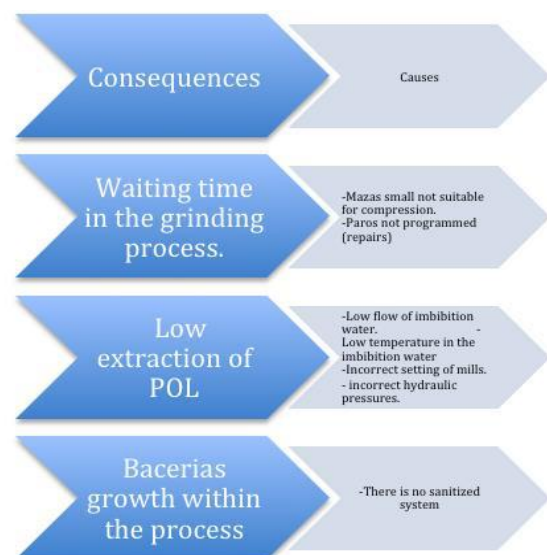


Fig. 1: Causes of lost POL

The above factors allow locating the inefficiency causes. With the aim of reducing the inefficiency of the productive processes, grinding is planned before the beginning of the harvest considering the following parameters:

- Reed to be milled in tons.
- Losses of Pol in bagasse (tolerable).
- Business days.

Studies carried out by Hugot in 1986, show that the water of imbibition must be double the percentage of fiber, this means that if the percentage of fiber cane is 13.659%, then 27.310% of water will be applied.

Currently, between 90 and 100 tons of steam are generated at a temperature of 260 ° C.

The hydraulic pressures and torque applied to the upper hub can range from 2100 to 2500 pounds per square inch.

The recommended dimensions for the club are:

- 35 ° angle
- Step of 1.5 "
- Diameter of 37 "
- Length 66 "

From a good preparation of the cane it is possible to extract between 60% to 75% of the sucrose in a first conventional mill, if the cane goes to a second mill is little juice that has been left in the bagasse therefore the recovery of sucrose will be much less.

## II. RESEARCH PROPOSAL

Figure 2 shows the quantity of POL planned in the 2016-2017 harvest.

Parameter	Planned	Real	Difference
<b>Tons of ground cane</b>	750,000.01	609,826.704	140,173.306
<b>POL</b>	0.684	0.890	0.206
<b>Tons of sugar</b>	84,030	63,987.250	20042.75

Fig. 2: Causes of lost POL

It can be seen in figure 2 that the request of POL planned against the real is 0.206, the foregoing indicates that even if it took advantage of the bagasse in the boilers.

Now, if these losses of Pol are transformed to economic losses, taking as a reference the Pol made sugar we will obtain the following.

*sugar lost*

$$= \frac{(\text{Tons of ground cane})(\text{Difference of POL loss})}{100}$$

Substituting the values in equation 1 we have:

$$\text{sugar lost} = \frac{(609\,826.704)(0.206)}{100} = 1256.243 \text{ ton}$$

To calculate the economic loss it is considered that the price of the ton of sugar in the market is 12,000 Mexican pesos, then 15074916.1 Mexican pesos are lost.

There is a method to extract more Pol, this process is called imbibition water; consists of mixing the imbibition

water with cane juice that remains after passing through the first mill.

The above dilutes the Pol contained in the bagasse and creates a material that can be compressed by the mill.

Hugot (2012) "the mills take the bagasse more easily than dry".

One ton of cane contains 13.659% fiber, using the method assumed by Hugot the following amount of water should be applied:

$$13.659\% \times 2 = 27.318\%$$

$$1000 \text{ kg}(0.27318) = 273.18 \text{ kg}$$

The milling capacity per hour of the sugar mill studied is 185,809 tons of cane per hour, then 50,759 tons of water per hour must be applied.

Another factor in the process of imbibition is the temperature of the water, Hugot (2012), "the experiences made with respect to the use of cold or hot water agree little, however, in certain factories can be checked a marked increase in the exhaustion of bagasse, when hot water is used. It seems that the temperature does not has no effect until it reaches 60 ° or 70 ° ", from this point on the efficiency of the imbibition is remarkably better with hot water.

The sanitizing of the mills is used for the elimination of bacteria that can harm the manufacture of sugar, the "tíbico" is the main bacteria to eliminate and prevent its reproduction, this bacterium feeds on the Pol that contains the cane.

Unfortunately the company does not have an organized sanitation system; irrigation pumps manually sanitize the mills at different times.

During the process of cane milling, it is important to avoid the production of reducing sugars.

Analysis of the results Through the implementation of the proposed solution, the following results are obtained:

Elimination of 96% of bacteria through steam sanitization, the remaining 4% will be eliminated by the application of a bactericide.

The rate of pollution in the tandem by reducers is 0.126, therefore the economic recovery will be:

$$(609826.704)(0.00504)/100 = 30.73 \text{ ton}$$

It will be possible to recover \$ 8, 851,800.00. The cost of the system is not yet negotiated, however some mills that count on this system comment that the cost of this does not exceed approximately 3.5 million pesos, this system will allow this recovery in a harvest season (6 months).

## III. CONCLUSION

As part of the strategies to maintain and improve the efficiency of the sugar mills, it is recommended to adjust the hubs and grease them according to the manufacturer's specifications. The previous things so that the maces support the hydraulic pressures that allow obtaining the

greater percentage of POL.

The proper temperature of the imbibition water is 75 ° to 90 °, another important point is the training of operative personnel in the imbibition system.

## REFERENCES

- [1] G. Eason, B. Noble, and I. N. Sneddon, "On certain integrals of Lipschitz-Hankel type involving products of Bessel functions," *Phil. Trans. Roy. Soc. London*, vol. A247, pp. 529–551, April 1955. (*references*)
- [2] Ausencio. (2015). Mercadotecnia. Córdoba: Trillas.
- [3] Betancourt, D. (12 De Julio De 2016). Ingenio Empresa. Recuperado El 24 De Julio De 2017, De Ingenio Empresa.
- [4] CENICAÑA. (23 de JULIO de 2015). CENICAÑA. Recuperado el 20 de JULIO de 2017, de CENICAÑA: [http://www.cenicana.org/pop\\_up/fabrica/diagrama\\_obtencion.php](http://www.cenicana.org/pop_up/fabrica/diagrama_obtencion.php)
- [5] Crawford, W. (1970). Cane extraction by milling. *Int. Sugar*.
- [6] Crossman, M. (1994). A Review Of Modify Shredder Systems.
- [7] Espejo, L. F. (2005). Mercadotecnia Tercera Edicion. International Thomson.
- [8] Franco, L. S. (2012). Eventos Kaizen. Incremente La Productividad De Su Empresa (Págs. 7-8). Guayaquil: Camara De Industrias De Guayaquil.
- [9] Gestion empresarial. (16 de marzo de 2014). Obtenido de Gestion empresarial: <https://renatamarciniak.wordpress.com/2014/03/16/como-elaborar-un-plan-estrategico/>
- [10] Hugot. (1985). Tecnología azucarera. Berlin: Bartens.
- [11] Hugot. (s.f.). manual para maestros azucareros.
- [12] Hugot, E. (1986). Handbook Of Cane Sugar Engineering. New York: Elsevier.
- [13] Kotler Philip, A. G. (2004). Marketing. Prentice Hall. merca2.0. (16 de febrero de 2014). merca2.0. Obtenido de merca2.0: <http://www.merca20.com/brevehistoria-de-la-publicidad>
- [14] Reid, M. (1994). A review of cane knifing. Durban: Sugar milling research institute.
- [15] Rein, P. (2012). Ingeniería de la Caña de Azúcar. Berlin: Bartens.
- [16] Rein, P. (s.f.). ingeniería de la caña de azucar.
- [17] Sánchez, J., & Chavarro, S. (2013). Reduciendo la reabsorción de jugo de molino mediante el uso de mazas con drenajes internos. Calí. Colombia: Fundiciones Universo S.A.
- [18] Stanton William, E. M. (2004). Fundamentos de Marketing. Mexico. D.F: Hill Interamericana.
- [19] Thomson, I. (Marzo 2006). Tipos de Publicidad. Promonegocios.



# Application of ICT and Electronic Technology in Election Management: Challenges in Rural Areas in South-Eastern Nigeria

Njoku O. Donatus<sup>1</sup>, Amaefule I. A<sup>2</sup>, Nwandu C. Ikenna<sup>3</sup>, Jibiri Ebere Janefrances<sup>4</sup>

<sup>1,3</sup>Department of Computer Science, Federal University of Technology, Owerri, Imo State, Nigeria.

<sup>2</sup>Department of Computer Science, Imo State University, Owerri, Imo State, Nigeria.

<sup>4</sup>Department of Information Management Technology, Federal University of Technology, Owerri, Imo State, Nigeria.

**Abstract**— This paper has presented the applications of Information Communication Technology and election management. The study has reviewed several challenges and bottleneck encountered in the electoral democratic system in Nigeria election. During the study, the use of electronic technology adoption in the electoral process has actually reduced human involvement in election process; this is due to irregularities and incessant increase in violence among electorates, party agents and other stakeholders. The relevance of this paper is to address the integration of ICT as well as electronic digital devices in carryout electrons in Nigeria. The research was conducted in the rural areas of the South-Eastern Nigeria States, it was discovered that about 60% of the respondent stated that the use of electronic technology in the deployment to rural areas has inadequate trained personnel in effective handling of the gadgets, issues on the use of card reader malfunctioning was also sported out. It was recommended that the electoral bodies should sensitized, make adequate available of electronic devices for efficient and effective election management in Nigeria.

**Keywords**— *Electronic Voting, Election Management, Electoral, Electronic Technology, ICT*

## I. INTRODUCTION

In today's globalization, Information Communication Technology (ICT) has taken the centre stage as nothing can be organized and executed with greater success without its use. This has motivated its use in electoral process in many countries all over the world. It has also been proven to be more efficient and reliable in achieving viable, credible and free election than the traditional (or manual) way of voting. Nigeria has keyed into the use of ICT in its election management because of the need to have viable, credible and free election.

Recently, elections in almost part of the world are geared towards using electronic technology. The use of

electronic technology (or machine) in election management is called electronic voting (e-voting). Several types of electronic technology have been adopted into the electoral process by electoral administrator [5]. In this type of election management system (EMS), the electoral process can be carried out by electronic digital (computer) equipment. This requires less human involvement or intervention. These electoral processes are highlighted and include voter, party and candidate registration; candidate support signatures verification; production of ballots; electoral logistics; identification of voter; voting in polling units or stations; counting of votes; transmission of results; preliminary and final presentation of results of data [5].

Election management in a few countries have been able to reach or attain this level of automation. Oftentimes, election management body of a country combines manual processes and electronic technology to form a suitable hybrid system. This is influenced by a wide range of factors which could be considered as peculiar system for any given country.

Electoral democracies the world over, are adopting the electronic voting (e-voting) and transmission of result. It is a common knowledge that the adoption of e-voting and transmission system in the management of election is to improve efficiency and credibility in the administration of electoral process [1]. Electronic voting is a type of voting in which voters are required to use electronic device to make and record their ballot choice [3]. Electronic voting and election management refers to the use of electronics devices or technologies for the organization, administration, and execution of electoral tasks so as to improve and automate the entire election process.

The Nigeria democracy like some other democracies practised in developing countries still "Young and fragile." This requires greater care and transparency to nurture it to full grown and developed democracy with strong democratic intuition and structure. Nigeria has been able to

join other nations in the use of electronic technology in its electoral process. This is occasioned by the fact that manual voting process has been characterized by widespread malpractices like violence, corruption and results falsification [2]. The use of ICT and electronic technology in EMS is due to the fact that elections in many countries especially in developing countries like Nigeria lack credibility. This because the electoral process are marred by rigging and violence [2]. As a result of this, many electoral reforms have sprung up in recent time in order to curtail or eliminate the inadequacy and weakness encountered in election management.

Majority of the settlers in rural areas are not conversant with the present day electronic technology and internet facilities. As a result of this, devices such as digital capturing camera, finger print scanner, laptop etc. are not fully deployed to rural areas for use during election period. This has led to the wastage of resources, encouraged rigging, violence and all other forms of election malpractices in rural areas. As reported in [4], e-governance suffered because the people living in rural areas could not adopt the technology and as such e-voting system was not able to yield fruitful result in rural areas in Nigeria during election exercise, though with e-governance in place, e-voting could be fully implemented.

## II. STATEMENT OF THE PROBLEM

The irregularities and widespread violence that occur during and after election occasion by rigging and election malpractices is a serious issue of great concern to election management body, government and other stakeholders. In order to address these, Information Communication Technology (ICT) and electronic technology has been employed in the electoral processes mostly in developed democracies. The adoption of ICT and electronic technology into the electoral process, its usefulness notwithstanding, still suffers some setbacks occasioned by poor or erratic power supply, malfunctioning, unskilled personnel, mass illiteracy, and election fraud using electronic voting. However, many research studies have been presented in literature based on the use of ICT and electronic voting in election management. Amongst these, only few have been considered the use of computer in election process in Nigeria with focus on rural areas. This study is presented to add to the gap existing in research works on the application of ICT and electronic technology in election management system in rural areas with focus on South Eastern Nigeria.

## III. SIGNIFICANCE OF THE STUDY

In the research works of [6] and [7], the use of ICT in electoral processes was presented through the use of digital devices but not in Nigeria. Also, in the work of [8],

election violence control was considered. This study examines the attendant issues arising in the application of ICT and electronic technology in election management in rural areas in South-Eastern Nigeria.

## IV. RESEARCH OBJECTIVE

To The main objective of this research is to study the issues arising in the application of ICT and electronic technology in election management in South-Eastern Nigeria. The other specific objectives are:

- I. To examine electronic voting system deploy all electoral activities, during and after election.
- II. To study election management in using ICT facilities in rural areas in South-Eastern Nigeria.

To establish the various issues facing the application of ICT and electronic technology in election management and proffer useful suggestion for improvement.

## 1. REVIEW OF PREVIOUS STUDY

There are many related literature on the management of election (which focused on the Nigerian electoral process). Some of the works previously done that relate to this study are reviewed in this section.

On the study of design and possible implementation of electronic voting system, some of the works based on Nigerian electoral processes are presented. The research study carried out by [9] based on electronic voting, its challenges and prospect in Nigeria democracy, examined the development and implementation of electronic voting system (EVS) that supports voters to cast votes online and also for election administrators to register voters and print out the votes casted. Kuye et al [10] in the same vein developed a window based programme in their study on design and analysis of electronic voting system in Nigeria. The study aimed to computerise the Nigeria voting system. Also a paper on technological framework for transparent E-voting solution in the Nigeria electoral system was presented in [11]. It maintained that traditional voting is time consuming and often times subjected to irregularities. Also, card readers with biometric authentication technology which has been widely employed in view to achieving transparent results are subject to high level electoral fraud because of human control. Thus the desired result is yet to be achieved. It then presented a framework that consists of different electronic voting systems in a way that conform to the Nigerian electoral system so build confidence and trust in electoral process.

Some research works have looked at problems facing electronic voting in Nigeria. Ahmad et al [12] studied issues and challenges of transition to e-voting technology in Nigeria. It stated that country like Nigeria with enormous challenges of transparent voting system has adopted e-voting as an alternative to weaknesses that have

characterized the Nigerian voting system. It then maintained that with Nigerian moving into electronic voting and with few literature available on the enormous challenges facing the voting system, there is need to avail policy makers and democratic practitioners the factors affecting the electoral process. This will make them to play by the rules so as to have an acceptable and yet reliable voting system. In the study presented in [2] on challenges of ICT and election management in rural areas in Nigeria, the challenges surrounding the application of ICT devices in election process in South western part of the country were examined. According to [1], it is essential to pilot the electronic systems or gadgets by the electoral commission so as to build confidence in the performance. It recommended that earlier piloting of the e-voting technology in election management with the involvement of stakeholders the better the chances of building trust and confidence during elections. According to [13], in order to have an established and sustained credible electoral process, an essential ingredient that all election management body must adopt to is planning and needs anticipation. This is true because proper planning and anticipation of electoral needs will eliminate certain lapses that may likely hinder the smooth conduction of election.

## 2. ELECTION MANAGEMENT, ICT, AND ELECTRONIC TECHNOLOGY

The elections in Nigeria (national, state, or local government area elections) cover a wide area of geographical land mass. This area of land is habited by people with different living environments and with a varying literacy and educational level among the electorates. These people of course have different access to technology. Hence it is appropriate to categorize electorates based on their access to ICT and the voting electronic technologies. The following categories are formulated based on the voting populace:

- a) Urban or rural dwellers
- b) Accessible or inaccessible internet area
- c) An internet (technologically) or non-internet (non-technologically) inclined electorate.

In this paper the focus is on rural dwellers. This is where the majority of the electorates resides. These areas are mostly referred to as remote areas. An area where it is not easy to have access to internet and modern electronic technology, and may not be internet connected. Majority of the electorates in this area are not internet or technologically inclined. So even when the electronic gadgets are provided and there is available internet service, their purpose for election often times suffers setback or are not utilized to the fullest. This is a challenge to the election management body and stakeholders.

The term ICT devices have been used in some literature to mean the same thing as electronic voting

technology. This may seem appropriate, but it has considered separately this paper for clarification purpose. Information Communication Technology (ICT) involves sharing of information through a medium using electronic device. On the other hand, an electronic voting technology is a device or gadget that can function in isolation or as a standalone without internet service but will give greater efficiency, credibility and transparency if connected to the internet so that data/information can be shared in real time (that is ICT).

Generally, based on the particular electronic voting (e-voting) system implemented, two main types are possibly identified. These are:

- i. Electronic voting in which physical supervision is carried out by election administrators or representative of government. That is a situation in which the electronic voting devices are located at the polling units; and this requires no internet (or ICT) services because data/information are shared or transferred in real time with any network.
- ii. In a situation where the registration or voting result is required to be received by election management body with their not being physically present owing to the remote location of the place where election is being held, an internet services, private computer network, or telephone lines can be used to transmit results from the polling station to election authority. This is known as remote e-voting or simply called i-voting.

Since the use of ICT and electronic technology in election management has been adopted in Nigerian electoral process, it is expected of the electorates to be able to recognize and identify the electronic voting devices and their functions. These electronic-voting devices must be made availing by the independent Electoral Commission (INEC) at the various registration centres and/or polling units depending on the level or stage. Table 1 below is a list containing the Election management levels employing ICT medium and electronic technology.

*Table.1: A List of Election Management Stages using ICT medium and Electronic Technology*

Election Management Level	ICT Services (On-line service)	Electronic Technology
E- Registration	Internet services (e.g. Websites, e-mail), computer network	e-voter registration system, optical scan, data capturing device, printer module, laptop

		computer
<b>E-Campaign</b>	Internet services, Telephone lines (mobile network), Radio and Television networks	Graphic device, Mobile phones, Radio set, Television, computer system, electronic pool book
<b>E-Voting</b>	Telephones, private computer networks, Internet	Optical Scan, punched cards, voting systems, voting kiosks
<b>E-Counting</b>	Vote counting server	Optical mark recognition, optical character recognition, punch card counting machines, electronic ballot boxes
<b>E-Compilation</b>	Internet services, computer network	Mobile phones, computer system, Storage devices
<b>E-Result</b>	Internet services, mobile network, computer network, radio and television networks	Radio, television, electronic publication, electronic magazine

The e-voting system in Nigeria has not been fully automated to the level of online voting providing internet services for connectable household devices and remote location. It is presently limited to e-voting in which there is physical supervision by INEC representatives. That is electronic voting systems are located at the various polling stations in the area where election is held.

### 3. METHODOLOGY

This research was conducted considering the rural areas in South-Eastern Nigeria following some of the recent re-run elections for State and Senatorial Constituencies in Imo State, Local Government Area (LGA) Chairmanship and Councillorship elections in Ebonyi State, Gubernatorial election in Anambra State, and the most recently conducted senatorial election in Anambra State. So, out of the five states that make-up the South-Eastern region of Nigeria, which are: Abia, Anambra, Ebonyi, Enugu, and Imo; only four states were considered. The sampling method was used to sample and cover the four states

considered. The process of data gathering used was based on participant's observation and oral conversation. This was conducted among randomly chosen or selected participants considering age, class, sex, and status. One hundred (100) participants within the four states were considered. The information collected was properly studied and analysed. The respondents were sectioned in percentage according to their response to the question put forward to them.

### 4. FINDINGS AND DISCUSSION

Though Nigeria has not fully moved into online voting where ICT will play a centre role, it has only employed internet services in voters' registration. This study finds out that even where ICT is used and electronic technology deployed to manage election in rural areas, certain problems arise.

Firstly, the problem of personnel handling the electronic devices: About sixty percent (60 %) of the respondents orally interviewed stated that the use of electronic technology in voting is marred by the problem of inadequate number of personnel to handle the gadgets. Even where adequate personnel are present, the available gadgets are few compared to the number of voters at the polling units. Also, most of the personnel deployed to rural areas to handle these gadgets are not properly trained to effectively operate them. That is, they lack the expertise required to operate the gadgets. This problem can lead to manipulation of votes, and the outcome is rigging of election.

Secondly, due to the remote nature of some parts of the rural areas where elections are held, the respondents (50 %) reported that politicians deployed hired thugs to snatch or destroy the e-voting facilities meant for elections. This act largely impact negatively on the success of the election. The result of this is rigging or inconclusive election. This also can lead to voters' apathy and loss of interest in participating in election because fear of being harassed or intimidated by thugs.

Thirdly, there is generally problem of unstable power supply in Nigeria. The ICT facilities and electronic devices needs constant power to operate efficiently. Forty percent (40 %) of the respondents reported that most of the voting machines stops during the voting process due to battery run down. And when this happens in most cases, no available power supply to recharge battery or power the system. This can create loss of confidence on the credibility, integrity, and reliability of the system and the entire process.

Also, the issue of card reader malfunctioning: the response of forty five percent (55 %) of the respondents orally interview showed that the electronic card readers deployed to conduct elections in rural areas are oftentimes not properly in good working state or are not well



programmed for the task. This act seems deliberate as most often when compared to elections in urban areas where this is uncommon. This problem occasioned by poor election management, gives room for manipulation of votes and rigging of elections most times in rural areas.

It was again observed from the response of thirty five percent (35 %) of the respondents that they were not given any pilot training nor were they exposed to the devices. This has resulted to the interference of the election officials to assign somebody or themselves to guide or support some of the electorates on how to go about using the electronic devices to cast their votes during the voting process. They claimed that oftentimes, the choice of the electorate on whom to vote is being influenced. It is obvious that a situation like this makes an election to be unfair and the right of the electorate to vote the person of his choice has been denied. In fact, the credibility and transparency of such an election is lost.

Generally, the study revealed that the success of the use of electronic technologies in the management of elections in rural areas is seriously and largely hindered due to the problem of malfunctioning of the voting devices. There is the problem of inability of the personnel deployed to properly operate the gadgets to enable maximum number of voters to be accredited and cast their votes. This will make many eligible voters who came out to cast their vote to be disenfranchised. Also, the fact that most of the rural areas, usually very remote from the city, have poor network or internet coverage. Hence, the result of the voting process cannot be tracked or checked online or in real time and this brings delay in data collation and result announcement.

## 5. RECOMMENDATIONS

In order to properly manage the e-voting system in Nigeria rural areas so as to reduce most of the issues that have impacted adversely in election process, they following are worthy of note.

1. There should be proper sensitization and pilot training organize for rural dwellers with respect to the use of the electronic technologies.
2. The election authority should ensure that the personnel deployed to handle the electronic device have adequately acquire the expertise training on its operation and usage.
3. The government in collaboration with mobile network providers should ensure that rural areas are equipped with stable and reliable internet access facilities.
4. An adequate and reliable power supply should be provided in rural areas.
5. Also, adequate security should be provided during election in rural areas to ensure the safety of life,

the electronic devices and other election materials used.

6. The electronic voting systems deployed to rural areas should be properly checked to ensure they are in good working condition.
7. There should be enough personnel trained by the election management body to handle election in rural areas.

## V. CONCLUSION

So far, the application of ICT and electronic technology in election management with focus on rural areas in South-Eastern Nigeria has been presented. The proper management of election in Nigeria so as to have a viable, free and fair election has been an issue of serious concern to election authority and stakeholders. In order to reduce or eliminate the irregularities that have marred the traditional voting system, the election management body decided to employ electronic voting system for proper conduct of election. This, it was believed, would make the election more transparent, reliable, credible, free and fair. However, its use in the conduction of election mostly in rural areas suffers some setbacks despite the fact that the application of this technology has somewhat improved confidence in the voting system. This paper has studied some of the issues surrounding the use of the electronic technology in rural areas in South-Eastern Nigeria. It revealed from the response of the respondents who were randomly selected and orally interviewed in rural areas covered that poor power supply, lack of expert personnel deployed to handle the devices, malfunctioning, inability of some electorates to use the gadget proper for voting, and insecurity are some of the problem being faced in using electronic technologies in the conduct of election in rural areas. This generally leads to poor election outcome and loss of confidence in the entire process by the electorates. Hence, the purpose of deploying such devices in election management seems to have been defeated.

## ACKNOWLEDGEMENTS

We wish to acknowledge everyone that has made meaningful contributions to the success of this paper.

## REFERENCES

- [1] The Zambian Observer (2017), "Electronic voting and result transmission systems Key to Efficient Elections management.
- [2] Adeleke, I. A (2014), "Challenges of ICT and Election Management in Rural Areas in Nigeria." Department of Computer Science, Emmanuel Alayande College of Education, Oyo.

- [3] Section 3: “Key Election Process Categories, Electronic Voting and counting.”  
[www.openelectiondata.net](http://www.openelectiondata.net)
- [4] Narasimhaiah G. (2008), “Hurdles in rural e-government projects in India, electronic Government.”An international Journal, vol. 5 No 1
- [5] Electronic Technology: [www.aceproject.org](http://www.aceproject.org)
- [6] Aaisha K., Anita G., Charu G., Hiteshyadav,D., (2012), “E-Governance: An Alternative Approach and Hurdles Faced By Rural People.” International Journal of Engineering and Innovative Technology (IJEIT), Volume 2, Issue 3,
- [7] Andreas S., Larry D., and Marc F. P., (1999) “The Self-Restraining State: Power and Accountability in New Democracies” pages/LC:98-44668  
[itlaw.wikia.com/wiki/Election\\_management\\_system](http://itlaw.wikia.com/wiki/Election_management_system)
- [8] Adesola S. A., and John O. A., (2014) “Electoral Violence and the Survival of Democracy in Nigeria’s Fourth Republic: A Historical Perspective.” Vol 10 No 3,
- [9] Alausa D. Wasiu S. and Akingbade L. O. (2017), “Electronic Voting: Challenges and Prospects in Nigeria’s Democracy.” The International Journal of Engineering and Science (IJES), Volume 6 Issue 5 Pages PP 67-76.
- [10] Kuye C.O; Coker J.O; Ogundeinde I.A and Coker C.A., (2013) “Design and Analysis of Electronic Voting System in Nigeria.” International Archive of Applied Sciences and Technology,IAAST; Vol 4 [2] 15-20
- [11] Uzedhe, G. O. and Okhaifoh, J. E. (2016) “A Technological Framework for Transparent E-Voting Solution in the Nigerian Electoral System.” Nigerian Journal of Technology (NIJOTECH), Vol. 35, No. 3, pp. 627 – 636
- [12] Sabo A, Siti A. J., Abdullah B. and Rozita B. (2015), “Issues and Challenges of Transition to e-Voting Technology in Nigeria.” Public Policy and Administration Research, Vol.5, No.4, pp 95-102,
- [13] Independent National Electoral Commission, Abuja, (2015) “The Election Management System (EMS): Project Report.” pp 1-176,.

# Buckling behavior of straight slot tubes under oblique loading – A comparative study

Belal Ahamad, Anand Singh, Masihullah, Afaq Umer, Mohd. Reyaz Ur  
Rahim

Department of Mechanical Engineering, Integral University, Lucknow, Uttar Pradesh, India

**Abstract**—Hollow tubes are the most important or crucial parts of the rapidly growing automobile and construction industry. The tube is subjected to pure buckling. In the analysis, one end is fixed and the force is applied to the other end and by application of different angles of inclinations ranging from  $0^\circ$  to  $20^\circ$  with different thickness of the range of 0.5 to 2.0. Linear buckling code was used for finding the critical buckling load. This research paper is about the effects of buckling under oblique loading. It is the process in which the tube is subjected to compressive oblique loading and the tube fails by the first increase in cross-sectional area and then bulging on any of the sides but in the case, oblique loading in hollow tube shell bulges internally or inside the perimeter of the tube.

**Keywords**—buckling load; straight slot; oblique loading; finite element analysis.

## I. INTRODUCTION

In the age of globalization and advancement in technology, every automobile industry is focusing primarily to ensure the crash safety without compromising the comfort and fuel efficiency. A detailed study has been carried out for finding the optimal design of structures for so as to act as a safeguard for humans and their stuff. Columns being the preeminent part of any structural design plays the vital role in presaging the structural efficiency. Thin walled tubes due to their light weight, low price, high strength to weight ratio, ease of fabrication is globally preferred over comparable solid section. The behavior of thin-walled tubes is exclusively dependent upon cross-sectional shapes and material properties. The behavior of tubes changes when their cross-sectional shape is changed thereby making it an arduous task for finding an optimal design for a circumstantial exercise.

It is evident that the hollow tubes for the intrinsic part of any structure and a lot of attempts have been made by the researchers previously for finding the individualized characteristics of a different cross-section such as rectangular, triangular, octagonal, 12 sided star, lateral corrugations to name a few [1-5]. The influence of geometrical features and modifications on the behavior of

tubes is presented by Z Fan [6]. The buckling response of tubes can be further enhanced by foam fillers [7]. The behavior of tubes are predominantly determined under axial loading conditions however in real case situation the structures are seldom subjected to pure axial or pure bending, rather a combination of two betides. Therefore in order to apprehend the buckling characteristics of the tubes, the reaction under oblique loading is even more important. The behavior of hollow tubes under static and oblique loading was investigated [8]. The previous study shows that the response of tubes under oblique loading can be improved by combining the cross-sectional shapes [9]

The present study has numerically investigated the buckling response of straight slot tube at various angles of inclinations for getting an insight of the effect of oblique loading

## NOMENCLATURE

SS – Straight Slot	T - Thickness
S – Steel	A - Aluminium

## II. NUMERICAL SIMULATION

### A. Material properties

The material for tubes is aluminum alloy with mass density  $\rho = 2.7 \times 10^{-6} \text{ kg/m}^3$  and having Young's modulus as 7100 Mpa, the Poisson's ratio as 0.33 and Ultimate tensile strength as 310 Mpa and steel is having the mass density  $\rho = 8.05 \times 10^{-6} \text{ kg/m}^3$ , Young's modulus as 7,800 kg/m<sup>3</sup> and the Poisson's ratio as 0.26 and the ultimate tensile strength as 250 Mpa.

### B. Finite element model

In this analysis, we use ANSYS with linear buckling module under oblique loading. The specific dimensions of the tube are presented in Table 1. CAD modeling was done in Solidworks. One end is fixed and the other end is free too which load is applied (100 N). The inclinations angles were taken as  $0^\circ$ ,  $5^\circ$ ,  $10^\circ$ ,  $15^\circ$ ,  $20^\circ$  as shown in Fig.1.

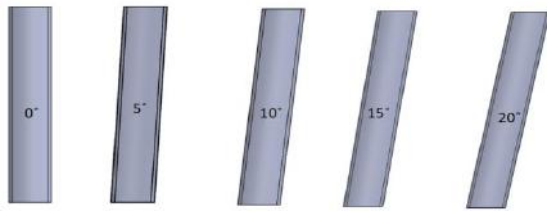


Fig.1. Inclinations under consideration

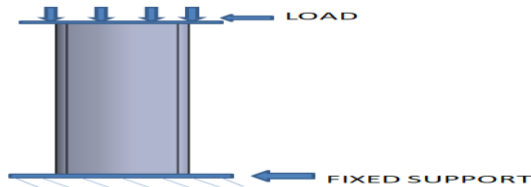


Fig.2. Boundary conditions

The thickness of the tube was taken as 0.5, 1.0, 1.5, and 2.0 while the length of the tubes was kept constant as 100 mm. A detailed geometric specification is presented in Table 1.

Table.1: Geometric configurations

SPECIM EN	THICKN ESS	LENG TH	PROFI LE
SS-T1	0.5	100	
SS-T2	1.0	100	
SS-T3	1.5	100	
SS-T4	2.0	100	

### C. Meshing of geometric profiles

The meshing of the tubes were done in such a manner that the number of elements were almost same in all the different configurations which was corresponding to thousand on an average. A detailed description of the mass of slot tubes as a function of element is given in Table 2.

Table.2: Mass and elements of specimen

ENTITY	MASS (Kg)	ELEMENTS
SS-S-T1	5.5347 e-002	1116
SS-S-T2	0.10947	1080
SS-S-T3	0.16235	1044
SS-S-T4	0.214	1044
SS-A-T1	1.953e-002	1116
SS-A-T2	3.8627e-002	1080
SS-A-T3	5.7287e-002	1044
SS-A-T4	7.5512e-002	1044

### III. RESULTS AND DISCUSSION

The objective of this ongoing analysis is to find out about the buckling behavior of straight slot tube under oblique loading. The straight slot geometry with a different angle of inclinations and different thickness with a constant length (100 mm) is taken for the analysis. The geometry is tested under 5 angles of inclination ranging from 0° to 20° with the same load of 100 N and further analysis is being made by considering several results like in case of steel maximum peak load are at 0° which is 2980.5 and thickness of (2.0) mm while the maximum peak load in case of Aluminum is 1047.8 which is at 0° inclination and thickness of (2.0) mm respectively.

Table.3: Buckling load for specimens

Specimen	LOAD MULTIPLIER				
	0°	5°	10°	15°	20°
SS-S-T1	64.29	53.41	43.30	35.02	28.29
SS-S-T2	448.7	406.71	349.1	293.2	241.7
SS-S-T3	1355.8	1277.5	1127.4	961.7	798.57
SS-S-T4	2980.5	2860.5	2569.3	2220.7	1852.1
SS-A-T1	22.66	18.79	15.23	12.38	9.9727
SS-A-T2	157.9	143.05	122.8	103.2	85.222
SS-A-T3	476.7	449.12	396.4	338.4	281.19
SS-A-T4	1047.8	1005.5	904.4	781.2	652.55



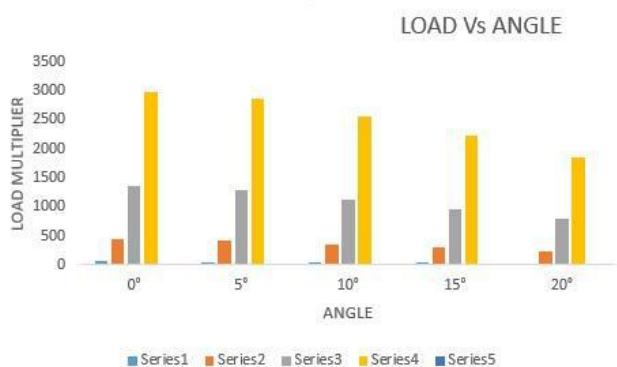


Fig.3. Buckling load for Steel

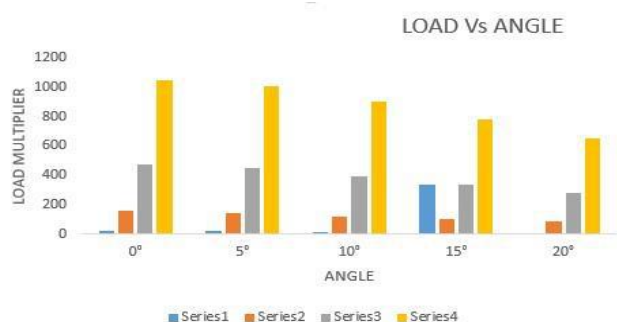


Fig.4. Buckling load for Aluminium

#### IV. CONCLUSION

The critical load of the straight slot thin-walled tubes was investigated at quasi-static axial and oblique loading numerically. The critical load changes with a change in the thickness and angle of loading. It was found that the value of the critical load may improve but limited to a certain extent. Based on the Numerical observations following conclusions can be wrap up:

- Steel is more stable because its critical buckling load is more than in case of aluminum as per this straight slot geometry is concerned.
- With the increase in the thickness of the slots, the buckling load was rising.
- Clearly further more comprehensive studies are needed to investigate this problem

#### REFERENCES

- [1] Reyaz-Ur-Rahim, M., Bharti, P. K., & Umer, A. (2017). Axial Crushing Behaviors of Thin-Walled Corrugated and Circular Tubes-A Comparative Study. *Technological Engineering*, 14(1), 5-10.
- [2] Rahim, M. R. U., Akhtar, S., & Bharti, P. K. (2016). Finite Element Analysis for the Buckling Load of Corrugated Tubes. *Vol-2, Issue-7, July*, 935-939.
- [3] Ata Azmi, Adil & Umer, Afaq & Rahim, Mohd Reyaz. (2018). Parametric Study of 2D Truss With

Thin-Walled Corrugated Tubes.  
 10.13140/RG.2.2.16380.23689.

- [4] Tarlochan, F., Samer, F., Hamouda, A. M. S., Ramesh, S., & Khalid, K. (2013). Design of thin wall structures for energy absorption applications: Enhancement of crashworthiness due to axial and oblique impact forces. *Thin-Walled Structures*, 71, 7-17.
- [5] Umer, A., & Rahim, M. R. U. (2018). Effect of Combined Cross-sectional Geometries on the Buckling Behavior of Thin-walled Tubes. *International Journal of Advance Engineering Science & Technology*, 1, 43-46.
- [6] Fan, Z., Lu, G., & Liu, K. (2013). Quasi-static axial compression of thin-walled tubes with different cross-sectional shapes. *Engineering Structures*, 55, 80-89.
- [7] Danish Anis Beg, Bakhtawar Hasan Khan, Afaq Umer, Mohd. Reyaz Ur Rahim(2018).Finite element Analysis of Honeycomb filled Metallic Tubes Subjected to Axial Loading. *International Journal of Advanced Engineering Research and Science (ISSN : 2349-6495(P) / 2456-1908(O))*,5(4), 146-149. <http://dx.doi.org/10.22161/ijaers.5.4.20>
- [8] Nia, A. A., Nejad, K. F., Badnava, H., & Farhoudi, H. R. (2012). Effects of buckling initiators on mechanical behavior of thin-walled square tubes subjected to oblique loading. *Thin-Walled Structures*, 59, 87-96.
- [9] Umera, A., Khana, B. H., Ahmada, B., Ahmada, H., Reyaz, M., & Rahima, U. Behavior of thin-walled tubes with combined cross-sectional geometries under oblique loading.

# Knowledge and Attitude of Dental Students and Staffs towards Basic life Support(BLS)

Dr Abdul Saheer P<sup>1</sup>, Shabna V Basheer<sup>2</sup>, Shabna M<sup>2</sup>, Shahanas Hakkim<sup>2</sup>,  
Sneha Sanjeev<sup>2</sup>, Sanisha Sadanandan<sup>2</sup>, Dr Shanila Abdul Majid<sup>3</sup>

<sup>1</sup>Assistant professor, Dept of Public Health Dentistry, Al AzharDental College,Thodupuzha, Kerala, India

<sup>2</sup>BDS final Year, Al AzharDental College,Thodupuzha, Kerala, India

<sup>3</sup>Assistant professor, Dept of OMR, Al AzharDental College, Thodupuzha, Kerala, India

**Corresponding author-** Dr Abdul Saheer P

B4/Alsa palm springs,RC road,Calicut, India

[Zaheer5475@gmail.com](mailto:Zaheer5475@gmail.com)

**Abstract—Introduction:** The present study was aimed to assess the awareness, knowledge, and attitude towards basic life support (BLS) among the dental students and faculty of Al Azhar dental college.

**Materials and Methods:** A descriptive study was conducted by using a Questionnaire comprising of 20 questions to collect the data pertaining to awareness and knowledge of BLS, attitude towards BLS among the 3<sup>rd</sup>, final year dental students and the faculty members. After excluding the incomplete response sheets which were none in the present study, the data from 212 members were subjected to the analysis. The Main outcome measure was the over all score in the BLS knowledge. Knowledge of BLS was assessed as per the data contained in the Basic life support manual from American Heart Association.

**Results:** Out of 212 members 109 were 3<sup>rd</sup> year students and 85 were final year students and 18 faculty members. The overall knowledge score was 33.7%. Overall results were poor with less than minimum knowledge on the topic BLS. A score of less than 50% was evident in the study indicating a poor knowledge of BLS among both the students and the faculty. The range of correct answers were 3-11 among students and 4-6 among the staffs. A significant difference ( $p < 0.05$ ) was observed between students and faculty members.

**Conclusion:** Present study reports just 33.7 % participants had knowledge regarding BLS necessitates immediate attention of training of dental students and faculties regarding BLS.

**Keywords—Dentistry, Dental Students, BLS.**

## I. INTRODUCTION

Basic life support (BLS) is a simple life saving protocol following a cardiac arrest. It is an integral part of emergency resuscitative care that aims to retain sufficient ventilation and circulation until the cause of the arrest is detected and eliminated.<sup>1</sup> As health care professionals, dental practitioners encounter life- threatening medical

emergencies. A study by Muller et al<sup>2</sup>, found that medical emergencies are no rare in dental practise, as about two-thirds of dentist faced at least one emergency during the 12 month study period. Early initiation of cardiopulmonary resuscitation by witnesses increases survival after cardiac arrest. In turkey<sup>3</sup> it is rare that basic life support is initiated by a layperson in the contest of medical emergencies, provision of a competent BLS carries a potential impact on lives. It is recommended that all dental students and staffs, who are exposed to patients, must be trained to offer basic life support. Data from previous studies suggest that more than 3 million sudden cardiac death occur worldwide every year and survival is lower than 8%.<sup>4-6</sup> It has also been estimated that by the end of present decade, 60% of world's heart disease is expected to occur in India and proportionately the incidence and prevalence is expected to rise<sup>4</sup>. It is very important for every medical/dental professionals to know about CPR to save life and improve overall quality of the community health. But low confidence among dental students in performing CPR has been reported from Europe<sup>1</sup>. Different reports have described the knowledge of BSL among health care professionals<sup>2-4</sup>. Chandrasekaran et al,<sup>7</sup> evaluated the knowledge of BLS among healthcare students and professionals and found that the study subjects were severely lacking in BLS knowledge. The American Heart Association (AHA) resuscitation guidelines recommend that all under graduated students who are in contact with the patients should have regular resuscitation training<sup>3</sup>. Reddy et al<sup>8</sup> assessed the knowledge of BLS among bachelor of dental surgery clinical students, dental interns, postgraduate students and dental faculty in dental school in India. The study concluded that postgraduate students and faculty had significantly poorer knowledge when

compared to undergraduate students and dental interns. A study by Gonzaga et al<sup>9</sup> found that 86% of the interviewed dentists had received information about CPR; however most of them had not received practical training for cardiopulmonary resuscitation. In recent years several publications have highlighted the deficiencies in CPR quality, both out of hospital and in hospital, which have partly been addressed in the newest BLS guidelines<sup>9,10</sup>.

CPR is controlled by guidelines developed by certain associations such as American heart association<sup>11</sup> and some other associations in Europe<sup>12</sup> Singapore<sup>13</sup> Australia, and New Zealand.<sup>14</sup> These guidelines are updated regularly to cope with new advances in this field.

In India, the undergraduate curriculum as proposed by the Dental Council of India (DCI) includes medical emergency management under the subjects of general medicine and oral and maxillofacial surgery.<sup>15</sup> Keeping this in mind, only III, IV, V years (clinical dental students) along with the faculty were included in the study.

Nevertheless, there is no detailed information regarding BLS knowledge and attitude among dental students and staff in dental schools in Kerala.

The aim of the present study is to assess and compare the level of knowledge and attitude toward BLS among bachelor of dental clinical students, staffs at Al- Azhar dental college Thodupuzha.

## II. MATERIALS AND METHOD

A Cross sectional survey was conducted in Al Azhar dental college (during Feb 2018) among 212 participants including dental students and the faculty members to

assess the knowledge and attitude towards basic life support. The sample size of 212 which includes 66 males and 146 females. Ethical approval was obtained from the Institutional review board. The sample is divided into two sections 3<sup>rd</sup>, 4<sup>th</sup> year students and faculty which includes 194 students and 18 faculty members. The questionnaire was adapted from the survey used by Shantachandrashekar<sup>7</sup> in a previous study with some modification. Data collection was done by distributing questionnaires among the students and staffs during the clinical and lecture time with prior permission. Questionnaire included 20 closed questions each to evaluate the knowledge and attitude of BLS respectively. Participants had four different options to answer the knowledge questions. For every correct answer a score of 1 was assigned and a score of 0 for every incorrect. The questions were incorporated after going through various literature related to that, which consisted of self-prepared 20 basic questions regarding adult and child BLS, including the experience and attitude of the participants to BLS, theoretical and practical knowledge of the participant to BLS and previous experience and exposure to BLS. The questionnaire prepared was then assessed by carrying out a pilot study among the experienced medical fraternity, and the necessary corrections were made accordingly. The answers were received on the next day of the survey and analyzed. Incomplete responses were excluded from the study. The professional qualifications of the participants were considered. Statistical analysis was performed using SPSS software 20.0. Significance level was kept at 5%.

## III. RESULTS

Table -1

Sl No.	Questions	Options	Clinical students		Staffs
			3rd YEAR	4th YEAR	
1.	What is the abbreviation of "BLS"?	Correct	109(100%)	81(95.2%)	18(100%)
		Incorrect	0	4(47%)	0
2.	When you find someone unresponsive in the middle of the road, what will be your first response?	Correct	48(44.03%)	30(35.29%)	7(39%)
		Incorrect	62(56.81%)	55(64.7%)	11(61%)
3.	If you confirm somebody is not responding to you even after shaking and shouting at him, what will be your immediate action?	Correct	55(50.4)	33 (38.81%)	9(50%)
		Incorrect	54(49.5%)	52(61.11%)	9(50%)
4.	What is the location for chest compression?	Correct	56(51.3%)	49(57.6%)	7(39%)
		Incorrect	53(48.6%)	36(42.3%)	11(61%)
5.	What is the location for chest compression in infants?	Correct	34(31.1%)	24(28.2%)	2(12%)
		Incorrect	75(68.8%)	61(71.7%)	16(88%)
6.	If you do not want to give mouth-to-mouth CPR, the following can be done EXCEPT	Correct	25(22.9%)	23(27.05%)	0
		Incorrect	84(77.06%)	62(72.9%)	18(100%)

7.	How do you give rescue breathing in infants?	Correct	3(2.7%)	0	0
		Incorrect	106(97.2%)	85(100%)	18(100%)
8.	Depth of compression in adults during CPR	Correct	61(55.9%)	41(48.2%)	6(25%)
		Incorrect	48(44.03%)	44(51.7%)	12(75%)
9.	Depth of compression in Children during CPR	Correct	26(23.85%)	30(35.2%)	6(34%)
		Incorrect	83(76.14%)	55(64.5%)	12(66%)
10.	Depth of compression in neonates during CPR	Correct	23(21.01%)	13(15.2%)	4(29%)
		Incorrect	86(78.89%)	72(84.7%)	14(71%)
11.	Rate of chest compression in adult and Children during CPR	Correct	18(16.51%)	19(22.3%)	4(29%)
		Incorrect	91(83.9%)	66(77.6%)	14(71%)
12.	Ratio of CPR, single rescuer in adult is	Correct	38(34.8%)	28(32.94%)	6(34%)
		Incorrect	71(65.1%)	57(67.05)	12(66%)
13.	In a new born the chest compression and ventilation ratio is	Correct	21(19.2%)	20(23.5%)	1(5%)
		InCorrect	88(80.7%)	65(76.4%)	17(95%)
14.	What does abbreviation AED stands for	Correct	21(19.2%)	18(21.1%)	0
		InCorrect	88(80.7%)	67(78.8%)	18(100%)
15.	What does abbreviation EMS stands for?	Correct	29(26.6%)	19(22.3%)	9(50%)
		InCorrect	80(73.3%)	66(77.6%)	9(50%)
16.	If you and your friend are having food in a canteen and suddenly your friend starts expressing symptoms of choking, what will be your first response	Correct	58(53.2%)	53(62.3%)	1(5%)
		InCorrect	51(46.7%)	32(37.6%)	17(95%)
17.	You are witnessing an infant who suddenly started choking while he was playing with the toy, you have confirmed that he is unable to cry (or) cough, what will be your first response	Correct	22(20.1%)	19(22.35%)	3(16%)
		InCorrect	87(79.81%)	66(77.6%)	15(84%)
18.	You are witnessing an adult unresponsive victim who has been submerged in fresh water and just removed from it. He has spontaneous breathing, but he is unresponsive. What is the first step?	Correct	15 (13.19%)	14(16.4%)	1(5%)
		Incorrect	94(86.2%)	71(83.5%)	17(95%)
19.	You noticed that your colleague has suddenly developed slurring of speech and weakness of right upper limb. Which one of the following can be done?	Correct	34(31.19%)	29(34.11%)	3(16%)
		Incorrect	75(68.80%)	56(65.88%)	15(84)
20.	A 50-year-old gentleman with retrosternal chest discomfort, profuse sweating and vomiting. What is next?	Correct	18(16.51%)	12(14.11%)	1(5%)
		Incorrect	91(83.4%)	73(85.88%)	17(95%)

Table.2: Descriptive data of questionnaire based on Gender, Academic level and Clinical experience.

	VARIABLE	NUMBER	MINIMAL SCORE	MAXIMAL SCORE	MEAN SCORE	STANDARD DEVIATION	P VALUE
GENDER	Male	66	3	11	6.375	1.875	0.696(t-test)
	Female	136	3	11	6.286	1.884	
ACADEMIC LEVEL	Third year dental students	109	3	11	4.432	1.888	0.0002*(Anova)

	Final year dental students	85	3	10	4.933	1.874	test) 3 <sup>rd</sup> yr vs 4 <sup>th</sup> yr(p=0.134)
	Lecturers	18	3	6	6.245	1.884	
<b>Clinical experience</b>	Less than 5 years	13	4	6	5.821	1.195	0.406(t-test)
	Between 5 and 10 years	5	3	6	6.663	1.214	

p <0.05 issignificant)

Out of 212 responders 109 were third year dental students, 85 were final year students and 18 faculty members. Ninety four percentage (94%) of the responders knew the abbreviation of BLS as Basic life support. More than half of the participants (62%) failed to insist on looking for safety as the first step in BLS. Majority of the participants (80%) failed to insist on activating EMS immediately after confirming the unresponsiveness in an adult. Around 70% responders did not know that the correct location of chest compression in an infant was one finger breadth just below the nipple line. Majority (77.5%) the responders did not know alternative techniques of resuscitation when mouth-to-mouth ventilation was not opted. Almost all of the participants (99.5%) of the responders failed to select mouth-to-mouth and nose technique as the rescue breathing for infants. Forty nine percentage participants did not know that the depth of chest compression in an adult was 1.5 to 2 inches. Lack of knowledge regarding the depth of chest compression in a child was one-third to one-half the depth of the chest was 72%. Eighty percentage did not know that the chest compression in an infant was one-third to one-half the depth of the chest. Only 18% of the responders answered the rate of chest compression as 100/minute in adults and children CPR. Only 33% of the responders had correctly answered that the compression ventilation ratio in a child and adult single rescuer CPR was 30:2. Only 20% knew that the ratio of compression ventilation in a new born was 3:1. Responders did not know that the abbreviation of AED was 'automated external defibrillator' was 80 % and only 25% cent knew that the abbreviation of EMS was 'Emergency Medical Service'. Fourty five (45%) % did not know that the first step in helping a suspected foreign body obstruction victim is to confirm the severity of obstruction by talking to him. Only 31.5% of the responders did not know the early signs of stroke and only 14% per cent knew how to recognise and help a patient with acute coronary syndrome. The overall knowledge score was 33.7%. No participants had complete knowledge on BLS.

Table 2 explains response comparison based on Gender, Academic level and clinical experience. Males and females had almost equal level of knowledge regarding BLS. (Mean value 6.3& 6.2 each). Third year students showed a mean value of 4.4, final years with 4.9 and staff being

highest value 6.9. The difference was statistically significant. (p<0.05). Staffs with less than and more than 5 years of experience did not show any much difference in the knowledge. (5.82&6.63)

#### IV. DISCUSSION

The present study assessed knowledge of students and faculty regarding BLS in a private dental college in southern Kerala. The study showed that dental students and faculty in the study group were lacking in the awareness of BLS. Awareness of BLS was poor in all the students. This study emphasized the cognitive approach to the general perception and skills of Basic Life Support, early recognition of stroke and acute coronary syndrome. The practising and teaching doctors in this study scored less this explained why many dental doctors were not good in carrying out effective CPR.<sup>16</sup> It is now essential to standardise training in advanced life support and make it a mandatory component of all dental school undergraduate curricula. It is also equally important that teachers, school children, public and all lay persons from the community be taught the facts of basic life support and first. Study population with positive knowledge score was 33.7%. A similar finding was observed in studies conducted by Shanthachandrashekaret al<sup>7</sup> and inadequate knowledge on BLS. A different and positive finding was reported by the study conducted by Malford TP et al.<sup>17</sup> The range of correct answers given by students was 6-11, whereas it is surprising and alarming that the same with faculties were in range of 4-6. Although the mean knowledge score is significantly differ from the student's, the negligible number of staff population must not be a representative population. The present study report that the students have a negative attitude ie mere 33.7% responded positively to the attitude and practical based questions. Lack of professional training of BLS was regarded as the most common hindering factor responsible for poor BLS knowledge by dental students.<sup>18-20</sup> Baduni N et al<sup>21</sup> reported score of 9.2 ±1.2 among dental practitioners which is better than the present study where mean score was 6.5. The majority of the study participants of the present study reported that BLS training should be a part of the dental curriculum and raised the point that there was no professional training available. A recommendation to



develop undergraduate health courses and strategies to teach professionals and students appropriate theoretical as well as practical knowledge, behaviour and attitudes when facing life-threatening emergencies was reported in a study conducted by Carvalho et al<sup>22</sup>. Studies conducted by Elanchezhian et al<sup>23</sup> Reddy et al<sup>8</sup>, Baduni et al<sup>21</sup> and Ehigior et al<sup>24</sup> reported that a considerable portion of the study population in the respective studies had knowledge scores below average and recommended that proper strategies should be devised to bridge the lacunae in the knowledge.

## V. CONCLUSION

The findings of the present study demonstrates poor knowledge (33.7%) among dental students regarding BLS and showed the urgent need for continuous refreshing courses for this critical topic.

## VI. ACKNOWLEDGMENT

Authors would like to acknowledge all the survey participants.

## VII. LIMITATIONS AND RECOMMENDATIONS

This study has some limitations that should be taken into consideration. One possible limitation is the likelihood of selection bias given that dental students who chose to participate in the survey may be keener interested or concerned with CPR than those who did not participate. Therefore, the results are likely not generalizable to non-respondents. In addition, a general limiting characteristic of self-reporting survey is the probability of socially acceptable responding. Nonetheless, despite these limitations, the study provides some important information about Al Azhardental students, Kerala knowledge and attitude regarding principles of BLS.

## REFERENCES

- [1] Berg Robert A, Hemphill Robin, Abella Benjamin S, Aufderheide Tom P, Cave Diana M, Hazinski Mary Fran, et al. Part 5: Adult basic support 2010 American Heart Association guidelines for cardiopulmonary resuscitation and emergency cardiovascular care. *Circulation* 2010; 122(18 suppl 3): S685- 7-05.
- [2] Muller MP, Hansel M, Stehr SN, Weber S, Koch T. A state- wide survey of medical emergency management in dental practises: incidence of emergencies and training experience. *Emerg Med J* 2008;25(5):296- 300
- [3] Sule Ozbligin, Mert Akan and Bahar Kuvaki: Evaluation of public awareness, knowledge and attitude about cardiopulmonary resuscitation: reports of izmir.
- [4] Boriani G, Valzania C, Diemberger I, Biffi M, Martignani C, Bertini M, et al. Potential of non- ant arrhythmic drugs to provide an innovative upstream approach to the pharmacological prevention of sudden cardiac death. *Expert opinion on investigational drugs*. 2007; 16(5): 605- 23.
- [5] Josephson ME, Wellens HJJ. Implantable defibrillators and sudden cardiac death. *Circulation*. 2004; 2685- 91
- [6] Sasson C, Rogers MAM, Dah J, Kellermann AL. Predictors of survival from out- of- hospital cardiac arrest: a systematic review and meta- analysis. *Circulation. Cardiovascular quality and outcomes* 2010; 63- 81.
- [7] Chandrasekaran S, Kumar S, Bhat SA et al : "Awareness of basic life support among medical, dental, nursing students & doctors". *Indian J Anaesth* 2010; 54 : 121-6 3. S Raghavan, H Schneider, WGJ Kloeck: "Basic resuscitation-knowledge
- [8] Sahithi Reddy, Dolar Doshi, Padma Reddy, Suhas Kulkarni, Srikanth Reddy. Awareness of basic life support among staff and students in a dental school. *J Contemp Dent Pract* 2013;14(3):5511-7.
- [9] Gonzaga Heron Fernando de Sousa, Chaves Marcelo es de, almeidaoslei Paes de. Evaluation of knowledge and experience of dentists of Sao Paulo State, Brazil about cardiopulmonary resuscitation. *Braz Dent J* 2003;14(3):220-2
- [10] Mohan V, Deepa R, Rani SS, Premalatha G. Prevalence of coronary artery disease and its relationship to lipids in a selected population in South India. *J Am Coll Cardiol*. 2001 ; 38:682-7.
- [11] Freund Y, Duchateau FX, Baker EC, Goulet H, Carreira S, Schmidt M, et al. Self- perception of knowledge and confidence in performing basic life support among medical students. *Eur J Emerg Med*. 2013;20:145- 6.
- [12] Florian Laurent, Pascal Augustin, Cathy Nabet, Sophie Ackers, Daamian Zamaroczy, Louis Maman. Managing a cardiac arrest ; evaluation of final year predoctoral dental students. *J Dent Educ* 2009;73(2): 211-7.
- [13] Lim SH. Basic cardiac life support: 2011 Singapore guidelines. *Singapore Med J*. 2011;52:538-42. [PubMed]
- [14] Australian Resuscitation Council; New Zealand Resuscitation Council. Basic life support: Cardiopulmonary resuscitation. ARC and NZRC Guideline 2010. *Emerg Med Australas*. 2011;23:259-60.
- [15] Dental council of India. [homepage on the internet]. BDS course syllabus. [Cited 2007 May 10]. Available from: [http:// www.dciindia.org/BDS-syl.pdf](http://www.dciindia.org/BDS-syl.pdf)

- 
- [16] Shrestha Roshana, Batajoo KH, Piryani RM, Sharma MW. Basic life support: knowledge and attitude of medical or paramedical professionals. *World J Emerg Med* 2012;3(2):141-5.
- [17] Tyson Pillow Malford, Donald Stader, Matthew Nguyen, Dazhe McArthur, Robert McArthur, Shkelzen H oxhaj. Perceptions of basic, advanced, and pediatric life support training in a United States medical school. *J Emerg Med* 2014;46(5):695-700.
- [18] Spencer B, Chacko J, Sallee D. American Heart Association. The 2010 American Heart Association guidelines for cardiopulmonary resuscitation and emergency cardiac care: An overview of the changes to pediatric basic and advanced life support. *Crit Care Nurs Clin North Am*. 2011;23:303–10. [[PubMed](#)]
- [19] Sandroni C, Nolan J. European Resuscitation Council. ERC 2010 guidelines for adult and pediatric resuscitation: Summary of major changes. *Minerva Anesthesiol*. 2011;77:220–6. [[PubMed](#)]
- [20] Wedgo Tsegaye, Million Tesfaye and Mengistu Alemu. Knowledge, attitude and practice of cardiopulmonary resuscitation and associated factors in Ethiopian university medical students; Jimma university, College of health sciences Ethiopia.
- [21] Baduni N, Prakash P, Srivastava D, Sanwal M, Singh B. Awareness of basic life support among dental practitioners. *Natl J Maxillofac Surg*. 2014;5(1):19–22.
- [22] Carvalho RM, Costa LR, Marcelo VC. Brazilian dental student's perceptions about medical emergencies: a qualitative exploratory study. *J Dent Educ*. 2008;72(11):1343–9.
- [23] Elanchezhian S, Elavarasu S, Vennila K, Renukadevi R, Mahabob MN, Sentilkumar B, et al. Awareness of dental office medical emergencies among dental interns in southern India: An Analytical study. *J Dent Educ*. 2013;77(3):364–9.
- [24] Ehigiator O, Ehizele A, Ugbodaga P. Assessment of a group of Nigerian dental student's education on medical emergencies. *Ann Med Health Sci Res*. 2014;4(2):248–52.

# Integration of TTF, UTAUT, and ITM for mobile Banking Adoption

Sayyed Khawar Abbas<sup>1</sup>, Hafiz Ali Hassan<sup>1</sup>, Jawad Asif<sup>2</sup>, Bilal Ahmed<sup>2</sup>, Fahad Hassan<sup>1</sup>, Syed Salman Haider<sup>3</sup>

<sup>1</sup>Hailey College of Commerce, University of the Punjab, Gujrat, Pakistan

<sup>2</sup>Lecturer, Department of Commerce, University of Gujrat, Gujrat, Pakistan

<sup>3</sup>Hailey College of Banking and Finance, University of the Punjab, Lahore, Pakistan

**Abstract**— The introduction of mobile banking facility has enabled customers to carry out banking transactions with the use of smartphones and other handheld devices from anywhere. It has become a luxurious and exclusive method of online payments. The recent growth of telecommunication sector and a tremendous increase in mobile usage has opened new doors for sparking future of banking sector industry. The following research is aimed to find out the mobile banking adoption attitudes with the integration of TTF, UTAUT, and ITM models.

**Keywords**— TTF, ITM, UTAUT, Mobile banking, Adoption behaviour, Pakistan.

## I. INTRODUCTION

The outraging technological advancements have made this world a global village. Most of the nations are interacting across borders for their common set of objectives (Hassan, Abbas, & Zainab, 2018). In this scenario, the dependence on online sources for faster communication and liaison of multiple business features has become crucial and employee engagement based on services environment of an organization (Hassan et al., 2018). Therefore, the financial transactions are being carried out through online sources domestically and worldwide (Hong, Thong, Chasalow, & Dhillon, 2011).

Mobile banking is the latest phenomenon in a series of mobile technology advancements. Although the availability of ATM (Automated Teller Machine), internet and telephone banking offers a variety of swift delivery service channels for traditional banking products, mobile banking is rapidly growing as a newest delivery source in developed and underdeveloped countries simultaneously (Safeena, Date, Kammani, & Hundewale, 2012). The process of automation, simplification and task competency with the use of latest technology is a pivotal element for adoption behaviour in the modern era (Abbas S. K., Hassan, Asif, Junaid, & Zainab, 2018). The extensive use of smartphones has impelled banks,

software houses, microfinance institutions, and telecommunication service providers to design a new set of applications and products to extend client reach with the provision of more customised services with enhanced efficiency and reliability (Shaikh & Karjaluoto, 2015). Similarly, the consumer credit market boosted its market share with the introduction of a variety of credit services through banks and other institutions (Abbas S. K., Hassan, Hashmi, & Waqar, 2018).

Despite such benefits and task expectancy, the use of smartphones and personal digital assistants to conclude mobile banking transactions or to access financial information is relatively low as expected (Luarn & Lin, 2005). According to Juniper Research (2013), it was proposed that approximately one billion people will be expected to use mobile banking by 2017 whereas, the level represents only 15% and half of the mobile users are non-banking users. There are many reasons which are account for low tendency including various types of financial, credit, and other risks associated with online transactions. Furthermore, the low-income level is also responsible for, especially in underdeveloped nations (Abbas S. K., Hassan, Asif, & Zainab, 2018). According to Abbas et al. (2018), the remodelling of risk management measures is crucial for banking sector performance. The introduction of more secure ways of online transactions and safeguard measures in case of uncertainty occurrence will help to get trust from potential consumers.

According to Afshan & Sharif (2016), the telecommunication sector of Pakistan is growing multifold during the last decade. In the year 2014, Pakistan ranked 8<sup>th</sup> for mobile usage all across the globe with more than 140 million users and 322, 683 million revenues (PTA, 2014). The outraging mobile usage has opened new market opportunities for banks and other financial institutions in the form of mobile banking concept as well as people are widely adopting this trend not



only in developed but also in underdeveloped countries.(Ahmed, Ammar, & ALI, 2016).

## II. LITERATURE REVIEW

Mobile banking is known as SMS banking, electronic banking or agile banking(Vaidya, 2011). According to Zhou, Lu, & Wang (2010), mobile banking termed as phone banking is a mechanism in which banking customer can access his account information and perform online financial transactions with his internet-enabled smartphone or personal digital assistants (PDA's) by accessing bank's online server via wireless application protocol (WAP).

Shaikh & Karjaluo(2015), stated mobile banking was first introduced in 1990 by German company Paybox in collaboration with Deutsche Bank. At first, mobile banking was introduced and tested in European countries including Spain, Sweden, Germany, UK, and Austria. In developing countries, Kenya was the first one to introduce text-based mobile banking. Later on, it was dispersed all over the world. Several researchers have named mobile banking differently such as branchless banking (Ivatury & Mas, 2008), mobile payments, m-transfers, m-finance,(Donner & Tellez, 2008) and pocket banking (Safeena, Date, Kammani, & Hundewale, 2012). Hence, Lee, & Cheng(2007), argued m-banking is an application of mobile commerce where mobile consumers access their bank accounts through their smartphones. The mobile banking facility comes free from spatial constraints compared to Internet-based banking and consumers have the liberty to access their real-time accounts anywhere (Luo, Li, Zhang, & Shim, 2010).

The concept of mobile banking is completely based on information technology structure. Information sharing effects broadly to employees working behaviour(Hassan, Asif, Waqar, Khalid, & Abbas, 2018).Moreover, price, information and social context affect the consumption pattern(Hassan H. , Abbas, Zainab, Waqar, & Hashmi, 2018) and Sharia screening process screening process also has some similarities with a country like Malaysia(Waris, Hassan, Abbas, Mohsin, & Waqar, 2018) .It has seen that firms deficit normally emphasises on capital raising through equity in Pakistan(Asif, Abbas, & Hassan, 2018) , so, people considered more vigilant with their transaction day to day banking. Zhou, Lu, Wang (2010), explained mobile user adoption is based on various factors like a relative advantage, perceived usefulness, perceived ease of use, and technology acceptance. Junglas et al. (2008), explained advancement in technology might not lead to adoption if it is not fulfilling consumers' need, desire or perceptions. Whereas, people tend to follow technological advancements which are in line

with their requirements and also improve their routine life (Goodhue & Thompson, 1995).

The mobile banking usage research has enriched the information technology literature via business context not only in practical life but also in academic research field(Oliveira, Faria, Thomas, & Popovič, 2014). Previously, various methods and techniques are being applied while exploring mobile banking adoption behaviors including TAM (technology acceptance model) presented by (Davis, 1989), IDT (innovation diffusion theory) by (Rogers, 1995), TTF (task-technology fit) from (Goodhue & Thompson, 1995) and UTAUT (unified theory of acceptance and usage of technology) by (Venkatesh, Morris, Davis, & Davis, 2003). Further, (Zhou, Lu, & Wang, 2010) integrates TTF and UTAUT models for mobile banking adoption.

TTF model explains the acceptance of new technology is thoroughly dependent on its task fulfilment characteristics. Likewise, the technology must be failed if is not fulfilling the desired need or unable to improve routine life (Goodhue & Thompson, 1995). The TTF model consists of four dimensions including task characteristics, task-technology, technology fit and use. The said model is widely used for research purposes like (Dishaw & Strong, 1999), concluded research with the integration of TTF and TAM models. Similarly, Lee et al. (2007), modified TTF model while examining the mobile commerce adoption attitudes followed by (Zhou, Lu, & Wang, 2010) completed their mobile banking behaviour research by assimilation TTF and UTAUT Models and (MHA, 2015)integrated TAM with perceived risks and benefits.

UTAUT is an extension of TAM model. The model not only explores the intention towards technological advancement but also examine subsequent behaviour. It includes three antecedents, effort expectancy, performance expectancy and social influence. The UTAUT model is bravely used for technology acceptance behaviours. Subsequently, (Oliveira, Faria, Thomas, & Popovič, 2014 and Afshan & Sharif, 2016) integrates task-technology fit, performance expectancy, technology characteristics, performance expectancy and initial trust model while exploring mobile banking adoption behaviours. The results of the studies above have explained these factors significantly impact the latest technology and mobile banking adoption behaviours.

## III. METHODOLOGY

Mobile banking is quite a new emerging technological fit for the upcoming banking system. It came with several pros and cons of the system. So, initially, this study utilises the questionnaire to collect the data. A questionnaire used by (Abbas S. , Hassan, Iftikhar, & Waris, 2018) and (Oliveira,

Faria, Thomas, & Popovič, 2014) adopted for the study. The study uses the snowball sampling of the non-probability sampling technique. This study contains the setting of non-contrived and having minimal interference of researchers. Sampling frame contains larger cities of Pakistan which includes Islamabad, Karachi, Lahore, Gujranwala and Multan. Questionnaire distributed through email. Initially, 900 questionnaires were distributed, but only 751 responses were complete. Following model been studied in this study.

$$MBA = \alpha + \beta TTF + \beta UTAUT + \beta ITM + \varepsilon$$

MBA = Mobile Banking adoption

TTF= Task-Technology Fit

UTAUT= unified theory of acceptance and usage of technology

ITM= Initial Trust Model

Data collected from the questionnaire tested for its normality. Normality condition is fulfilled. Cronbach's Alpha was also around 0.70 for all of the constructs. So, reliability condition is also full filled. Data contains the 67% male and 33% females. Ages of the respondents were between 18 to 40 years. The majority were between 25 to 35 years and male.

#### IV. RESULTS

Dependent variables were dichotomous, so binary logistic regression model is used for analysis. Following table represents the results.

<i>Variables in the equation</i>			
	<b>B</b>	<b>S.E.</b>	<b>Sig.</b>
TTF	.323**	.033	.024
PE	.103**	.011	.045
EE	.307**	.020	.029
SI	.133***	.031	.003
FC	.210**	.091	.021
IT	.307**	.054	.017
Constant	.233	.235	.129

\*\*p<.05 \*\*\*p<.01

Above table shows the values of TTF (0.323) and IT (.307), it means both TTF and IT having strong positive relation with mobile banking adoption. Both are having significance at 5% level of significance. Whereas shaded area in the table shows the UTAUT components, an overall glance shows positive significance too. But delineate description shows PE (.103), EE (.307), FC (.210) having a strong positive relationship with mobile banking adoption at 5% level of significance whereas, SI (.133) having a strong positive relationship at 1% level of significance. It shows that Social influence in Pakistan has a significant role that other UTAUT components. Overall R square explains 67% to mobile banking adoption concerning TTF, UTAUT and ITM. Standard errors are less than beta, so data normality also confirmed here. Major parts of results are consistent with (Abbas S. , Hassan, Iftikhar, & Waris, 2018) and (Abbas S. K., Hassan, Asif, Junaid, & Zainab, 2018). Whereas, rest of the results are consistent with (Oliveira, Faria, Thomas, & Popovič, 2014).

#### V. CONCLUSION

Concluding the study results, it can be inferred that all three models TTF, UTAUT and ITM explains the mobile banking

adoption in Pakistan UTAUT and ITM effects the intention to mobile banking adoption whereas TTF directly affects the mobile banking adoption. In the presentence of current results, it can understand that although UTAUT model is having stronger significance concerning Social influence the nature of significance and relation is same for both other models to mobile banking adoption. In Pakistan, Mobile banking adoption along with all other pros and cons are working and having scope to enhance its productivity. Technological aspect can be modified and can be a strong significant part later with the enhancement of technology. Whereas, Trust factor provides a very important role. Initially, people will trust mobile banking so that mobile banking can be enhanced. It could widen the base of mobile banking users in a very significant way. But Govt. and all other regularity authorises required to spread the mobile banking phenomenon through seminars and awareness schemes. So, their investment could get productivity level. This study is having the implications for regularity authorities, Mobile banking providers and Mobile banking users. Moreover, future researchers could develop a unique mechanism with timing, venality and political instability

along with mobile banking adoption. It could show some interesting results and findings for future research.

### REFERENCES

- [1] Abbas, S. K., Hassan, H. A., Asif, J., & Zainab, F. (2018). HOW INCOME LEVEL DISTRIBUTION RESPONDS TO POVERTY: EMPIRICAL EVIDENCE FROM PAKISTAN. *Global Scientific Journals*, 6(3), 131-142.
- [2] Abbas, S. K., Hassan, H. A., Asif, J., Junaid, H. M., & Zainab, F. (2018). What are the key determinants of mobile banking Adoption in Pakistan? *International Journal of Scientific & Engineering Research*, 9(2), 841-848.
- [3] Abbas, S. K., Hassan, H. A., Hashmi, Z. M., & Waqar, N. (2018). HOW COGNITIVE, EMOTIONAL AND BEHAVIORAL DETERMINANTS AFFECT CONSUMER CREDIT APPROACH? *Global Scientific Journals*, 6(3), 164-171.
- [4] Abbas, S., Haider, S., Zainab, F., Hassan, H., & Fazal, A. (2018). Why remodeling of risk management Practices in banking is required? Evidence from Pakistan. *International Journal of Scientific & Engineering Research*, 9(2), 686-691.
- [5] Abbas, S., Hassan, H., Iftikhar, S., & Waris, A. (2018). Assimilation of TTF and UTAUT for Mobile Banking Usage . *International Journal of Advanced Engineering, Management and Science* , 4(4), 305-308.
- [6] Afshan, S., & Sharif, A. (2016). Acceptance of mobile banking framework in Pakistan. *Telematics and Informatics*, 33(2), 370-387.
- [7] Ahmed, E. M., Ammar, A., & ALI, A. E. (2016). SUDANESE MICROFINANCE SERVICES PROVIDERS DRIVERS FOR INTENTION TO ADOPT MOBILE BANKING. *The Journal of Internet Banking and Commerce*, 21(3), 1-12.
- [8] Asif, J., Abbas, S., & Hassan, H. (2018). Valuation Based Test of Market Timing Theory. *International Journal of Academic Multidisciplinary Research* , 2(4), 28-30.
- [9] Davis, F. D. (1989). Perceived usefulness, perceived ease of use, and user acceptance of information technology. *MIS quarterly* , 319-340.
- [10] Dishaw, M. T., & Strong, D. M. (1999). Extending the technology acceptance model with task-technology fit constructs. *Information & Management*, 36(1), 9–21.
- [11] Donner, J., & Tellez, C. (2008). Mobile banking and economic development: linking, adoption, impact, and use. *Asian J. Commun.* , 18 (4), 318–332.
- [12] Goodhue, D. L., & Thompson, R. L. (1995). Task-technology fit and individual performance. *MIS quarterly*, 213-236.
- [13] Hassan, H. A., Abbas, S. K., & Zainab, F. (2018). ANATOMY OF TAKAFUL. *Global Scientific Journals*, 6(3), 143-155.
- [14] Hassan, H., Abbas, S. K., Iftikhar, S., Waqar, N., & Waris, A. (2018). Determinants Of Employee Engagement Practices In IT Sector. *INTERNATIONAL JOURNAL OF SCIENTIFIC & TECHNOLOGY RESEARCH*, 7(5), 156-158.
- [15] Hassan, H., Abbas, S., Zainab, F., Waqar, N., & Hashmi, Z. (2018). Motivations for Green Consumption in an Emerging Market . *Asian Journal of Multidisciplinary Studies*, 6(5), 7-12.
- [16] Hassan, H., Asif, J., Waqar, N., Khalid, S., & Abbas, S. (2018). The Impact of Knowledge Sharing On Innovative Work Behavior . *Asian Journal of Multidisciplinary Studies*, 6(5), 22-25.
- [17] Hong, W., Thong, J. Y., Chasalow, L. C., & Dhillon, G. (2011). User acceptance of agile information systems: A model and empirical test. *Journal of Management Information Systems*, 28(1), 235-272.
- [18] Ivatury, G., & Mas, I. (2008). *The early experience with branchless banking*. . CGAP Focus Note, No. 46,.
- [19] Junglas, I., Abraham, C., & Watson, R. T. (2008). Task-technology fit for mobile locatable information systems. *Decision Support Systems*, 45(4), 1046–1057.
- [20] Juniper Research. (2013). *Mobile banking handset and tablet market strategies*. Juniper Research.
- [21] Lee, C. C., Cheng, H. K., & vCheng, H. H. (2007). An empirical study of mobile commerce in insurance industry: Task–technology fit and individual differences. . *Decision Support Systems* , 43(1), 95-110.
- [22] Luarn, P., & Lin, H. H. (2005). Toward an understanding of the behavioral intention to use mobile banking. *Computers in Human Behavior*, 21(6), 873–891.
- [23] Luo, X., Li, H., Zhang, J., & Shim, J. P. (2010). Examining multi-dimensional trust and multi-faceted risk in initial acceptance of emerging technologies: An empirical study of mobile banking services. . *Decision support systems* , 49(2), 222-234.
- [24] MHA, K. (2015). A mobile banking adoption model in the Jordanian market: an integration of TAM with perceived risks and perceived benefits. *Journal of Internet Banking and Commerce*, 20(3), 1.
- [25] Oliveira, T., Faria, M., Thomas, M. A., & Popovič, A. (2014). Extending the understanding of mobile banking

- adoption: When UTAUT meets TTF and ITM. *International Journal of Information Management*, 34(5), 689-703.
- [26] PTA. (2014). *Pakistan Telecommunication Authority Govt Agency*.
- [27] Rogers. (1995). *Diffusion of innovations (3 ed.)*. New York: New York Free Press.
- [28] Safeena, R., Date, H., Kammani, A., & Hundewale, N. (2012). Technology adoption and Indian consumers: study on mobile banking. *International Journal of Computer Theory and Engineering*, , 4(6), 1020.
- [29] Shaikh, A. A., & Karjaluoto, H. (2015). Mobile banking adoption: A literature review. . *Telematics and Informatics*, 32(1), 129-142.
- [30] Vaidya, S. R. (2011). "Emerging Trends on Functional Utilization of Mobile Banking in Developed Markets in Next 3-4 Years". *International Review of Business Research Papers* , 7(1), 301 – 312.
- [31] Venkatesh, V., Morris, M. G., Davis, G. B., & Davis, F. D. (2003). User acceptance of information technology: Toward a unified view. . *MIS quarterly*, , 425-478.
- [32] Waris, A., Hassan, H., Abbas, S., Mohsin, M., & Waqar, N. (2018). Sharia Screening Process: A Comparison of Pakistan and Malaysia. *Asian Journal of Multidisciplinary Studies*, 6(5), 13-21.
- [33] Zhou, T., Lu, Y., & Wang, B. (2010). Integrating TTF and UTAUT to explain mobile banking user adoption. *Computers in Human Behavior*, 26(4), 760-767.

# Senti-Lexicon and Analysis for Restaurant Reviews of Myanmar Text

Yu Mon Aye, Sint Sint Aung

University of Computer Studies, Mandalay

**Abstract**— Social media has just become as an influential with the rapidly growing popularity of online customers reviews available in social sites by using informal languages and emoticons. These reviews are very helpful for new customers and for decision making process. Sentiment analysis is to state the feelings, opinions about people's reviews together with sentiment. Most of researchers applied sentiment analysis for English Language. There is no research efforts have sought to provide sentiment analysis of Myanmar text. To tackle this problem, we propose the resource of Myanmar Language for mining food and restaurants' reviews. This paper aims to build language resource to overcome the language specific problem and opinion word extraction for Myanmar text reviews of consumers. We address dictionary based approach of lexicon-based sentiment analysis for analysis of opinion word extraction in food and restaurants domain. This research assesses the challenges and problem faced in sentiment analysis of Myanmar Language area for future.

**Keywords**—Dictionary-based, Myanmar Language, Opinion Word Extraction, Senti-Lexicon, Sentiment Analysis

## I. INTRODUCTION

Nowadays, people are thrilled in online communication according to the rapid growth and development of World Wide Web. People express their opinion in social media with contents are usually unstructured texts. In Natural Language Processing, sentiment analysis (opinion mining) is an emerging field of artificial intelligence deals with analyzing opinions, sentiments and emotions articulated in informal data. Sentiment lexicons and opinion words extraction are main part of sentiment classification system.

There are no various resources and tools in sentiment analysis for Myanmar Language such as corpora, sentiment lexicons and dictionary. So, we faced challenges and language specific problem. When writing social media texts, there are mainly two style of writing such as formal and informal style Textual reviews may contain sufficient information but it is often complex to work for unstructured review.

There is a problem that inconsistency of customer review between star rating and text reviews. This paper tackles the textual reviews to extract information. This information is vital for customers and organizer.

This paper is structured into seven sections. Section 2 provides state of art for other language. In section 3, the methods in sentiment classification are discussed. The center contribution of this paper is expressed in section 4. Section 5 shows in detail how to extract the opinion words, the way it is used to extract from Myanmar's text reviews. Section 6 gets the experiments to evaluate the work. In section 7, the last section concludes the paper and also presents an evaluation of this method.

## II. LITERATURE REVIEW

Many studies have been carried out in the sentiment analysis. Researchers have proposed various approaches and developed different systems to deal with the problem. Most of systems are developed for the English language. In this section, we discuss the related works of sentiment analysis for other languages.

Rehman and Bajwa [10] presented Lexicon-based sentiment analysis for Urdu Language. This research intends at generating an application of Urdu comments on a variety of websites. Convolutional system architecture is conversed in specify with techniques employed; experiment process and establish results of 66% accuracy are premeditated and F-measure is 0.73.

Wu, et.al. [2] Discussed several common sentiment dictionaries into a larger dictionary. They expressed a language independent method of integrating existing sentiment dictionaries with value extrapolated from seed words. They built an evaluation Chinese Sentiment dictionary based on commonsense facts for sentiment classification of song lyrics system. They compared the performance iSentiDictionary with ANEW, SenticNet and SentiWordNet.

Akhtar, Ekbal and Bhattacharyya [5] proposed aspect based sentiment analysis in Hindi for resource construction and assessment. They assessed the dispute of sentiment in Hindi by providing benchmark setup by creating an annotated dataset of high quality with product



reviews from diverse online resource. This paper used CRF and SVM of classification algorithm for aspect term extraction and sentiment classification. The average F-measure is 41.09% for aspect extraction and 54.05% is the result of sentiment classification.

Santarcangelo, et.al [8] proposed an approach of Italian Language for social opinion mining by considering the state of art. They showed interesting approach based on Adjective, Intensifier and Negation (AIN) approach is built-up for Italian. This approach is based on the use of an Italian Sentiment Thesaurus developed by the writer and presented.

### III. METHODOLOGY

Sentiment analysis can be classified into two approaches such as machine learning approach and lexicon based approach. Lexicon based approach handle by searching the sentiment words from the sentence and then compare with seed words. Two branches of this approach are dictionary and corpus based approach.

Machine learning contends with sample review for the sentiment words. There are two approaches in this approach. First, unsupervised approach which compares each word of the text with valued of positive and negative word for ranking. Second, supervised approach which uses equations to obtain the sentiment and various machine learning algorithms are used for sentiment classification. In this paper, we used lexicon based approach in our study.

#### 3.1. Lexicon Based Approach

Sentiment words are used in many tasks of sentiment classification. The lexicon based approach is based on the statement that the appropriate sentiment orientation is the sum of the each sentiment words or phrases. This approach is an unsupervised learning approach since it does not require prior training datasets. Lexicon based approach deals with searching the lexicons such as adjective, adverb, verb, etc. from the sentence and comparing with seed words. Two approaches are: Dictionary Based Approach and Corpus Based Approach [3, 6]. In this paper, we used the dictionary based approach for sentiment analysis of Myanmar Language.

##### 3.1.1. Dictionary Based Approach

Sentiment words are collected manually to form a small list, which is later developed by searching more words from a known corpora wordnet. Wordnet is a corpora which produces synonyms and antonyms for a word. The new words found exclusive of the seed words are included to the list. The process continues until now new words are found from the corpora [3].

##### 3.1.2. Corpus Based Approach

This approach is to resolve the problem of dictionary based approach. Corpus based approach is not as efficient as dictionary based approach because there is a

need to make a huge corpus for covering words and this approach is very difficult task [3]. It requires annotated training data to produces accurate semantic word.

#### 1.2. Approach for Creation of Senti-Lexicon

There are two approaches to build the resource of sentiment lexicon are manual and automated.

##### 3.2.1. Manual Creation of Sentiment Lexicons

Opinion lexicons are manually created which involves simply make a decision on the structure of the sentiment lexicon and annotate the list of lexicon with their polarity value. The list can be attained from the corpus and dictionary. As an outcome, no computational or algorithmic complexity is occupied. This is beneficial property for sentiment classification using an accurate resource is bound to execute better. However, the problem of this approach is time consuming.

##### 3.2.2. Automatic Creation of sentiment Lexicons

Automatic methods are to overcome the disadvantage of manual sentiment lexicons creation. One of the most popular of several methods is to create the set of starting seed words with known sentiment orientation but enlarge the seed using an offered lexical resource. The advantages of an autonomous approach to the promise of high coverage are achieved only by compliance with its accuracy dictionary, as the methods used are perfectly excellent [4].

### IV. BUILD LANGUAGE RESOURCES

The proposed system creates own dataset and extract the sentiment lexicon from the sentence.

#### 4.1 Corpus Creation

We faced the largest problem which is the lack of available annotated data for Myanmar Language. To overcome this difficulty, we built the resource for our own corpus. We manually collected reviews of restaurants from the social media (Facebook). This corpus contains the objective and subjective reviews such as positive, neutral, negative reviews and mixed by writing with formal and informal style without any segmentation. Customers write the review with different opinion. Some write only positive review or negative review. Some writes the mix opinion both positive and negative reviews. Some reviews are not clear for their opinion.

In this paper, we collect 800 reviews of customers for food and restaurant domain from social media facebook page. These reviews contain opinionative and non-opinionative reviews. Sample of reviews are shown in Table 1.

Table 1. Sample of Restaurants' reviews.

Positive	အရသာကောင်းသော ဟင်းဖွယ်များ (good taste dishes)
----------	---

Negative	ဝန်ဆောင်မှုတော်တော်ညံ့ပါသည် (bad customer service)
Neutral	ဈေးနှုန်းကတော့ ပုံမှန်ပါပဲ (price is regular)
Objective	စားချင်တယ် ဘယ်ကလဲ မကွေးကောရှိလား (I would like to eat this food. Where does this restaurant locate? Is this located in Magway city?)

### 1.3. Creation of Myanmar Senti-Lexicon for food and restaurants' domain

Senti-Lexicon is a lexical resource for sentiment classification which is a database of lexical element for a language beside with their sentiment orientations. This section presents the creation of Myanmar Senti-Lexicon for food and restaurant domain. These are no any reference resources to classify the sentiment orientation in Myanmar Language. Therefore, in this thesis a lexicon that includes the sentiment words associated with a restaurant review is constructed by analyzing the restaurant reviews. We collect manually sentiment bearing words from the restaurants' reviews based on our knowledge and grew by searching more antonyms and synonyms for Myanmar Language. We made by using a based dictionary that available from Myanmar Lexicon (Version 2)-Lexique Pro. A small set of sentiment words for food and restaurants' reviews of customers' emotion are collected. And we also collect emoticons which are used to express their feeling.

We assign the polarity of the sentiment words and emoticons such as positive, negative and neutral with their target such as food and taste, place, price, staff, service and common. We change the polarity of each sentiment word into a numeric value to calculate the further computation i.e. positive=1, Negative=-1, Neutral=0. We collected 872 (817 sentiment words and 55 emoticons) which included 425 positive words, 428 negative words, 19 neutral. The sentiment lexicon (L) is made up of a set as

$$L=\{\text{Target, Sentiment word, POS, Polarity}\}$$

The value that corresponds to target is a subject matter that expresses an emotion. This represents an evaluative attributed such as food and taste, place, price, staff and service that can feel when visiting a restaurant and sentiment lexicon is added to the previous work [12]. When target is not shown explicitly, it is expressed as common. Sentiment word expresses an emotional word. POS expresses a part of speech of the emotive word. A polarity is expressed as positive, negative or neutral of the emotional word. Additionally, a word such as “စား(eat)”, which carries little emotive meaning, is eliminated [13].

Table 2. Example of Senti-Lexicon for Food and Restaurant domain

Target	Sentiment word	POS	Polarity
Food & taste	ညှို့စော်နံ (smell acrid)	Verb	Negative
Place	ကျဉ်းကျပ် (cramped)	Adj	Negative
Service	ချက်ချင်း (immediately)	Adv	Positive
Staff	ပျူဇာ (be cordial)	Verb	Positive
Price	သက်သာ (be cheap)	Verb	Positive

### 1.4. Emoticons

Users of social media use a variety of emoticons such as :) :-) :D :-( and :P. Emoticons have been widely used in sentiment analysis as features or as entries of sentiment lexicons. Customers write the reviews with emoticons to express their feeling. This paper collects the 21 category of emoticons to classify the polarity of reviews such as happiness/smile, wink, amused, kiss, thumbs up, etc and included 55 emoticons icon [1].

Table 3. Example of Emoticons.

Emoticons	Category	Polarity
:)	Happiness/smile	Positive
:(	Sadness	Negative
:P	Kidding	Positive
:’(	Cry	Negative

## V. OPINION WORD EXTRACTION OF MYANMAR LANGUAGE

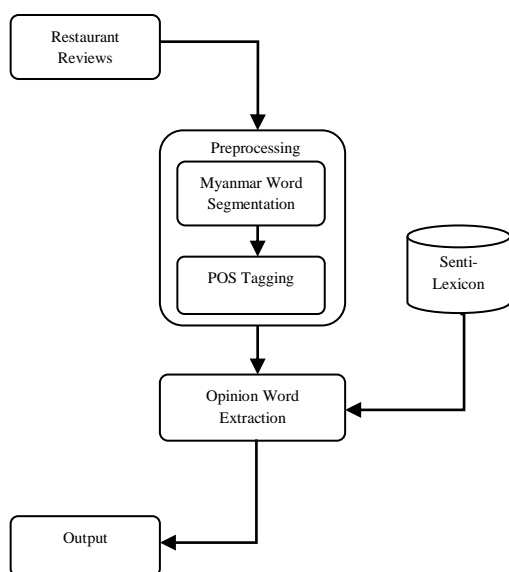


Fig. 1: System Architecture for Opinion Word Extraction

This section describes a method for performing of sentiment classification of restaurants' review by using lexicon based sentiment analysis. Opinion words extraction is also the essential part of the sentiment classification system. In this paper, we propose opinion word extraction for Myanmar restaurant reviews.

### 5.1. Preprocessing of Myanmar Text

Input texts of sentiment analysis are restaurants' reviews from social media which are Myanmar texts. Myanmar text is a sequence of characters without word boundary delimiters. Texts are written in string from left to right with no explicit word boundary markup. We need preprocessing steps of Myanmar reviews for informal and formal texts.

#### 5.1.1. Segmentation of Myanmar Syllable

A syllable is a fundamental sound or sound unit. A word consists of one or more syllables. A Myanmar syllables has a base character, a post-base, an above based and a below base character. A syllable is formed based on rules that are quite specific and unambiguous in Myanmar text. An approach of rule based heuristic applies for segmentation of Myanmar syllable [11].

The following six syllable segmentation rules were proposed in [7] is used for syllable segmentation.

1. Single character rule
2. Special ending characters rule
3. Second consonant rule
4. Last character rule
5. Next starter rule
6. Miscellaneous rules (Non-Myanmar characters, Numeric characters, Punctuation marks, spaces and similar characters)

### 5.1.2. Syllable Merging

The next step is to merge the segmented syllables into words. Dictionary based approach with longest matching is used to perform syllable merging. Word segmentation for Myanmar language is an essential part which is prior to natural language processing (NLP). Syllable segmentation and syllable merging are two steps of Myanmar word segmentation [7].

The two methods of word segmentation can be roughly classified into dictionary-based and statistical methods. In dictionary-based methods, only words that are stored in the dictionary can be identified and the performance depends to a large upon the coverage of the dictionary. New words appear constantly and thus, increasing size of the dictionary is a not a solution to the out of vocabulary word (OOV) problem [9].

Although statistical approaches can identify unknown words by utilizing probabilistic and also suffer from some drawbacks. The main issues are: this approach requires large amounts of data and the processing time required. For low-resource languages such as Myanmar, there is no freely available corpus. We faced linguistic specific problem for the lack of resource such as lexicon and corpus for Myanmar sentiment classification. There is no large amount of data reviews to use this approach [9].

### 5.1.3. Part-of-Speech (POS) tagging

Part-of-Speech tagging is the makeup of assigning the suitable part of speech or lexical type. POS tagging is a primary task in Natural Language Processing (NLP).

### 5.2. Opinion Word Extraction

Opinion words are extracted from reviews based on Myanmar sentiment lexicon of food and restaurants domain such as Adjective, Verb, Adverb, Noun and emoticons. And the polarity is assigned to each word match with sentiment dictionary. An objective review based on fact information, while a subjective review expresses some personal opinions, beliefs, feelings, or impression. We also extract the opinion word with negation (not such as မ, မ---ဘူး).

Example: ဒီနေ့ မှာစားတာ အရမ်းစားကောင်းတယ် လာပို့တာလဲ မြန်တယ် (Today, very good taste and fast delivery service.)

Opinion word extraction: ကောင်း(good), မြန်(fast)

These reviews express the opinion and feeling. We can extract the sentiment words match with sentiment dictionary.

## VI. EXPERIMENT AND RESULT



Customers write the reviews which contain the opinion words about their feeling, opinion and emotion. These opinion words are important to classify the polarity of sentiment analysis. In this section, we describe the extraction of opinion words from customers' reviews of Myanmar Language. In this paper, we used 500 customers' reviews to extract the opinion words by using the proposed 872 Myanmar Senti-Lexicon of food and restaurant domain.

Table 4. Opinion words extraction of Sample Reviews

Customers' Reviews	Extracted Opinion words from customers' reviews
အလွန်ကောင်းတယ် သန့်ရှင်းတယ် ဝန်ထမ်းတွေလည်း ဖော်ရွေတယ် (Good taste, clean and affable staff)	ကောင်း(good), သန့်ရှင်း(clean), ဖော်ရွေ(affable)
ကြိုက်တယ် မြန်မာမုန့်တွေက သန့်ရှင်းတယ် (I like Myanmar snacks and clean.)	ကြိုက်(like), သန့်ရှင်း(clean)
အရမ်းစားလို့ကောင်းတဲ့ ဆိုင်လေးပါ။အေးချမ်းပြီး ဝန်ထမ်းတွေလဲ ပျူငှာကြပါတယ် ဈေးနှုန်းလဲ သင့်တင့်ပါတယ် (This restaurant is good taste, frosty and cordial staff, decent price)	ကောင်း(good), အေးချမ်း(frosty), ပျူငှာ(cordial), သင့်တင့်(decent)
အရသာနဲ့ ပေးရတဲ့ဈေးမဆိုးပါဘူး (taste and price are not bad)	မဆိုးဘူး(not bad)
ဝန်ထမ်း ဆက်ဆံရေးညံ့ (employee relation is bad)	ညံ့ (bad)
နေရာလည်းကောင်း အင်တာနက်လည်းကောင်း :) (good place and internet is good connection)	ကောင်း(good), :) (emoticon)
တော်တော်လေး စိတ်ပျက်မိတယ် :' (somewhat disappoint)	စိတ်ပျက်(disappoint), : '(emoticon)

Casher က တစ်ခုတည်းနဲ့တန်းစီစောင့်ရတာ လုံးဝအဆင်မပြေပါဘူး (It is not convenience to wait with only one cashier.)	စောင့်(wait), အဆင်မပြေ(inconvenience)
စားကြည့်ချင်တယ် ကွေ့တီယိုက ဘာလဲ မသိလို့နော် (I would like to eat "kwe ti yo", and what is it? I don't know.)	-
မနေ့ညက ကြက်သားအလူး ကတ်သလိပ် ၁ပွဲ ၂၅၀၀နဲ့ ဝယ်စားတယ် (Yesterday, I ate "chicken potato" with 2500 kyats.)	-

Evaluation is used to calculate the overall performance of the proposed system with opinion word identification, error of extracted opinion words and not extracted opinion words. We compared with manually extracted opinion words 1113 which contains 38 emoticons icons from 500 reviews which are chosen randomly from 800 reviews. In this experiment, we cannot extract 66 opinion words from the review and extract 98 opinion words incorrectly. We can extract all of 38 emoticons icons and 977 opinion words contain in the customers' reviews correctly.

Accuracy = no. of correct opinion word extraction

Table 5. Analysis of Opinion Words Extraction

Description	Result
Accuracy of Opinion word extraction (contains 3% of emoticon icon extraction)	85%
Error of Opinion words extraction (cannot extract the opinion word (6%) + incorrectly extracted opinion word (9%))	15%

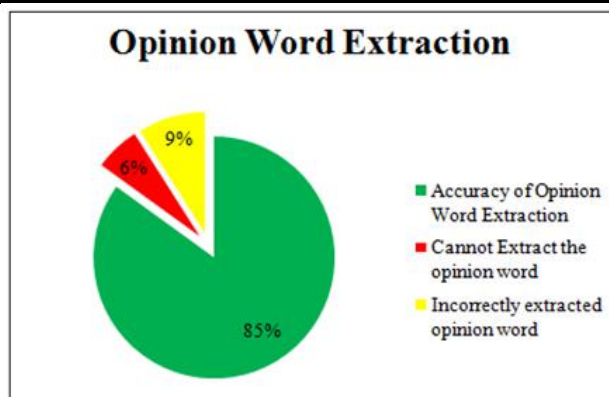


Fig. 2: Result of Opinion Word Extraction

We can extract 85% accuracy for the opinion words from the customers' reviews. This is important in sentiment analysis for food and restaurant domain and aims to classify the polarity by using this sentiment words for the sentiment analysis of the customers' reviews to develop the business.

## VII. CONCLUSION

This paper built the Senti-Lexicon using manual approach to over the challenges and language specific problem. We used lexicon based approach to extract the sentiment word extraction. This system tested with 500 customers' review randomly without unseen reviews and simple. In this paper, we proposed the resources for food and restaurant domain of Myanmar Language and analysis of opinion word extraction. We can extract opinion words 85% correctly with proposed lexicon. This lexicon does not contain the informal opinion words and cannot extract the informal opinion words from informal reviews. We extracted the opinion words incorrectly from comparison reviews and due to spelling error. For future work, we need to improve the performance of opinion words extraction, to cover both formal and informal reviews and to classify the subjectivity classification contain sentiment analysis such as subjective review (positive, negative or neutral) reviews and objective reviews.

## REFERENCES

- [1] Vashisht, G. and Thankur, S. (2014). Facebook as a Corpus for Emotions-Based Sentiment Analysis. In *IJETA*, 904-908.
- [2] Wu, H.H., Tsai, A.C.R., Tsai, R.T.H. and Hsu, J.Y.J. (2013). Building a Graded Chinese Sentiment Dictionary Based on Commonsense Knowledge for Sentiment Analysis of Song Lyrics. In *Journal of Information Science and Engineering*, 647-662.
- [3] Haseena Rahmath, P., and Ahmad, T.(2014). Sentiment Analysis Techniques - A Comparative Study. In *IJCEM International Journal of Computational Engineering & Management*, Vol. 17, Issue 4, 25-29.
- [4] Korayem, M., Crandall, D., Abdul-Mageed, M. (2012, December). Subjectivity and Sentiment Analysis of Arabic: A Survey. In *International Conference on Advanced Machine Learning Technologies and Applications*, 128-139.
- [5] Akhatar, M. S., Ekbal, A. and Bhattacharyya, P. (2016). Aspect based Sentiment Analysis in Hindi: Resource Creation and Evaluation, In *LREC*, 2703-2709.
- [6] Rohini,V and Thomas, M. (2015). "Comparison of Lexicon based and Naïve Bayes Classifier in Sentiment Analysis", In *IJSRD - International Journal for Scientific Research & Development*, Vol. 3, Issue 04, 1265-1269.
- [7] Thet, T.T, Na, J.C and Ko, W.K. (2008). Word segmentation for the Myanmar language. In *Journal of Information Science*, 34 (5), 688-704.
- [8] Santarcangelo, V., Oddo, M. Pilato, G., Valenti, F. and Fornaro, C. (2015). Social Opinion Mining: an approach for Italian language. In *International Conference on Future Internet of Things and Cloud*, IEEE, 693-697.
- [9] Teahan, W. J., Wen, Y., McNab, R., and Witten. I. H. (2000). A compression-based algorithm for Chinese word segmentation. *Computational Linguistics*, 26(3), 375-393.
- [10] Rehman. Z.U. and Bajwa. I.S. (2016). Lexicon-based Sentiment Analysis for Urdu Language. in *Sixth International Conference on Innovative Computing Technology*, IEEE, 497-501.
- [11] Myanmar lexicon analyzer – Sorting and Segmentation. Retrieved from <https://github.com/minthanthoo/myanmar-collation-stats>.
- [12] Aye, Y.M. and Aung, S.S. (2017). Sentiment analysis for reviews of restaurant in Myanmar Text, In *18th IEEE/ACIS International Conference on Software Engineering, Artificial Intelligence, Networking and Parallel/Distributed Computing (SNPD)*, Kanazawa, Japan, 321-326.
- [13] Kang, H., Yoo, S. J., and Han, D. (2012). Senti-lexicon and improved Naïve Bayes algorithms for sentiment analysis of restaurant reviews. In *Expert Systems with Applications*, 39(5), 6000-6010.

# Applying Soft Computing Techniques in Information Retrieval

Namrata Nagpal

Amity Institute of Information technology, Amity University, India  
Email: nnagpal@lko.amity.edu

**Abstract**— *There is plethora of information available over the internet on daily basis and to retrieve meaningful effective information using usual IR methods is becoming a cumbersome task. Hence this paper summarizes the different soft computing techniques available that can be applied to information retrieval systems to improve its efficiency in acquiring knowledge related to a user's query.*

**Keywords**— *fuzzy logic, information retrieval, IR models, neural networks, soft computing.*

## I. INTRODUCTION

There is an urgent requirement of effective Information Retrieval Systems (IRS) has aroused with the quick growing development of the Internet, and plethora of availability of online text based information. The goal of an IR System is to retrieve relevant information regarding a user's query.

The efficiency of an Information Retrieval System can be calculated using parameters which are prime in order to meet the requirement of the system and accomplish its goal instantly. The keywords put by the user while forming a query as per his requirement is mostly vague and uncertain. Also the document representation as well as the process by which the query is matched to the document is also uncertain. Hence the effectiveness of an Information Retrieval System crucially depends upon the system's capability to deal with the vague and uncertain retrieval process.

There are various techniques utilized for above efficiency; we majorly focus on the significance of soft computing related to artificial neural networks, fuzzy logic, genetic algorithms, or rough sets, to name a few.

The paper states about the significance of information retrieval and various IR models in section 2. Section 3 deals with soft computing techniques available whereas Section 4 specifies the application of soft techniques to improve the information retrieval process.

## II. INFORMATION RETRIEVAL

Information retrieval refers to a task of finding the relevant documents from given a set of documents and applying a user query. Information retrieval applications also require characteristics like accuracy, speed, consistency and ease of use in recovering relevant documents that satisfy user queries. Some required characteristics for efficient information retrieval are as under [2]:

- **Accuracy:** It refers to the relevant correct response of information retrieved in recall i.e., the percentage of relevant information retrieved with high precision.
- **Consistency:** Consistency of data retrieval should be maintained via indexing of the text by the groups of indexers or by the authors.
- **Ease of use:** Information retrieval has become the blood in the vein of the users in current scenario using Internet on daily basis. Hence, it is more of a responsibility now of information retrieval systems to cater user requests with utmost efficiency and effectiveness.
- **Speed:** It refers to the instant time taken in return to searching the given information using fast search techniques like NLP or run as "batch" indexing.

### 2.1 IR MODELS

Information Retrieval (IR) is by far the most sought after process used nowadays with the netizens. It is the process which shows that a data collection is represented, stored, then searched for the purpose of discovering knowledge in response to user's query. Information Retrieval (IR) came into existence in 1950s out of sheer necessity of acquiring information from users' perspective. Since then, there has been a constant development in this field in search of the betterment of IR systems. Several IR systems like google.com have become an everyday commodity and are used by wide variety of users. Thus, Information retrieval has become an integral part of our lives and an ever growing research area too. The quality of information retrieval can be measured using two main features:

- **Precision:** This is the percentage of documents retrieved related to the user's query.

- Recall: This is the percentage of documents that are query related and are actually retrieved.

The fundamental IR models can be classified into Boolean, vector & probabilistic models. Each model has been introduced in its basic format as under:

1. The Boolean model: The Boolean model is the most primitive information retrieval method and one of the most criticized one too. This model takes a query term as an unambiguous definition of a set of documents. The Boolean model makes use of Boolean algebra operators like AND, OR, NOT in formulating a query. The major disadvantage found in this Boolean system is that the model is not able to give ranking to the returned list of documents [4]. This model associates a document and its set of keywords as a part of query separated by AND, OR, NOT. The retrieval function in the end determines if the document is relevant or not.
2. Vector space model: In the Vector Space Model, documents and query are represented as a Vector and the angle between the two vectors are computed using the similarity cosine function as:

$$\text{Sim}(d_j, q) = d_j \cdot q / |d_j| \cdot |q|$$

The Vector Space Model has introduced a weight scheme called *tf-idf weighting*. The new scheme has weights defined as:

- Term frequency (tf): This factor determines the the number of times a term has occurred in the document/ query.
  - Inverse document frequency (idf): This factor measures the inverse of the number of documents that holds a given query / document term [4].
3. Probabilistic Model: The probabilistic model attempts to rank the documents by their probability of relevance of a given query. Binary vectors  $\sim d$  and  $\sim q$  are used to denote the document queries. Each binary vector indicates if a given term or document attribute occurs in the document/ query.

### III. SOFT COMPUTING TECHNIQUES

Soft Computing is a field in CS/IT dealing with the fusion of methodologies that are designed to model and provide solutions to real world problems mathematically. It aims to exploit the uncertainty, imprecision and approximate

reasoning so as to achieve low-cost solutions that are robust and tractable [1]. Its solutions are majorly unpredictable, uncertain and between 0 and 1.

Soft computing is but different from hard computing; it can tolerate imprecision, approximation uncertainty, partial truth. The human mind holds the pivotal position in soft computing. In fact soft computing deals in implementation of optimization techniques to find probable solutions of hard core problems.

Various techniques used under soft computing are genetic algorithms (GA), fuzzy logic (FL), neural networks (ANN), Bayesian networks, machine learning, etc. some of which are described as under:

- Neural networks: Artificial neural network (ANN) is a very demanding field of computer science research in today's era. ANN is an information system whose working and thinking is based on the working of the brain. It is similar to brain in two possible ways:
  - a) ANN acquires knowledge via a set learning process.
  - b) Knowledge is stored in interconnected links called synaptic weights.ANN is mostly used in areas related to weather prediction, pattern recognition, data recognition, stock market prediction, image processing, image compression, to name a few. ANN works best in areas which do not have set algorithms. ANN architecture comprises of three layers: input, hidden and output layer; each layer having many nodes. Back propagation algorithm is the most common method used in ANN networks [5].
- Fuzzy Logic: Fuzzy logic is a rule-based system that relies on the practical experience of an operator. Fuzzy logic was first devised by Dr. Zadeh of University of California at Berkeley during 1960s. Fuzzy logic deals with the concepts which can't be exactly explained in terms of binary 0 or 1. It defines the way of reasoning the Boolean values by giving results between 0 and 1. It is quite similar to the way our brain functions. Fuzzy systems are a part of developing human like capabilities. It reflects to those areas where our solution is not absolute but something fuzzy. Fuzzy logic is a form of artificial intelligence software; therefore, it would be considered to be a subset of AI.
- Genetic algorithms(GA) : Genetic algorithm is a subset of AI and fuzzy logic. It is majorly used to deduce different optimization problems related to real-life applications. The basic idea of any GA is to copy the normal selection of any user the way he would to find a suitable solution for given application. Genetic algorithm is basically machine learning model motivated by the biological evolution model. It solves both the types of problems –



constrained and unconstrained and repeatedly modifies series of individual solutions [6].

The utility of genetic algorithms can be seen in varied fields like climatology, control engineering, automated manufacturing & design, biomedical engineering, games theory, code-breaking, and electronic design.

#### IV. APPLYING SOFT COMPUTING TO INFORMATION RETRIEVAL

A lot of effort has been made to improvise the performance of Information retrieval systems in recent years. Till now the researchers are trying hard to explore the information retrieval systems further by applying new methodologies. Applying soft computing techniques is giving positive results in increasing the efficiency of IR systems. Using the artificial neural networks and fuzzy logic concepts with information retrieval generate altogether a new field called soft information retrieval [7]. Fuzzy set theory is hence applied to increase the flexibility of IR systems. The main vagueness of IR system can be tapped well with the use of fuzzy logic. The main concern of applying fuzzy set theory to IR is:

- How to define the Boolean model representing the documents and the query language.
- How to define the associative mechanism like fuzzy clustering or fuzzy thesaurus.

To solve above mentioned problems, Boolean models have been extended to represent a document as a fuzzy set of terms. Each term has a numeric weight specified which describes the association of keywords to the document's content.

Various other fuzzy methods devised to improve the IR systems can be applying numeric query weights, linguistic query weights, and aggregation operators, fuzzy thesauri of terms or fuzzy clustering of documents.

Another successful method of implementing soft information retrieval is to apply ANN to the IR systems. The efficiency of information retrieval can be improved by applying the Supervised and Unsupervised learning method of neural networks.

Supervised learning method of ANN incorporates an "external teacher" [7]. This teacher then specifies the required output of the Neural Networks. During the initial learning phase, the ANN takes the values of the weights to obtain the required output.

An unsupervised learning procedure is not bothered about any learning or teaching feedback. It aims at applying self-learning. This method is also called "self-organization" because the system relies only upon local information and internal control by using the input patterns. Hence unsupervised learning has become more popular in IR specifically for documents or terms classification & clustering.

#### V. CONCLUSION

Soft computing techniques have become the talk of the town in recent years and a promising area for the researchers to explore. The implementation of soft computing on IR systems to improvise its efficiency has become more important as the power of computer processing devices has increased while the cost has reduced.

The soft computing techniques have become an integral part of our daily life in the form of applying fuzzy logic, expert systems and artificial neural networks to the appliances like cookers, washing machines and refrigerators. Many commercial and industrial applications of soft computing are widely in use and is expected to grow exponentially over the years to come..

The application of soft computing techniques on information retrieval should increase drastically when combined with IoT devices in years to come.

#### REFERENCES

- [1] [http://shodhganga.inflibnet.ac.in/bitstream/10603/10161/1/11\\_chapter%203.pdf](http://shodhganga.inflibnet.ac.in/bitstream/10603/10161/1/11_chapter%203.pdf)
- [2] [http://www.doc.ic.ac.uk/~nd/surprise\\_97/journal/vol2/hks/infor\\_ret.html](http://www.doc.ic.ac.uk/~nd/surprise_97/journal/vol2/hks/infor_ret.html)
- [3] A. Roshdi, A. Roohparvar, "Review: Information Retrieval Techniques and Applications", International Journal of Computer Networks and Communications Security, VOL. 3, NO. 9, SEPTEMBER 2015
- [4] D.Hiemstra,P. de Vries, "Relating the new language models of information retrieval to the traditional retrieval models", published as CTIT technical report TR-CTIT-00-09, May 2000.
- [5] [https://www.doc.ic.ac.uk/~nd/surprise\\_96/journal/vol4/cs11/report.html#Introduction%20to%20neural%20networks](https://www.doc.ic.ac.uk/~nd/surprise_96/journal/vol4/cs11/report.html#Introduction%20to%20neural%20networks)
- [6] Dogan Ibrahim, "An overview of soft computing", 12th International Conference on Application of Fuzzy Systems and Soft Computing, ICAFS 2016, 29-30 August 2016, Vienna, Austria.
- [7] Fabio Crestani, Gabriella Pasi, "Soft Information Retrieval: Applications of Fuzzy Set Theory and Neural Networks".

# The Effect of Service Quality on Loyalty using Satisfaction as an Intervening Variable (*Study on Entrepreneurs in Bekasi Bonded Zone*)

Jumawan

Lecturer of Faculty of Economics, Bhayangkara Jakarta Raya University, Jakarta, Indonesia  
[jumawan164@gmail.com](mailto:jumawan164@gmail.com)

**Abstract**— This research aims to discover and analyse the effect of service quality on loyalty of entrepreneurs in Bonded Zone using entrepreneurs' satisfaction as the intervening variable. Research population is Bonded Stockpile Entrepreneurs in the Operational Area of Supervision and the Office of Customs and Excise Type Madya A Bekasi, particularly entrepreneurs in Bonded Zone. According to Slovin's formula, the number of respondents is 70. Data analysis is conducted using path analysis. Result of the research indicates that all proposed hypotheses are accepted and proven true.

**Keywords**— Service Quality, Satisfaction, Loyalty.

## I. INTRODUCTION

In the free trade era, marketing strategy has shifted towards customer-oriented strategy. As stated by Kotler and Armstrong (2001), marketing should be perceived differently from its old definition of *telling and selling*, but rather as fulfilling customer's need. Consequently, customer-oriented marketing strategy requires a company to understand and fulfil customer's behaviour and need to bring customers' satisfaction.

Customers' satisfaction must as well build customers' loyalty. Truly loyal customers are not only potential word-of-mouth advertisers but are also potentially loyal to company's portfolio of product and service for a longer period. Every businessperson certainly desires successful customer relationship with high level of customers' satisfaction and loyalty. At this position, company will receive many benefits, such as encouraging customer to testify positively to other customers, reducing marketing cost, attracting new customers, responding to competitor's threat, as well as achieving cumulative point of sustainable business (Aaker, 1995, in Hasan, 2009). To achieve such objectives, every businessperson must be able to satisfy customers by improving service quality, as measured in *reliability, responsiveness, assurance, empathy, and tangibles* dimensions.

This is similar to the efforts by Directorate General of Customs and Excise in providing best service for Bonded

Stockpile Entrepreneurs. Consequently, service policy, system and procedure of the Directorate General of Customs and Excise must be oriented towards improvement of service quality. Supervision and the Office of Customs and Excise as an operating unit of the Directorate General of Customs and Excise is the spearhead of provision of high-quality service. With its key position, Supervision and the Office of Customs and Excise (SOCE) Type Madya A Bekasi is required to be responsive to the needs of Bonded Stockpile Entrepreneurs (Yusuf, 2009).

Bureaucratic reform in the Directorate General of Customs and Excise in SOCE Type A Bekasi is carried out by providing service to Bonded Stockpile Entrepreneur, particularly in Bonded Area and Bonded Warehouse in the Operational Area of SOCE Type Madya A Bekasi as service user (*stakeholders*). Bonded Zone refers to a Bonded Stockpile Facility to stockpile imported goods and/or goods sourced from other location within a customs area for processing or combination, where the resulted product will be used for export (Regulation of Director General of Customs and Excise Number 57/BC/2011).

Therefore, this research aims to discover how service quality affects loyalty and satisfaction of entrepreneurs in Bonded Zone under the management of SOCE Type Madya A Bekasi. As high level of satisfaction of customs and excise service users implies satisfaction of improved customs and excise service, it is expected that good investment environment and optimum state revenue will be realized. The objectives of this research are to discover and analyse the effect of service quality on loyalty of entrepreneurs in Bonded Zone using entrepreneurs' satisfaction as the intervening variable.

## II. LITERATURE REVIEW

### 2.1. Service Quality

Service quality is obligatory for a company to be able to survive and gain customers' trust. According to Lewis&Booms in Prabawa (2014), service quality refers to "the degree of capability of a service to meet customers'



expectation". Under this definition, service quality is determined by company's ability to meet customers' need and wish according to their expectation. Service quality must begin with customers' need and end with customers' satisfaction and positive perception towards service quality. This is in line with a number of previous researches, which concluded that service quality affected customers' satisfaction, such as: Ravichandran (2010); Malik, et al (2012); Osman & Ilham (2014); Horsu & Yeboah (2015); and Harahap, et al (2017). Meanwhile, previous researches indicated that service quality affected customers' loyalty, such as: Kheng et al (2010); Bostanji (2013), Iddrisu et al (2015); Komowal, et al (2016); and Dubey & Srivastava (2016).

## 2.2. Customers' Satisfaction

Many experts had made definition of customers' satisfaction. Kotler and Keller (2009) defined satisfaction as "person's feeling of pleasure or disappointment which resulted from comparing a product's perceived performance or outcome against his/ her expectations. When performance does not meet expectation, customers will be unsatisfied. When performance meets expectation, customers will be satisfied. When performance exceeds expectation, customers will be highly satisfied. There are some researches that explain customers' satisfaction affects customers' loyalty, such as: Mohsan, et al (2011); Karunanithy (2013); Ibojo, et al (2015); and Khadka (2017).

## 2.3. Customers' Loyalty

Customers' loyalty is one of the key objectives in modern marketing. This is since loyalty is expected to bring long-term advantage for the company from mutualism relationship during a certain period. Literally, loyalty refers to the quality of being loyal to an object.

Kotler, Hayes and Bloom (2000) in Mardalis (2005) stated that there are six reasons for an organization to win loyalty of its customers, i.e. 1) Loyal customers will bring great advantage for the organization. 2) Customer retention cost will be lower in comparison to the cost to get new customers. 3) Customers who have trusted an organization for a matter will also trust it for other matters. 4) organization's operating cost will be lower when it has many loyal customers. 5) The organization will be able to reduce psychological and social cost as the existing customers have positive experiences with the organization, and 6) Loyal customers will defend the organization and pursue to attract and suggest others to become a customer of the organization.

There are some researches that suggested the importance of keeping customers' loyalty continuously, such as: Magatef, et al (2015); Bhakar, et al (2015); and Kamau (2017).

## 2.4. Conceptual Framework and Hypothesis

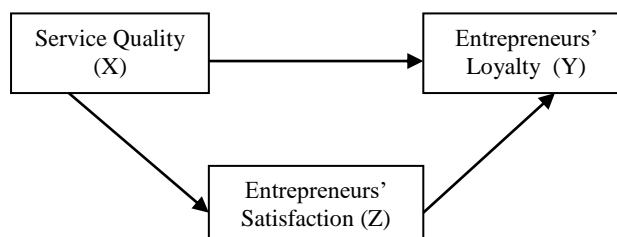


Figure 2.1. Conceptual Framework

Based on the above literary review, the hypothesis of this research is as follows:

### Hypothesis 1

It is assumed that service quality directly affects entrepreneurs' satisfaction.

### Hypothesis 2

It is assumed that service quality directly affects entrepreneurs' loyalty.

### Hypothesis 3

It is assumed that entrepreneurs' satisfaction directly affects entrepreneurs' loyalty.

### Hypothesis 4

It is assumed that service quality directly affects entrepreneurs' loyalty through entrepreneurs' satisfaction.

## III. RESEARCH METHOD

This research is an explanatory research. According to Sugiyono (2011), explanatory research examines variables in the hypothesis. There is hypothesis of which the truth will be examined. The population of this research is Bonded Stockpile Entrepreneurs in the Operational Area of Supervision and the Office of Customs and Excise Type Madya A Bekasi, particularly entrepreneurs in Bonded Zone that consists of 222 companies. The guideline to determine sample population is taken from Slovin's theory (Sangadji and Sopiah, 2010) as follows:

$$n = \frac{N}{1 + N(e)^2} \rightarrow n = \frac{222}{1 + 222(0.1)^2} = 69 = 70.$$

Where:

n = Number of samples: N = Number of population: e = Error rate (10%).

According to Slovin's formula, the number of sample in this research is 70 respondents. As to sampling technique, simple random sampling was used. Respondents were asked to complete research instrument in the form of questionnaires that were distributed directly to them. Path Analysis was used to analyse data Path Analysis was used to analyse relationship pattern between variables with a

purpose to find out both direct and indirect effect of a series of independent (exogenous) variables on the dependent (endogenous) variables (Sugiyono 2011). Meanwhile, variables used in this research are defined operationally as follows:

a. Service Quality (X), refers to any activity carried out by SOCE Type Madya A Bekasi to meet Entrepreneurs' expectation in Bonded Zone. According to Parasuraman *et al.*, in Darwin & Kunto (2014) and Kristianto (2006), service quality can be measured using 5 indicators of service quality dimensions as follows:

- 1) Tangible, i.e. appearance of physical facility, equipment, staffs, and buildings.
- 2) Reliability, i.e. ability to provide promised service reliable and accurately.
- 3) Responsiveness, i.e. ability to promptly assist the entrepreneurs and provides service.
- 4) Assurance, i.e. staff's knowledge, manner and ability to build confidence and trust.
- 5) Emphaty, i.e. personal concern and attention given to entrepreneurs.

b. Entrepreneurs' Satisfaction (Z), i.e. entrepreneurs' feeling of pleasure resulted from having service expectation and performance fulfilled by SOCE Type Madya A Bekasi. According to Yusuf (2009) and Kristianto (2006), Entrepreneurs' Satisfaction can be measured by using the following indicators: 1) Orientation towards customers' need is the ability to understand customers' need to create superior values for the organization. 2) Service effectiveness indicates timely completion of work as scheduled. 3) Delighted and sincere acceptance by customers indicates customers' satisfaction, i.e. when customers accept treatment and their rights delightfully and sincerely. And 4) Organization image implies that the organization is committed to satisfy customers' needs.

c. Entrepreneurs' Loyalty (Y) refers to loyalty of service users to keep on subscribing the service for long term. Jill Griffin (in Hurriyati, 2010) stated that loyalty can be measured using the following indicators: 1) Recommendation of service for other users. 2 Not affected by another stockpile location. And 3) Use of facility in long term.

## IV. RESEARCH FINDINGS AND DISCUSSION

### 4.1. Result of Instrument Testing and Prerequisite Testing

Result of validity and reliability testing indicated that all question indicators, both under independent variables (X) and dependent variables (Y), had r value of  $\geq 0.3$ , while reliability value of  $\geq 0.6$  indicated that the result was valid and reliable, by which research could proceed to the next

analysis. Meanwhile, assumption testing resulted in linear data, normal data and there was no multicollinearity.

### 4.2. Result of Hypothesis Testing

The results of path analysis and hypothesis analysis as follows:

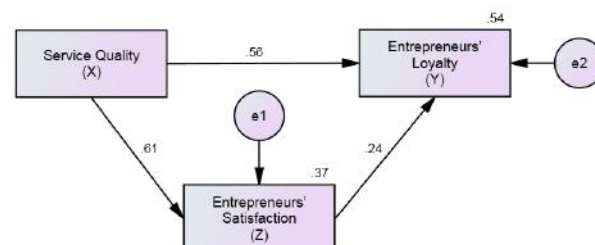


Fig.4.1: Result of Path Analysis

From the picture above, we get the equation of path analysis as follows:

$$Z = 0.61X + e1$$

$$Y = 0.61X + 0.24Z + e2$$

The hypothesis test results as follows:

Table.4.1: Hypothesis Test Results

Variables Influence	Estimate	S.E.	C.R.	P
X → Z	.542	.084	6.431	.000
X → Y	.353	.065	5.459	.000
Z → Y	.173	.073	2.370	.018

Based on the result of path analysis, below is the result of hypothesis testing in this research:

- a. Service quality variable (X) directly and significantly affected entrepreneurs' satisfaction (Z), with significance value of  $0.000 < 0.05$ .
- b. Service quality variable (X) directly and significantly affected entrepreneurs' loyalty (Y), with significance value of  $0.000 < 0.05$ .
- c. Entrepreneurs' satisfaction variable (Z) directly and significantly affected entrepreneurs' loyalty (Y), with significance value of  $0.018 < 0.05$ .
- d. Service quality variable (X) indirectly and significantly affected entrepreneurs' loyalty (Y) through entrepreneurs' satisfaction (Z) and, therefore, the first to the third hypotheses were accepted.

### 4.3. Direct, Indirect and Total Effect

The levels of both direct and indirect effect of each variable, as well as the total effect, are as follows:

Table.4.2: Direct, Indirect, and Total Effect

Variables Influence	Direct Effect	Indirect Effect	Total Effect
X → Z	0.612	-	0.612
X → Y	0.562	0.149	0.711
Z → Y	0.244	-	0.244

Based on the above table, it can be explained as follows:

- Service quality variable (X) had direct effect on entrepreneurs' satisfaction (Z) with a score of 0.612.
- Service quality variable (X) had direct effect on entrepreneurs' loyalty (Y) with a score of 0.562 and indirect effect of 0.149. Total effect score was 0.711.
- Entrepreneurs' satisfaction variable (Z) had direct effect on entrepreneurs' loyalty (Y) with a score of 0.244.

Meanwhile, the levels of simultaneous contribution of the variables to other variables are explained as follows:

- Service quality variable (X) contributed to entrepreneurs' satisfaction (Z) at 37.5%.
- Service quality variable (X) contributed to entrepreneurs' loyalty (Y) through entrepreneur's satisfaction at 54.3%.

### 4.3. Result

#### a. Service quality (X) directly affects entrepreneurs' satisfaction (Z).

Result of the research indicated that service quality variable (X) positively and significantly affected entrepreneurs' satisfaction (Z), with a score of 0.612. This implies that better service provided by SOCE Type Madya A Bekasi will better satisfy entrepreneurs who use the facility in the bonded stockpile. With significance score of  $0.000 < 0.05$ , the first hypothesis that states service quality has direct effect on entrepreneurs' satisfaction is accepted. Result of this research is in line with previous researches by Ravichandran (2010), Malik, et al (2012), Osman & Ilham (2014), Horsu & Yeboah (2015), and Harahap, et al (2017). As stated by Parasuraman *et al.*, in Darwin & Kunto (2014), the higher service quality is perceived, the higher customers' satisfaction will be. This confirms close relationship between service quality and customers' satisfaction. Therefore, when an organization seeks to develop and survive, it must be able to provide high quality product and service to the customers, in addition to provide better service than its competitors. To bring customers' satisfaction, it is important to properly manage service quality. In order to increase service quality and for improvement of service quality in accordance with Service Quality Guideline as determined by Head of SOCE Type Madya A Bekasi in Decree Number PDM/WBC.08/KPP.MP.01/01 dated 1 July 2013, as well as to ensure compliance of service with the regulation,

customers' satisfaction survey is conducted annually for service provided by SOCE Type Madya A Bekasi, and the result may indicate realization of service provision from Customers' side.

#### b. Service quality (X) directly affects entrepreneurs' loyalty (Y).

Result of the research indicated that service quality variable (X) positively and significantly affected entrepreneurs' loyalty (Y), with direct effect score of 0.562 and indirect effect score of 0.149. Total effect score was 0.711. This implies that better service provided by SOCE Type Madya A Bekasi will increase loyalty of entrepreneurs who use the facility in the bonded stockpile. With significance score of  $0.000 < 0.05$ , the second hypothesis that states service quality has direct effect on entrepreneurs' loyalty is accepted. Result of this research is in line with previous researches by Kheng et al (2010); Bostanji (2013), Iddrisu et al (2015), Komowal, et al (2016), and Dubey & Srivastava (2016) Research by Hennis and Klee (Cadogen&Foster, 1999) explains that loyalty rises from perception of service quality. Customers' loyalty is achieved after psychological experience encountered by customers with regard to the service that is properly provided by service provider, by which such memory will be kept by customers for a long term. Therefore, it is important for service provider to maintain customers' loyalty continuously, as suggested by researches by Magatef, et al (2015), Bhakar, et al (2015), and Kamau (2017).

#### c. It is assumed that entrepreneurs' satisfaction (Z) directly affects entrepreneurs' loyalty (Y).

Result of the research indicated that entrepreneurs' satisfaction variable (Z) positively and significantly affected entrepreneurs' loyalty (Y), with direct effect score of 0.244. This means that the more entrepreneurs are satisfied with bonded stockpile facility provided by SOCE Type Madya A Bekasi will increase loyalty of entrepreneurs in the Bonded Zone. With significance score of  $0.018 < 0.05$ , the third hypothesis that states entrepreneurs' satisfaction has direct effect on entrepreneurs' loyalty is accepted. Result of this research is in line with previous researches by Mohsan, et al (2011), Karunanithy (2013), Ibojo, et al (2015), and Khadka (2017). According to Heskett and Sasser (1997), relationship between customers' satisfaction and customers' loyalty is illustrated with a single-directional straight line. This means that when a company increases customers' satisfaction, customers' loyalty will also increase.

#### d. It is assumed that service quality (X) indirectly affects entrepreneurs' loyalty (Y) through entrepreneurs' satisfaction (Z).

Result of this research indicates that the first hypothesis to the third hypothesis are accepted, by which the fourth

hypothesis that states service quality indirectly affects entrepreneurs' loyalty through entrepreneurs' satisfaction is accepted. The result is in line with the research conducted by Ravichandran et al (2010), in which increase of service quality may satisfy and increase customers' satisfaction, which will eventually maintain customers' loyalty. Gonderson in Cadogen&Foster (1999) explained that when service quality factor is really taken into company's consideration, customers' loyalty will be built through satisfaction.

As to this research, entrepreneurs' satisfaction (Z) is the intermediate variable between service quality (X) and entrepreneurs' loyalty (Y). This means that entrepreneurs' satisfaction variable (Z) may increase and decrease the effect of service quality on customers' loyalty. Total score of service quality (X) effect on entrepreneurs' loyalty was at 0.562. Meanwhile, service quality (X) effect on entrepreneurs' loyalty (Z) through entrepreneurs' satisfaction variable (Z) increased to 0.711. It can be concluded that entrepreneurs' satisfaction (Z) is capable of being an intermediate to strengthen relationship between service quality and entrepreneurs' loyalty in the Bonded Zone within operating area of SOCE Type Madya A Bekasi.

## V. CONCLUSION

Based on the result of the research and the discussion, the following conclusions can be made: Service quality variable positively and significantly affects entrepreneurs' satisfaction in the Bonded Zone. Service quality variable positively and significantly affects entrepreneurs' loyalty in the Bonded Zone. Entrepreneurs' satisfaction variable positively and significantly affects entrepreneurs' loyalty in the Bonded Zone. Service quality indirectly and significantly affects entrepreneurs' loyalty through entrepreneurs' satisfaction.

## REFERENCES

- [1] Bhakar, Sher Singh., Nischay Kumar Upamannyu, Nischay Kumar Upamannyu, and Sangeeta Jauhari. (2015). Effect of Customer Loyalty Program on Customer Retention: A Study of Organized Retail Sector in Gwalior. *A Handbook on Writing Research Paper in Social Sciences*. pp: 47-75.
- [2] Bostanji., Dr. Galib Mohammed Al. (2013). The Impact of Service Quality on Customers Loyalty A Study on five stars hotel's customers in Riyadh, KSA. *European Journal of Business and Management*. Vol.5, No.31, 2013, pp: 230-240.
- [3] Cadogen & Foster. (1999). Developing Customer Loyalty: The Role Of Salesperson And Firm Spesific Relationship. *Journal of Personal Selling & Sales Management*.
- [4] Darwin, Steven., dan Yohanes Sondang Kunto. (2014). Analisis Pengaruh Kualitas Layanan Terhadap Loyalitas Pelanggan dengan Kepuasan dan Kepercayaan Pelanggan Sebagai Variabel Intervening Pada Asuransi Jiwa Manulife Indonesia – Surabaya. *Jurnal Manajemen Pemasaran Petra*. Vol 2, No. 1 (2014): h: 1-12.
- [5] Dubey, Archi., and Dr. A.K. Srivastava. (2016). Impact of Service Quality on Customer Loyalty- A Study on Telecom Sector in India. *IOSR Journal of Business and Management (IOSR-JBM)*. Volume 18, Issue 2 .Ver. I (Feb. 2016), pp: 45-55.
- [6] Griffin, Jill. 2010. dialih bahasakan oleh Dwi Kartini Yahya. Customer Loyalty How to Earn it, How to Keep it. Lexington Books. Singapore.
- [7] Harahap , Ahmad Rizki., and Dede Ruslan, Fitrawaty. (2017) The Influence of Service Quality on Customer Satisfaction and Loyalty of Muamalat Bank Branches Tanjung Balai. *Journal of Business and Management Sciences*. 2017, 5(3), 72-76.
- [8] Hasan, Ali. (2009). *Marketing*. Jakarta: Media Presindo.
- [9] Heskett, James. L., W. Earl Sasser, Jr., and Leonard A Schlesinger. (1997). *The. Service Profit Chain*. New York: Free Press.
- [10] Horsu, Emmanuel Nondzor., and Solomon Tawiah Yeboah. (2015). Influence of Service Quality on Customer Satisfaction: A Study of Minicab Taxi Services In Cape Coast, Ghana. *International Journal of Economics, Commerce and Management United Kingdom*. Vol. III, Issue 5, May 2015. pp: 1451-1464.
- [11] Hurriyati, Ratih. (2010). *Bauran Pemasaran dan Loyalitas Konsumen*. Bandung: Alfabetha.
- [12] Ibojo, Bolanle Odunlami., and Asabi, Oludele Matthew. (2015). Impact of Customer Satisfaction on Customer Loyalty: A Case Study of a Reputable Bank in Oyo, Oyo State, Nigeria. *International Journal of Managerial Studies and Research (IJMSR)*. Volume 3, Issue 2, February 2015, pp: 59-69.
- [13] Iddrisu, A.M., I.K. Nooni, Fianko, and K.S., W. Mensah. (2015). Assessing The Impact of Service Quality on Customer Loyalty: A Case Study of The Cellular Industry of Ghana. *British Journal of Marketing Studies*. Vol.3, No.6, July 2015, pp:15-30.
- [14] Kabu Khadka & Soniya Maharjan. (2017). *Customer Satisfaction and Customer Loyalty: Case Trivsel Städtjänster (Trivsel siivouspalvelut)*. Thesis. Business Management. Centria University of Applied Sciences.
- [15] Kamau, Linda W. (2017). *Effect of Loyalty Programs on Customer Retention: A Case of Nakumatt*



- Supermarkets Kenya*. Degree of Master in MBA. United States International University. Africa.
- [16] Karunanithy, Kamalakumati., and Dilani Rasanayagam. (2013). Impact of Customer Satisfaction on Customer Loyalty towards Sri Lanka Telecom PLC. *Industrial Engineering Letters*. Vol.3, No.7, 2013, pp: 66-71.
- [17] Kheng, Lo Liang., Osman Mahamad, T. Ramayah, and Rahim Mosahab. (2010). The Impact of Service Quality on Customer Loyalty: A Study of Banks in Penang, Malaysia. *International Journal of Marketing Studies*. Vol. 2, No. 2; November 2010, pp: 57-66.
- [18] Komowal, Rivo Christian., S. L. H. V. Joyce Lopian, and Johan Tumiwa. (2016). The Effect of Store Brand Image and Service Quality Toward Customer Loyalty at Freshmart Superstore Manado. *Jurnal EMBA*. Vol.4 No.1 Maret 2016, pp: 306-314.
- [19] Kotler P., Hayes, Thomas, Bloom Paul N. (2002). *Marketing Professional Service*. Prentice Hall International Press.
- [20] Kotler, Philip dan Gary Armstrong. 2001. *Prinsip-prinsip Pemasaran*. Jilid 2. Edisi . Kedelapan. Erlangga. Jakarta.
- [21] Kotler, Philip dan Kevin Lane Keller. (2009). *Manajemen Pemasaran*. Jilid I Edisi 13. Erlangga. Jakarta.
- [22] Kristianto, Andi. (2016). Pengaruh Kualitas Pelayanan Terhadap Kepuasan dan Kepercayaan Pengusaha Penerima Fasilitas Tempat Penimbunan Berikat di Kantor Pengawasan dan Pelayanan Bea dan Cukai Tipe Madya Pabean A Bekasi. *Tesis*. Program Magister Manajemen. Sekolah Tinggi Manajemen Labora. Jakarta. Tidak Dipublikasikan.
- [23] Magatef, Dr. Sima Ghaleb., and Dr. Elham Fakhri Tomalieh. (2015). The Impact of Customer Loyalty Programs on Customer Retention. *International Journal of Business and Social Science*. Vol. 6, No. 8(1); August 2015, pp: 78-93.
- [24] Malik., Muhammad Ehsan, Muhammad Mudasar Ghafoor, and Hafiz Kashif Iqbal. (2012). Impact of Brand Image, Service Quality and Price on Customer Satisfaction in Pakistan Telecommunication Sector. *International Journal of Business and Social Science*. Vol. 3 No. 23; December 2012, pp: 123-129.
- [25] Mardalis, Ahmad. 2005. Meraih Loyalitas Pelanggan. *Benefit*. Vol. 9, No. 2, Desember 2005, pp: 111-119.
- [26] Mohsan, Faizan., Muhammad Musarrat Nawaz, M. Sarfraz Khan, Zeeshan Shaukat, and Numan Aslam. (2011). Impact of Customer Satisfaction on Customer Loyalty and Intentions to Switch: Evidence from Banking Sector of Pakistan. *International Journal of Business and Social Science*. Vol. 2 No. 16; September 2011, pp: 263-270.
- [27] Osman, Zahir., and Ilham Sentosa. (2014). Influence of Customer Satisfaction on Service Quality and Customer Loyalty Relationship in Malaysian Commercial Banking Industry. *International Journal of Economics, Finance and Management*. Vol. 3, No. 2, March 2014, pp: 115-120.
- [28] Prabawa, Andi. 2010. Hubungan Kualitas Pelayanan Program Aplikasi Pertukaran Data Elektronik dengan Kepuasan Pengusaha di Tempat Penimbunan Berikat Pada Kantor Pelayanan dan Pengawasan Bea dan Cukai Tipe A1 Jakarta. *Tesis*. Fakultas Ilmu Sosial dan Ilmu Politik. Program Pascasarjana. Universitas Indonesia. Jakarta. Tidak Dipublikasikan.
- [29] Ravichandran K., Mani, B. Tamil and Kumar, S. Arun. (2010). Influence of Service Quality on Customer Satisfaction Application of Servqual Model. *Journal of Business and Management*. Vol. 5, No. 4, pp: 117-124.
- [30] Sangaji, Etta Mamang., dan Sopiah. (2010). *Metodologi Penelitian*. Yogyakarta: ANDI.
- [31] Sugiyono. (2011). *Metode Penelitian Pendidikan*. Bandung: Alfabeta.
- [32] Yusuf, Prayudi. (2009). Hubungan Kualitas Pelayanan dengan Kepuasan Pengusaha di Kawasan Berikat Pada Kantor Pengawasan dan Pelayanan Bea dan Cukai Tipe A2 Tangerang. *Tesis*. Fakultas Ilmu Sosial dan Ilmu Politik. Program Pascasarjana. Universitas Indonesia. Jakarta. Tidak Dipublikasikan.

# Security Issues & Threats in IoT Infrastructure

Archana Sahai

Assistant Professor, Amity University Lucknow, India  
asahai @amity.edu

**Abstract**— IoT (Internet of Things) expands the future Internet, and has drawn much attention. As more and more gadgets (i.e. Things) connected to the Internet, the huge amount of data exchanged has reached an unprecedented level. IoT today has a wide scope and researches say that IoT will definitely be a huge reason in the change of human lifestyle. But irrespective of the scope of IoT, we cannot be sure enough to implement it due to the security concerns. There is a genuine need to secure IoT, which has therefore resulted in a need to comprehensively understand the threats and attacks on IoT infrastructure. This paper discusses about the flaws in the security structure of IoT, it is a study about the various layers of IoT and how different attacks are possible in those layers.

**Keywords**— Internet of Thing (IoT), Denial of Service (DOS), Radio Frequency Identification (RFID), Data Distribution Services (DDS), Data Centre (DC).

## I. INTRODUCTION

Internet can be defined as a bunch of connected items, network technologies, sensing and gateway devices, endpoints, data analysis systems/approaches, protocols and standards including the Internet Protocol (IP). Internet of Things can be defined as the Interconnectivity of devices which are physical. The Internet of Things enables a smarter bridging of digital, physical and human spheres by adding data capture and communication capacities to objects in a secure way to a networked environment. Internets of Things allow objects to be interconnected and are controlled on remote using networking. According to Gartner “The Internet of Things (IoT) is the network of physical objects that contain embedded technology to communicate and sense or interact with their internal states or the external environment”.

The IoT is comprised of the three core components: A collection of smart, connected products, product systems, and other Things connected through an Internet-like communication infrastructure to a computing infrastructure that are creating new forms of value. Data from the product condition, operation, and environment are delivered in real-time enabling capabilities to control, service, and upgrade the

product and system performance. For manufacturers (i.e., those in the Things business), these innovations not only have the potential to generate incredible amounts of new value, but also to disrupt the status quo.

We live in a smart, connected world. The number of things connected to the Internet now exceeds the total number of humans on the planet, and we’re accelerating to as many as 50 billion connected devices soon.

The rise of the IoT has been driven by the convergence of market forces and parallel innovation of enabling technologies. Products have evolved from purely physical components to complex systems combining processors, sensors, software, and digital user interfaces that are now connected to the Internet and each other. As their definition has evolved, product capabilities have multiplied, creating new forms of value and even doing things well beyond their primary function.

The impact is a fundamental transformation of how manufacturers create and exchange value with customers. This transformation is shifting the sources of value and differentiation to software, the cloud, and service, and spawning entirely new business models. To capture this great wave of value creation opportunity, manufacturers have an urgent need to rethink nearly everything — from how products are created, sold, operated, and serviced.

IoT incorporates everything in itself such as body sensor or cloud computing [2]. No matter its parking your vehicle, or it’s a detail of a patient, or your wrist watch that reminds you to take your medicine, or a device that track you activity around [3]. We are today living in the ocean of IoT where every physical device is interrelated. The key element in IoT is the sensors.

### 1.1. The major contributors of IOT are:

- RFID (Radio Frequency Identification) : RFID tracks the data and helps to find the things and the related information.
- Sensors: In things when some physical change is detected, sensors collect that data and process it further.



- **Smart technologies:** The smart Technologies develop some of the processing capabilities and then it can also modify the capacity of networks.
- **Nano technologies:** Nano technologies are the smallest unit that can be used to interconnect the things using IoT.

### 1.2. IoT requires five phases:

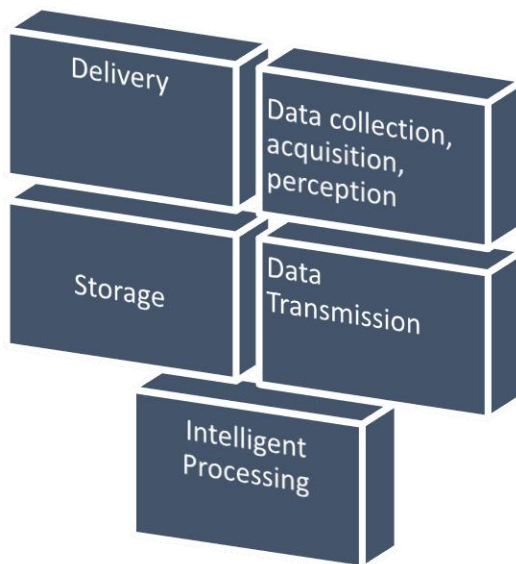


Fig.1: Five phases of IoT

#### Phase 1: Data collection, acquisition, perception

Firstly, we assemble and retrieve various kind of Information from things or devices. After this some of the important factors are examined and is preceded by the collection of data. The things that can be used in the data collection can be a static body or it can also be a dynamic vehicle.

#### Phase 2: Storage

All the data that has been collected in phase 1 is allocated to the memory locations and as we know that generally all the components of IoT are stored in small memories and use the cloud computing. Due to the low memory all kinds of data storage in the stateless devices is done in the form of cloud.

#### Phase 3: Intelligent processing.

The data stored in the cloud is analyzed and is provided with the intelligent processing for real time. And then IoT becomes capable of controlling things

#### Phase 4: Data Transmission.

We can say that data transmission is a part in all of the above phases; Data is transmitted from various kinds of sensors, and the different RFID tags or chips to the DCs. And then the data is transmitted from DCs to the processing unit. From

processors the data is transmitted to the controllers and the end users.

#### Phase 5: Delivery.

All the delivery of information and data from the processors, processors to controllers and end user is completed in the delivery phase.

## II. THREATS & ATTACKS IN IoT

Cyber threats could be launched against any IoT assets and facilities, potentially causing damage or disabling system operation, endangering the general populace or causing severe economic damage to owners and users [9, 10]. Examples include attacks on home automation systems and taking control of heating systems, air conditioning, lighting and physical security systems. The information collected from sensors embedded in heating or lighting systems could inform the intruder when somebody is at home or out. Among other things, cyber-attacks could be launched against any public infrastructure like utility systems (power systems or water treatment plants) [11] to stop water or electricity supply to inhabitants.

Security and privacy issues are a growing concern for users and suppliers in their shift towards the IoT [12]. Data Integrity, Data vulnerability & Data confidentiality must be kept in mind when we study anything related to the security issues of internet. A Threat can be defined as a possible danger that might exploit a vulnerability to breach security & therefore cause problem. Thus we can say that due to the evolution of threats security needs to be increased and steps must be taken to prevent various threats & attacks[1].

The attacks can be classified into three parts

### 2.1. Phase attack

- Phase attack Phase attack deals with the variety of attacks that are on the layers that we have already discussed.
- Data Leakage is an activity done by a dishonest person; it can be internal i.e. within the organization or external.
- Data leakage is international & may be authorized or malicious.
- Data Sovereignty says that all the information should be a part of the laws of the country
- Data Loss can also be one of the attacks of phase attack, Data loss or loss of information or data due to a failure in the software or hardware.
- Data Authentication provides integrity & originality to our data.
- Modification of Sensitive Data During transmission of data this may happen that the data is modified and sent to the end node

## 2.2. Attacks as per architecture

Well defined IoT architecture is not established properly yet. However, a three-layerhigh level architecture is commonly accepted [13]. This architecture consists ofthree layers:

Perception Layer

Network Layer

Application layer

A brief description of each layer is given[14]:

2.2.1. **Perception Layer:** the main task of the perception layer is to perceive the physical properties of things around us that are part of the IoT. This processof perception is based on several sensing technologies (e.g. RFID, WSN, GPS,NFC, etc.). In addition, this layer is in charge of converting the information todigital signals, which are more convenient for network transmission.

2.2.2. **Network Layer:** the network layer is responsible for processing the received data from the Perception Layer. In addition, it is in charge of transmitting data to the application layer through various network technologies, suchas wireless/wired networks and Local Area Networks (LAN). The main mediafor transmission include FTTx, 3G/4G, Wifi, bluetooth, Zigbee, UMB, infrared technology, and so on. Huge quantities of data will be carried by the network.Hence, it is crucial to provide a sound middleware to store and process thismassive amount of data. To reach this goal, cloud computing is the primarytechnology in this layer.

2.2.3. **Application Layer:** the application layer uses the processed data by the previous Layer. In fact, this layer constitutes the front end of the whole IoTarchitecture through which IoT potential will be exploited. Moreover, this layerprovides the required tools (e.g. actuating devices) for developpers to realize theIoT vision. The range of possible applications is intelligent transportation, logistics management, identity authentication, location based services, safety, etc.

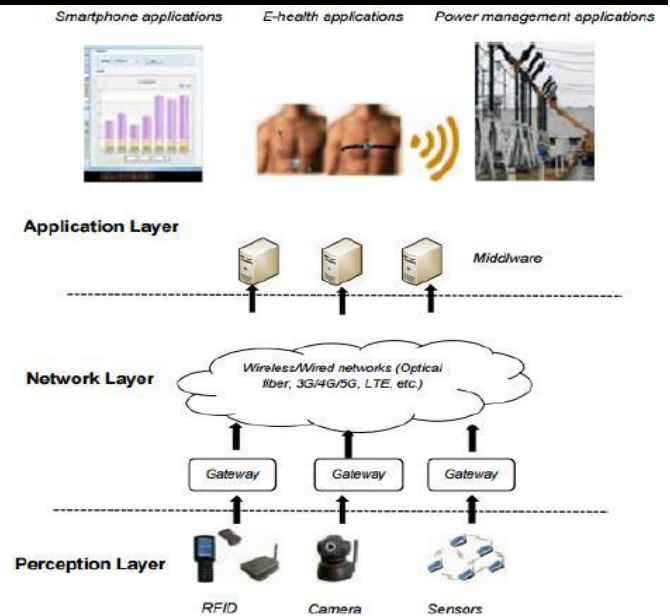


Fig.2: IoT layers

The possible threats that can be in these layers are.-

- **External attack:** These external terrifying attacks come from experienced & trained hackers. These external hackers can find vulnerable network or socially manipulate insiders to get past outer network defenses.
- **Wormhole attack:** In the wormhole attack the intruder does not capture the data, instead the intruder forwards this data in another node and then he retransmits the data from that node [8].
- **Selective forwarding attacks:** In this attack the intruder chooses some selective packets and drop them: i.e. , they select some packets and allow the rest.
- **Sinkhole attack:** In Sinkhole attack, for long durations the sensors are not attended. Therefore the intruder attacks the information and post attacks like selective forward, fabrication, & modification.
- **Sewage Pool attack:** In this malicious user select a particulars region and now the intruder changes the selected base station node so that the selective attacks becomes less successful.
- **Hello flood attack:** In this a Hello message will be introduce to all the neighbor of the reachable area at a certain frequency level. And then, this malicious node converts itself into a neighbor for all the selected nodes of that region and starts to broadcast. And hence a flooding attack cause unavailability of the records by sending huge number of unwanted messages.
- **Addressing All Things in Iot:** In this the malicious users implements the malicious machine to attack the virtual machine of the user. Using this, a person can hack all the confidential data and use the data for malicious purpose.

➤ **DDoS:** Thousands of attackers grouped together to initiate such attacks. In this type of attack some unwanted traffic size of huge size are populated so that they could deplete the memory resources. And, now the some important request is not allowed to reach the DC & thus it depletes the bandwidth of DC. In Denial of service, the authorized user is banished from the usage of such services.

➤ **IP Spoof Attack:** In spoofing the intruder pretends to be someone else so that he could access some confidential information IP spoof attacks, can be IP address attacks, in which the attacker impersonates the IP address of the authorized user.

There are various kinds of Spoof attack

- Hiding attack
- Refraction attack
- Impersonation attack

➤ **GoodPut:** GoodPut is the rate at which the data can be transferred from one node to another. We can also say that GoodPut is the ratio between the total data we are receiving and the delivery time.

➤ **Data Center (DC's) :** A DC can be said to be a centralized for storage purpose as well an management purpose. A DC can be used in house computer system as well as in large storage system.

### 2.3. Attacks based on Component

As we know that IOT connects everything from the internet. Data can not only be attended, theft loss, breach or disaster data can also be modified by some compromised sensors. Due to this reason it is mandatory for the end user to verify the received information.

## III. SECURITY ISSUES & PRIVACY CONCERN

As we discussed from the threats we know that with the vast use of IOT in our day to day environment, we need to find measures for security so that we could own an IOT network that will be effective and the one that could manage security risk. There is immense potential in IOT but it all becomes flamed when we see it from the security point of view, There are some most common security issues that flaws the entire IOT systems.

### 3.1. Security issues in the wireless sensor networks-

As we study about the attack on network availability we learn that the DOS attack can affect all five layers which are physical layer, link layer, network layer, transport layer & application layer[6].

### 3.2. The DOS attacks the physical layer by-

1. **Jamming-** In this the intruder creates a jam between the communicating nodes and thus prevent nodes from communication.

2. **Node Tampering** - Tampering the node physically so that some sensitive information may be tampered.

### 3.3. DOS (denial of service) attack at the link Layer

The data link layer in WSN multiplexes the data stream; it detects the data frame and checks the error control. The denial of service attack in link layer are-

- 1) **Collision-** When two data nodes transfer packets of data at equal frequency and at the same time then this type of DOS attack ,i.e. collision can be initiated . Due to the collision attack small amount of data changes that result in the mismatch of result in the end node. Due to which the whole set of data needs to be re-transmitted.
- 2) **Unfairness-** In unfairness, the collision attack is repeated again and again and the data needs to be transmitted for every collision attack.
- 3) **Battery Exhaustion-** It is similar to jamming but battery Exhaustion attack creates high traffic due to which end nodes become incapable of communicating to one-another. This occurs when there are large numbers of requests in the system.

### 3.4 DOS attack on the network layer

The main and the most important usage of network layer are routing. The main DOS attack that takes place in the network layer are-

- 1) **Spoofing-** In spoofing the intruder gains an unauthorized access, i.e., the confidential information is at a risk of leakage. The main reason to spoofing can be to gain vulnerability to someone else's confidential data
- 2) **Hello flood attack-** In Hello flood attack, as we have already discussed, a large amount of messages are sent that are useless, but these messages occupy the resources due to which two or more nodes are unable to communicate and hence the traffic or a Jam is created in the system.
- 3) **Hamming-** In this kind of network attack traffic is created of cluster heads these cluster heads have a capability to shut down the whole system and thus the entire network.
- 4) **Selective Forwarding-** In this type of a DOS attack only few selected nodes are send rather than all the nodes. And the criteria of selection of node are done as per the requirement of attacker so that this

malicious motive is achieved and the data packets are not forwarded.

### 3.5 DOS attack on the transport layer

In this a reliable data transmission comes into action i.e. all the congestion is avoided and all the high traffic jams and floods are prevented[5].

The main DOS attacks on the transport layer are:-

- 1) **Flooding:** In this DOS attack a huge amount of unnecessary message are sent so that the attackers can successfully create congestion.
- 2) **De Synchronization:** In this DOS attack, a fake message is created either at one or both nodes of the system so that the retransmission can be requested for the correction of an error that not even exists. Due to which energy is lost at both ends and the attacker can be successful in his malicious motive.

### 3.6 DOS attack on the application layer

In this the traffic management is monitored. This layer also provides the software for application that translates data into different forms and sends queries. In application layer a path is based, denial of service attack is initiated so that the sensor node can create heavy traffic and congestion is created.

## IV. CONCLUSION AND FUTURE DIRECTIONS

It is a challenge to secure IoT network. IoT networks have to worry about sophisticated attackers from both nation-states and competitors, and the misuse from employees, and vendors. As IoT uses network architecture which is similar to traditional network architecture for communication among different devices, flaws of traditional network architecture is also inherited in it. With the development of IoT, many kinds of attacks also have been invented to breach the security of IoT devices. This paper discusses about the possible threats and attacks which can arise from the application of IoT. This paper will be of much use for researchers in the field of securities; it will help to identify the major problems in IoT security and will provide better knowledge of the threats, increase in the ethical issue, theft, and misuse of information and privacy issues.

## REFERENCES

- [1] L. Atzori, A. Iera, and G. Morabito, (2010), "The internet of things: A survey," <http://citeseerx.ist.psu.edu>.
- [2] Shen, Guicheng, and Bingwu Liu., (2011), "The visions, technologies, applications and security issues of Internet of Things." E-Business and E-Government (ICEE), International Conference on. IEEE, 2011.
- [3] Brussels, (29 September 2008), *Future networks and the internet: Early Challenges regarding the "Internet of Things,"*, Commission Staff Working Document, SEC (2008)2516.
- [4] Pawel Rotter, (2008), *A Framework for Assessing RFID System Security and Privacy Risks*. IEEE Pervasive Computing, 7(2):70–77, June 2008.
- [5] D. Eastlake,( 2011), *Transport Layer Security (TLS) Extensions: Extension Definitions*, RFC 6066, 2011.
- [6] J. M. Kizza, (2013), *Security and Privacy in Internet of Things (IoTs): Models, Algorithms, and Implementations* Guide to Computer Network Security. Springer, 2013.
- [7] J. Lopez, R. Roman, and C. Alcaraz, (2009), "Analysis of security threats, requirements, technologies and standards in wireless sensor networks," in Foundations of Security Analysis and Design V. Springer.
- [8] D. Jiang and C. ShiWei, (2010), "A study of information security for m2m of iot," in Advanced Computer Theory and Engineering (ICACTE), 2010 3rd International Conference.
- [9] Y. Cheng, M. Naslund, G. Selander, and E. Fogelstrom, (2012), "Privacy in machine-to-machine communications a state-of-the-art survey," in Communication Systems (ICCS), 2012 IEEE International Conference on. IEEE, 2012, pp. 75–79.
- [10] M. Rudner, (2013), "Cyber-threats to critical national infrastructure: An intelligence challenge," International Journal of Intelligence and CounterIntelligence, vol. 26, no. 3, pp. 453–481, 2013.
- [11] R. Kozik and M. Choras, (2013), "Current cyber security threats and challenges in critical infrastructures protection," in Informatics and Applications (ICIA), 2013 Second International Conference on. IEEE, 2013, pp. 93–97.
- [12] P. N. Mahalle, N. R. Prasad, and R. Prasad, (2013) "JCyber Security and the Internet of Things - River Publishers" in International Journal of Computer Applications, vol. 63, no. 12, pp. 1–6. [https://www.riverpublishers.com/journaldownload.php?file=RP\\_Journal\\_2245-1439..](https://www.riverpublishers.com/journaldownload.php?file=RP_Journal_2245-1439..)
- [13] Wu, M., Lu, T., Ling, F., Sun, J., Du, H., (2010), *Research on the architecture of internet of things*. In: 3rd International Conference on Advanced Computer Theory and Engineering (ICACTE), IEEE (2010).
- [14] Romdhani, Imed & Abdmeziem, Riad & Tandjaoui, D. (2015). *Architecting the Internet of Things: State of the Art*.



# Practicality and Effectiveness of Student' Worksheets Based on Ethno science to Improve Conceptual Understanding in Rigid Body

Agnes Amila W<sup>1</sup>, Abdurrahman<sup>2</sup>, Agus Suyatna<sup>2</sup>, I Wayan Distrik<sup>2</sup>, Kartini Herlina<sup>2</sup>

<sup>1</sup>Student of Physics Education, Graduate Program, University of Lampung Indonesia,

<sup>2</sup>Lecturer of Physics Education , Graduate Program, University of Lampung Indonesia

**Abstract**— Generally, the learning process in classes still used worksheets that does not link the matter and instructional topics with local knowledge of local area. Though it is able to increase the students' conceptual understanding of the specific physics topics. This study aimed to analyze the practicality and effectiveness student' worksheet based on Ethno science in improving student understanding of rigid body' concept. The study used a quasi-experimental with pretest-post test control group design. The sample was students' senior high school in Lampung' province, Indonesia. The sampling technique used simple random sampling technique. Data were obtain through the questionnaire, responses of teachers and students, and test of learning outcome in multiple choice questions reasoned type. Data were analyzed by percentage, N-gain, and effect size. The results showed that student worksheet based on Ethno science was practically using in learning and effective in improving conceptual understanding which is indicated by the differences in test results between the control and the experimental class.

**Keywords**—Effectiveness, Ethno science, Conceptual Understanding, Practicality, Student Worksheet.

## I. INTRODUCTION

Education has a strategic role in improving the quality of human resources that can meet the development of the curriculum. The 2013 curriculum is curricula for primary and secondary education, the curriculum requires that learning must be responsive to the development of science, culture, technology, and art so as to build curiosity and the ability of the student (Kemendikbud, 2014). Teachers must have the ability to develop teaching materials were varied so that learning will be applied not monotonous and tend to be boring for students. The purpose of science teaching is to enable students not only to develop knowledge, understanding, positive attitude, and skill, but also interest to learn objects in environment

(Permendikbud, 2006). Generally, the success of students in the learning is determined by the ability of teachers to teach (Sumarni et al., 2017). Therefore, as educators must be creative in making the innovation of teaching materials in order to achieve these demands.

Based on observations in high school showed that the teaching materials in the form of student worksheet still contain practice questions and short course materials, and generally, the learning was using teacher center. This case gave the significant problems in conceptual understanding as well as student's mind set is not to be creative. Meanwhile, the results of needs analysis data showed that 73% of students felt difficult to understand the equilibrium of rigid body concept, and 85% of students stated that they required student worksheet oriented local wisdom in order to develop their conceptual understanding in physics.

The equilibrium of rigid body concept is difficult enough to students in secondary school. This is in accordance with the opinion of Sahala et al (2013) stated that although the learning was done about rotational dynamics and equilibrium of rigid body in school, but in fact many students who have difficulty to understand and apply the concept of rotational dynamics and rigid body's equilibrium. To learn about equilibrium of rigid body concept will be many obstacles and difficulties when administered directly without starting from the events in the environment in the form of art and culture (Mujadi, 2015). Culture can be used as a means for linking indigenous science with the learning process in school (Berkes et al., 2000).

Science integrated learning in activities that begin by using a variety of learning resources to explain a phenomenon (Novi et al., 2012). Ethno science was an activity to transform the original science (knowledge developed in the community) into scientific science (Rahayu et al., 2015; Sardjiyo, 2005). Local knowledge is a system in the order of the social, political, cultural,

economic, and environmental life in the midst of the local community (Misnah, 2015). Ethno science was a learning approach that relates to the local culture, indigenous science and science theory that has been developed in Brazil (Battiste, 2002) and Canada (Ward, 2010), and Tanzania (Ruheza et al., 2013). In addition, Ethno science also closely related to the environment, where the environment has become the center of attention of various scholars, intellectuals, scientists, politics and government (Dhanya, 2017). Learning based Ethno science approach digs initial views on culture or habits of a person that are used in everyday life, and then it was translated into scientific knowledge (Sudarmin et al., 2017; Rist et al., 2006). Ethno science is important for the level of local wisdom and knowledge in the science curriculum that aims to promote the spirit of nationalism students (Kidman et al., 2013). In addition, environment-based learning helpful in preserving the environment, students play an important role in raising public awareness and protecting the environment (Talens, 2016).

The role of local knowledge-based learning is important in understanding the concept of students' ability to generate. Understanding is the mental or thought process for observing phenomena or events, and ideas that can be delivered either orally or in writing, visually or symbolically. Cognitive processes included in the category of understanding of interpreting, exemplifying, classifying, summarizing, in summing up, compare, and explain (Knuth et al., 2002; Canon et al., 2005; Anderson et al., 2001). Based on Afrianawati et al (2016) also showed that learning by applying the Ethno science model can increase students' cognitive abilities. Other studies have shown that the use Ethno science approach in learning has a high potential in exploring the ability of students' conceptual understanding (Parmin et al., 2017).

The purpose of this study was to apply learning with student worksheets based on Ethno science to analyze an improved physics conceptual understanding in terms of practicality and effectiveness of students worksheets in learning equilibrium of rigid body concept. Based on these objectives, then formulation of the problem in this study, as follows:

- 1) How practicality student worksheet based on Ethno science in equilibrium of rigid body learning?
- 2) How effectiveness student worksheet based on Ethno science in equilibrium of rigid body learning?

## II. RESEARCH METHODS

### 2.1 Research Design

This research used quasi-experimental with pretest-post test control group design. The assessment of practicality test showed by feasibility student worksheet and the response of teachers and students towards learning using

student worksheets based on Ethno science in qualitative data. While, the assessment of effectiveness demonstrated by the results of conceptual understanding test in quantitative data. This study was conducted in two classes, the one was experimental class that taught by using student worksheet based on Ethno science and the other one was control class that taught by using conventional student worksheet.

### 2.2 Research sample

The sample collecting technique was purposive sampling, the samples were selected based on consideration of the researcher. Samples of this study involved three physics teachers and 50 students of high school in Lampung province, Indonesia, where 25 students were in the experimental class that taught by using student worksheet based on Ethno science. Meanwhile, 25 other students were in control class were taught by conventional worksheet.

### 2.3 Research Instruments

Research instruments used to practicality test consists of two instruments namely feasibility observation sheets and sheets of teachers and students response. Feasibility observation sheet used to determine the level of adherence to learning using student worksheet based on Ethno science consisting of 35 items consisted of a questionnaire that require respondents to choose answers, excellent, good, fair, or poor. While, the sheets student responses to student worksheet used to know the teachers and students response after learning using student worksheet based on Ethno science which consisting of 20 items. Furthermore, the effectiveness of the conceptual understanding test consists of 10 multiple choice questions reasoned. Prior to use all instruments were validated by the experts and has been declared valid.

### 2.4 Data Analysis

Data analysis results practicality student worksheet were determined by calculating the average score of every aspect. The result of the acquisition of scores form of quantitative data which is then converted into qualitative data. The determination of the conversion of the score is taken from Arikunto (2006) which can be seen in Table 1.

Table.1: Conversion Score Quantitative Data  
Into Qualitative Data

Accomplishment' Level	Qualification
81-100%	Excellent
61-80%	Good
41-60%	Sufficient
21-40 %	Insufficient
0-20%	Very Insufficient

Analysis of the data to determine the students' increased conceptual understanding in using student worksheet



based on Ethno science consist of average score of *N-Gain* and effect size. Analysis of *N-Gain* is used to determine whether there is an increased conceptual understanding between pre test and post test. Interpretation criteria *N-gain* proposed by Hake (2002) as shown in Table 2. Effect size is used to determine the influence of student worksheet based on Ethno science in learning to the student conceptual understanding. To calculate the magnitude of the effect size was using *Cohen's*, then interpreted based on the criteria according to Cohen that can be seen by Becker (2000) in Table 3.

Table.2: Criteria Interpretation of gain

N-Gain	Interpretation
$g > 0.7$	High
$0.3 < g \leq 0.7$	Medium
$g \leq 0.3$	Low

Table 3: Interpretation of Effect Size

Effect Size	Interpretation
$d \geq 0.80$	Large
$0.50 < d \leq 0.80$	Medium
$d \geq 0.50$	Small

### III. RESULT AND DISCUSSION

The main results of this study conducted the high school in the province of Lampung, Indonesia was an analysis about the practicality and effectiveness of student worksheet based on Ethno science that has been developed. Learning was done by using worksheets based Ethno science consisting of three meetings which therein were preliminary, content, and cover. Student worksheet equipped with various phenomena Ethno science, exercises, practical guidance, and the task independently. As for some of the phenomena that exist Ethno science on student worksheets used in this study as shown in Figure 1. The teacher had taught the student by using the student worksheet based on Ethno science and obtained data of practicality and effectiveness.

The assessment of practicality student worksheet based on Ethno science in learning measured through feasibility student worksheet and response of teachers and students to student worksheet in implementation. The results of the student worksheets feasibility observation illustrated by the diagram shown in Table 4.

Table 4 shows the results of observation feasibility student worksheet overall with an average score of 92% was included in the very high category. This means that the student worksheet based Ethno science used has a step of learning activities, social system, the principle of reaction, support system, and a very good instructional impact. Learning activities using student worksheets

## Pertemuan 2: Sistem Keseimbangan Benda

### TUJUAN PEMBELAJARAN

Melalui proses mengamati, menanya, mencoba, menalar dan mengkomunikasikan, peserta didik mampu:

1. menggambarkan gaya-gaya yang bekerja pada benda saat terjadi keseimbangan
2. menyelidiki besarnya gaya yang bekerja pada tali dalam sistem setimbang
3. menganalisis gaya tegangan tali pada sistem keseimbangan benda

### KEGIATAN



Perhatikan gambar rumah sesat di samping! Rumah tradisional adat Lampung ini termasuk dalam kategori rumah panggung. Atapnya terbuat dari anyamanalang dan sebagian

Sumber: <http://batindubudayapoerba.blogspot.co.id/2013>

besar bahannya terbuat dari kayu. Bentuk rumah panggung seperti ini dibuat dengan tujuan untuk menghindari serangan hewan dan lebih lebar bila terjadi gempa bumi, karena masyarakat Lampung telah mengenal gempa dari zaman dahulu dan Lampung terletak di pertemuan lempeng Asia dan Australia. Pernahkah kalian berpikir mengapa rumah sesat mampu berdiri tegak meskipun penyangga yang digunakan hanya dengan kayu?

Fig.1: Student's Worksheet On Second Meeting

Table.4: Observations Feasibility of Student Worksheet BasedOn Ethno science

N	Percentage	Criteria
o.		
1 Introduction Activities	94%	Very High
2 Core Activities	89%	Very High
3 Closing Activities	87 %	Very High
4 Time Management	92%	Very High
5 Observations	94%	Very High
6 Systems Social	92%	Very High
7 Principle of Reaction	88%	Very High
8 Support Systems	87%	Very High
9 Impact of Instructional and Accompaniment	80%	High
Average Score of Feasibility in Student Worksheet	92%	Very High

based Ethno science facilitated students understanding and recognize the equilibrium of a rigid body concept then it connected with the culture or customs in their neighborhood.

Feasibility in learning activities aspects such as preliminary activities, core, and the cover obtain a very high score, it indicated that the student worksheet-based

Ethno science in learning was very good. Activity was a preliminary stage of activities to re-announcements about the learning objectives and explain to students about the use of worksheets based Ethno science. At the core activities of the students were divided into five groups, and each student is required to listen to the explanation of teachers and students were asked to observe the phenomenon Ethno science that exist in the worksheet, the phenomenon Ethno science observed equilibrium concept in Lampung's dancers, the concept of traditional house building in Lampung, Indonesia, then the equilibrium on teeter totter and ladders are used to facilitate the work. Without realizing the process of making the art of dance and the traditional house is not off to do with the concept of physics, in particular the concept of equilibrium objects. This sort of thing can be used by teacher to relate the physics concepts to the culture in a learning process. Studying about equilibrium of rigid body will be many obstacles and difficulties when administered directly without starting from the phenomena in the environment in the form of art and culture (Mujadi, 2015).

Feasibility of social system in the learning visible from the interaction between teachers and students when the teacher guides the students in group discussions to resolve the existing problems in students worksheet based Ethno science, while the interaction between students and his group demonstrated when they conducted an experiment to prove their hypothesis that they created, then they presented the results of an experiment in front of the class. Teacher as facilitator to guide them in the presentation, as well as providing reinforcement as a scaffolding on their findings. In line with this results Abdurrahman et al (2018) revealed that through scaffolding activities, students tend to be more active and enthusiastic in interacting with teachers, other students, and learning resources. This is done to assist students in solving the problems that exist in the worksheet. According to Nurulsari et al (2017) a positive interaction between students, teachers, and learning resources, the effect on the implementation of the social systems that obtain very high percentage.

Adherence to the principle of the implementation of the learning percentages reaction is very high at 88%. This happens because the role of teacher as facilitator is able to create a pleasant atmosphere. Based on the observation of the observer, the students looked enthusiastic in working with the program material physics bendar strong equilibrium, in terms of the completion of the core activities of teachers not so involved in the learning process so that students can be trained independence.

Feasibility support system obtained percentage is very high, reaching 87%. Analysis of support system conducted through conformity assessment by the observer is learning the implementation of appropriate lesson plans have been made, as well as learning resources in the form of worksheets based Ethno science in accordance with the ongoing learning materials. Therefore, the enforceability of the test vote on aspects of the support system is very high.

Assessment of the impact of instructional aspect and companion reached a score of 88%, which shows that its implementation is very high. Student worksheet implementation Ethno science based learning instructional impacts for students is to improve understanding of scientific concepts and attitudes. In addition to the instructional impact, student worksheet Bridesmaids result of the development impact that fosters creativity, a sense of caring for the culture and the environment, careful, thorough, and the responsibility to conduct a study.

Furthermore, the student response seen from the clarity of the language used in the student worksheet, suitability appearance, ease of use, and the level of student satisfaction in using worksheets result of the development. Student response was positive in every aspect. The results of students 'response to student worksheet result of development reached 87%, this means students' response to the use of very high student worksheet. The students' responses also supported by positive comments when they were asked at the end of the lesson. According to the students, they said that learning to use this worksheet is new and exciting, because the student worksheets with pictures, the phenomenon of the surrounding culture, and content material that is easy to understand. Response teachers were having observed and used worksheets result of the development which is the average teacher found student worksheet developed in accordance with Core Competencies (CC) and Basic Competencies(BC) were already standard.

Teachers argue that by using student worksheet based on Ethno science, students are able to discover new things in the understanding of physics concepts. Student worksheet result of the development is able to enhance students' understanding in solving problems in physics particularly equilibrium of rigid body. There are so many phenomena Ethno science shown in student worksheet, so it allows students to hone their ability in problem solving and group discussion. In addition, the questionnaire responses have filled teacher can be seen in Table 5

Table 5: Results of Response Teachers to Use Worksheet  
Student Based Ethno science

N	Result of	Percent	Criteria
o	Response in	age (%)	
	Physics Teacher		
1	Physics Teacher 1	91.7	Very
2	Physics Teacher 2	86.5	Good
3	physics teacher 3	90.8	
	average	89.6	
	Percentage		

based on the responses of teachers to use student worksheets based Ethno science, it is known that the physics teacher had a positive response to the use of worksheets, the average physics teacher responds by 89.6%, or very good. These results indicate that work-based Ethno science acceptable to facilitate teacher in physics. Teachers assume that Ethno science based learning can make students were able to relate their real science with theory, more creative, and easy to accept learning. The same thing was stated in the research Sudarmin et al (2017) that learning can dig Ethno science original view about the culture and habits of students in the learning community. Additionally, Rist et al (2006) suggested that Ethno science help to improve students' assumptions about culture in the society with regard to the natural sciences.

Based on the results of enforceability of the product and the response of teachers and students gain a very high category, it can be concluded that based student worksheet Ethno science practical development results to be used in high school physics teaching material particularly rigid body equilibrium. The practical teaching materials can be interesting, as well as to motivate learning (Uno, 2006).

The results of the effectiveness of student worksheets based Ethno science in learning is measured through student conceptual understanding test results on an experimental class and control class. The test results effect size using a calculator *Cohen's* (Figure 2) showed that the effect of the used student worksheet based on Ethno science was large enough to generate students conceptual understanding. Effect-size was calculated and

showed the value  $r$  0.7493158 or in medium category. That was, the effect of using student worksheet based on Ethno science for generating the student conceptual understanding was in the medium size. Meanwhile, based on the analysis of N-gain in the experimental class and control class can be seen in Table 6.

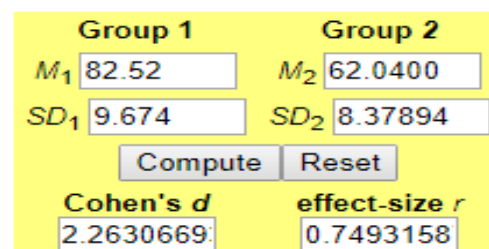


Figure 2: Effect size on conceptual understanding

Table 6: Average yield N-gain and Concept Training  
Effect size Student

Class	Pret est	Post test	Std. dev	N-gain	Category
Experiment	46.96	82.52	9.67	0.66	Medium
Control 1	62.04	41.44	8.37	0.34	Low

Based on Table 6, the experimental class that used student worksheet based Ethno science got an increased gain of conceptual understanding that was higher than the control class that used a conventional student worksheet. The experiment class got N-gain score 0.60 or in the category of moderate improvement, while the control class got N-gain score 0.34 or lower improvement. Learning that using learning resource of student worksheet based Ethno science provide experience for students to relate phenomena in the surrounding areas with the existing physical theories. Posttest results of the students after learning Ethno science increased, it was consistent with a research (Sudarmin et al, 2017; Afrianawati, 2016; Kartimi, 2014).

Student's answer in student worksheet based on Ethno science was effective in improving students' conceptual understanding that can be seen in Figure 3.

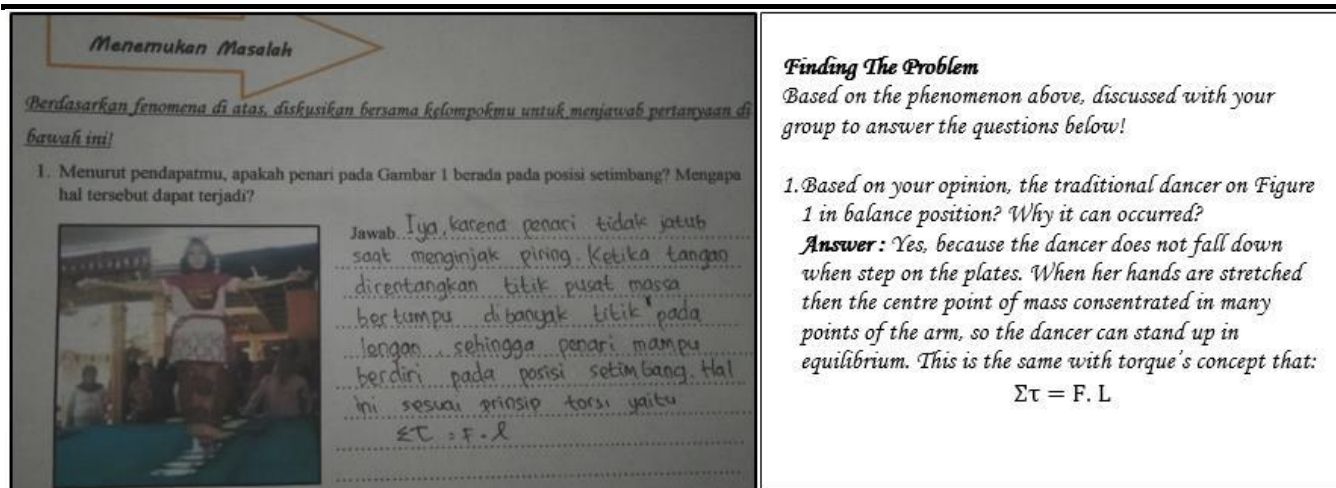


Fig.3: The student's answer on Ethno science' worksheet

Based on student worksheet question based on Ethno science in Figure 3, the worksheet showed that the phenomenon Ethno science occurred in traditional Indonesian dancers that dance dishes. Dancers plate capable of holding a candle in her arms as she stepped on the plate. Seen in the figure that the plates were not broken, it is then analyzed by the students why it happens. Through the analysis process, teacher would guide students to relate the equilibrium of rigid body concept in this Ethno science phenomenon. It turned out learning by using student worksheet based on Ethno science guided students to apply the concept of rigid body equilibrium, look at the students' answers in Figure 3 students were able to decipher the reasons for the existing problems and were associated with the concept of style moment. The steps began by observing the phenomenon, and then analyzed the phenomenon, answered questions, and then conducted an experiment to prove the answer to the problem of the phenomenon. Through these activities the ability of conceptual understanding began to grow, conceptual understanding was very important in learning physics (Suryaniet al., 2018). Natural science was better when taught through the cultural approach, customs, and traditional methods, this was in line with research Gasat et al (2017). The process of learning using student worksheet based on Ethno science will open their views of nature and culture, basically a physics concept that originated from nature.

#### IV. CONCLUSION

Based on the description in the discussion can be concluded that student worksheet based Ethno science, 1) practically viewed from the results feasibility of student worksheet in learning, teachers' response were very good and positive students' responses against student worksheet. 2) effectively viewed from differences in test results between the students' conceptual understanding of

experimental class and control class. Students' conceptual understanding in experimental class are taught using student worksheet based Ethno science higher than the control class. Learning physics used student worksheet based Ethno science has several advantages consist of attractive design, hone the idea of student creativity, curious, accompanied by figures of the phenomenon realistic, step coherent learning, and guided to find the concept to be learned.

#### ACKNOWLEDGMENT

We thank to the University of Lampung, Indonesia. This research would not be possible without the help from all members of our team who are not authors on this paper.

#### REFERENCES

- [1] Abdurrahman, A., Saregar, A., & Umam, R. (2018). The Effect of Feedback as Soft Scaffolding on Ongoing Assessment Toward The Quantum Physics Concept Mastery of The Prospective Physics Teachers. *Jurnal Pendidikan IPA Indonesia*, 7(1), 34-40.
- [2] Afrianawati, S., Sudarmin, & Sumarni, W. (2016). Model pembelajaran kimia berbasis etnosains untuk meningkatkan kemampuan berpikir kritis siswa. *Jurnal Pengajaran MIPA*, 21(1), pp. 46-51.
- [3] Anderson, I.W. & Krathwohl, D.R. (2001). *A Taxonomy for Learning, Teaching and Assessing*. A revision of Bloom's Taxonomy of education Objectives. New York: Addison Wesley.
- [4] Arikunto, Suharsimi. (2006). *Dasar-dasar Evaluasi Pendidikan*. Jakarta: Bumi Aksara
- [5] Battiste, M. (2002). Indigenous knowledge and pedagogy in first nation education a literature review with recommendation. Accessed on Mei 2018. [http://www.afn.ca/uploads/files/education/24.\\_2002\\_](http://www.afn.ca/uploads/files/education/24._2002_)



- [6] Becker, L. A. (2000). Effect size (ES). Accessed on October, 12(2006), pp. 155-159.
- [7] Berkes, F., Colding, J., & Folke, C. (2000). Rediscovery of traditional ecological knowledge as adaptive management. *Ecological Applications*, 10(5), pp. 1251–1262.
- [8] Canon, H.M & Feinstein, A. H. (2005). Bloom Beyond Bloom: Using the Revised Taxonomy to Develop Experiential Learning Strategies. *Developments in business Simulations and Experiential Learning*, 32, pp. 348-356.
- [9] Dhanya, C. H., & Pankajam, R. (2017). Environmental awareness among secondary school students. *International Journal of Research - Granthaalayah*, 5(5), pp. 22-26.
- [10] Gasat, V. J. P., Del Rosario, M. P. N., and Monalo, F. O. (2017). Comparative Analysis of Traditional versus Authentic Teaching Method in DNA Extraction to Biology Students. *International Journal of Advanced Engineering, Management and Science (IJAEMS)*, 3, pp. 199-204
- [11] Hake, R. R. (2001). Lessons from the physics-education reform effort. Lessons from the physics-education reform effort. *arXiv preprint physics/0106087*.
- [12] Kartimi. (2014). Implementation of biology learning based on local science culture to improvement of senior high school students learning outcome in Cirebon district and Kuningan district. *Scientiae Educatia*, 3, pp. 1-10.
- [13] Kementerian Pendidikan dan Kebudayaan. (2014). *Konsep dan Implementasi Kurikulum 2013*. Jakarta: Kementerian Pendidikan dan Kebudayaan.
- [14] Kidman, J., Chung, F., & Eleanor, A. (2013). Indigenous student experiences of the hidden curriculum in science education: A cross national study in New Zealand and Taiwan. *International Journal of Science and Mathematics Education*, 11(2), pp. 43-64.
- [15] Knuth, R.A. & Jones, B.F. (2002). Teachers' conception of proof in the context of secondary school mathematics. *Journal of Mathematics Teacher Education*, 5(1), pp. 61-88.
- [16] Misnah. (2015). *Kearifan Lokal Sebagai Sumber Pembelajaran IPS*. Bandung: Pendidikan IPS UPI
- [17] Mujadi. (2015). Indiginasi Senidan Budaya dalam Pembelajaran Fisika. *RKPF UAD*, 2(2). pp. 67-72
- [18] [18] Novi, R., & Parmin. (2012). Pengembangan Modul Pembelajaran IPA Terpadu Berwawasan Sains, Lingkungan, Teknologi, dan Masyarakat. *Jurnal Penelitian Pendidikan*, 29(8), pp. 125-136.
- [19] Nurulsari, N., Abdurrahman A., & Suyatna, A. (2017). Development of soft scaffolding strategy to improve student's creative thinking ability in physics. *Journal of Physics: Conference Series*, 909, pp. 1-8.
- [20] Parmin, Sajidan, Ashadi, Sutikno, & Fibriana, F. (2017). Science integrated learning model to enhance the scientific work independence of student teacher in indigenous knowledge transformation. *Jurnal Pendidikan IPA Indonesia*, 6(2), pp. 365-372.
- [21] Permendikbud No. 22 Tahun 2006 tentang Standar Isi untuk Satuan Pendidikan Dasar dan Menengah. Jakarta.
- [22] Rahayu, W. E., & Sudarmin. (2015). Pengembangan modul IPA terpadu berbasis etnosains dalam kehidupan untuk menanamkan jiwa konservasi siswa. *Unnes Science Education Journal*, 4(2), pp. 920-926.
- [23] Rist, S., & Dahdouh, F. G. (2006). Ethno sciences—A step towards the integration of scientific and indigenous forms of knowledge in the management of natural resources for the future. *Journal of EnvDevSustain*, 8(4), pp. 467-493.
- [24] Ruheza, S, Mattee, Z.A; Chingonikaya, E.E, and, Zuenakilugwe, (2013). Integration of The Indigenous Knowledge System (IKS) for sustainable management and use of biodiversity in South Nguru mountain forest: The influence of socio-economic and political factors. *Journal of Sustainable Development in Africa*, 15(8), pp.94-114.
- [25] Sahala, S., & Oktavianty, E. (2013). Remediasikesulitan belajarsiswakelas XII IPA MAN 1 Pontianak pada materi dinamika rotasi menggunakan model learning cycle 5E. *Jurnal Pendidikan dan Pembelajaran*, 2(6).
- [26] Sardjiyo. (2005). Pembelajaran berbasis budaya model inovasi pembelajaran dan implementasi kurikulum berbasis kompetensi. *Jurnal Pendidikan*, 6(2), pp. 83-98.
- [27] Sudarmin, Febu, R., Nuswawati, M., & Sumarni, W. (2017). Development of Ethno science approach in the module theme substance additives to improve the cognitive learning outcome and student's entrepreneurship. *Journal of Physics*, 824, pp. 1-14.
- [28] Sumarni, W., Sudarmin, Wiyanto, Rusilowati, A., & Susilaningih, E. (2017). Chemical literacy of teaching candidates studying the integrated food chemistry ethnosciences course. *Journal of Turkish Science Education*, 14, pp. 60-72.
- [29] Suryani, Y., Distrik, I.W., and Suyatna, A. (2018). The practicality and effectiveness of student worksheet based multiple representation to improve conceptual understanding and students' problem-solving ability of physics. *International Journal of Research - Granthaalayah*, 6(4), pp. 166-173.



- [30] Talens, J. D. (2016). Development and Validation of Responsible Environmental Behavior Scale towards Solid Waste Management (REBS-SWM) in School Setting. *International Journal of Advanced Engineering, Management and Science (IJAEMS)*, 2, pp. 191-197.
- [31] Uno, H. B. (2008). *Perencanaan Pembelajaran*. Jakarta: Bumi Aksara
- [32] Ward, J. (2010). Grounding curriculum and pedagogies in indigenous knowledge and indigenous knowledge systems. Accessed on Mei 2018: [ejournal.narotama.ac.id](http://ejournal.narotama.ac.id)

# Transient Stability Assessment of Hybrid Distributed Generation and its Impact on Critical Clearing Time and Oscillation Duration Considering its Complementary Nature

P. K Olulope

Ekiti State University, Ado- Ekiti, Nigeria  
[paulade001@yahoo.com](mailto:paulade001@yahoo.com)

**Abstract**— Presently, the grid accommodates several mixed energies so as to improve power generation and cater for demand which is ever increasing. These energy sources interact with each other and with the existing grid. Due to the complementary nature of most renewable energy and the mixed dynamics associated with them coupled with the bi directional power flow, transient stability based on single source will not give the overall assessment of the network. This paper presents the impact of hybrid Solar PV-Wind and Small Hydro distributed generation on transient stability of power system so as to take advantages of their complementary roles. To investigate this impact, a detail modeling of grid connected wind / solar PV and small hydropower system with single machine infinite system is carried out. The configuration of the proposed typical grid connected hybrid distributed generation (HDG) consists of hybrid Doubly fed induction generator (DFIG), solar PV and small hydropower system. DFIG is integrated through PWM converter into the existing grid while the solar PV consisting of DC sources is integrated through PWM inverter and the hydro power is directly connected through a synchronous generator. The simulation was done in DIgSILENT power factory software

**Keywords**— Hybrid distributed generation, stability index, and critical clearing time. Wind turbine, Solar PV, Hydropower system, export, import, distributed generation.

## I. INTRODUCTION

The concept of distributed generation was introduced mainly to service loads locally and avoid excessive voltage drop due to long transmission. However, to meet most load demands locally the load must be shared among the locally integrated mixed energies for economic benefits. Besides, the energies are complementary which makes the assessment based on the combined energy sources important and relevant. In case of hybrid solar PV and

small hydro power, the solar PV supplies power only during the day and the small hydro power complement during the night [1]. This complementary roles and also the intermittency of the energy source need to be considered in order to give correct assessment of the system. The system dynamics is altered and more complexities are introduced when a hybrid sources are connected to distribution network compared to single energy sources. Hybrid distributed generation with multi-sources therefore can be defined as a small set of co-operating units that generates electricity and heat, with diversified primary energy carriers (Renewable and non-renewable), while the coordination of their operation takes place by utilization of advanced power electronics and are located closed to the consumers end. They are either grid connected or standalone system, renewable or non-renewable system [2]. It can be described as distributed generation when it is connected close to the consumers to deliver power to local or industrial load [3]. There are many reasons why HDG is a focus for research. They are:

1. Since the DG complements one another, the outputs are also interdependent resulting in possibilities of higher degree of instabilities compare to single energy source.
2. Most renewable energies are weather dependent with constant daily load variation leading to negative impact on the entire system [6].
3. Economic load sharing among the distributed generators allow uneven participation of the generator and interaction with one another and the grid with tendency of higher degree of instability.
3. Possibilities of insufficient supply will be higher in a village with Solar PV alone or Solar PV combined with other renewable because PV does not supply energy during the nights.
4. Lack of inertia constant contributes to the poor voltage regulation and low power quality produce by PV array. It therefore increases instability during fault [8].

5. The existing control mechanism might not be able to handle load management, power interchange between the grid and the distribution network and the economic power supply
6. The renewable energies are stochastic in nature. So the output behavior solely depends on the environment. A robust transient stability models is needed
7. In the scheduling process, decisions to commit or de-commit units to meet the varying system load demand and the amount of spinning reserve required appropriate dynamic optimization programming which in a way contribute to different stability assessment output .

Today, most of the energy demand is supplied by conventional energy system such as fossil fuels which is characterized by greenhouse gases that can damage the environment and bring about serious health challenges. Our dependence on this is not advisable as the resources are not everlasting. In order to address these problems, renewable energies are introduced such as solar PV, Wind, Geothermal and hydropower system. Unfortunately most of these renewables are weather dependent and are mainly subject to variation. In some part of the world, the maximum availability of wind energy occurs during winter while solar energy peaks occurs in summer. On the other hand energy consumer requirements are highest during winter. These energy requirement might not be met by wind power alone, there is need to supplement with other renewable energies so as to benefits from their strength and thus reduce the effect of their weaknesses.

American wind energy association account for 1/5 of the global wind power available for US. Wind energy resources has characteristic of randomness, intermittent, unpredictable nature and cannot be stored which will result in instability of the grid. To solve this problem, there is need for good assessment of the system when three phase is applied as well as to employ the complementary capability of the wind, solar and small hydro power[1]. The complementary power is achieved when the generating system is combined in such away that the sufficiency of one energy is used to assist the deficiency of the other.

Due to this complimentary nature, there are wide-spread uses of hybrid distributed generation (hybrid Solar PV , Hydro power) across the globe though the level of penetration is still low [3, 4]. In 2011, few grid systems have penetration levels above five percent. Examples are Denmark – 26%, Portugal – 17%, Spain – 15%, Ireland – 14%, and Germany – 9%. For the U.S. in 2011, the penetration level was estimated at 2.9% [5]. Germany, Demark and Ireland are already proposing a significant proportion of installed capacity to be connected to the distribution system below 100kV [6]. By year 2020, the

penetration level of DG in some countries such as USA is expected to increase by 25% as more independent power producers; consumers and utility company imbibe the idea of distributed generation [7]. In the same way, solar PV is gaining wide spread especially in Germany. 3% of total generation in Germany today is from solar PV. South Africa also concludes that the realization of the vision 2030 will be based on solar PV, Concentrated solar power (CSP) and wind power [8]. However, the rapid progress in renewable energy power generation technologies, and the awareness of environmental protection have been the major reasons why alternative energy and distributed generation is a promising areas [9].

The larger the penetration level of hybrid distributed generation (HDG) in a power system, the more difficult it becomes to predict, to model, to analyze and to control the behavior of such system [10]. Some HDG using induction generators are not grid friendly because they consume reactive power instead of generating it. Most power converters do not have adequate control mechanism to actively support DG integration. The system inertia for some of them (e.g., solar PV or fuel cell) is extremely low. They are weather dependent with constant daily load variation [11]. Also, existing protection mechanism might not be able to take care of the problem of bi-directional power flow that takes place due to DG connection in radial networks. New design controllers are needed to effectively manage the multi-energy sources distributed generation in other to service remote villages.

Due to the natural intermittent properties of wind and solar PV, stand alone wind/PV renewable energy systems normally require energy storage devices or some other generation sources to form a hybrid system.

In an electrical power grid without energy storage, energy sources that rely on energy stored within fuels (coal, oil, gas) must be scaled up and down to match the rise and fall of energy production from intermittent energy sources. In this way the operators can actively adapt energy.

## II. DISTRIBUTED GENERATION AND HYBRID DISTRIBUTED GENERATION CONCEPT

Many of the primary energy sources are complimentary and abundant in nature which gives it a good opportunity to increase availability, power quality and flexibility of power supply when they are fully optimized. The objective of the integration is to capitalize on the strengths of both conventional and renewable energy sources, both cogeneration and non-cogeneration types. Presently, the promising sources of distributed generation are wind turbine and Solar PV. A PV cell harvest energy directly from sunlight and converting it to electricity. Due to the high cost, they were initially preferred only for space research applications. Later, as the cost of PV began to

decrease, several other applications were developed. Attempt to decrease the cost has brought the use of organic semiconductors like conjugated polymers [2] in the fabrication of solar cells. The locally made production of Solar panel is ongoing at least to reduce the high cost of production. However, the running cost and the maintenance cost of these PVs as well as the long life usage makes it an attractive alternative energy source. The drawbacks are:

- 1) The variability of the energy sources causes instability to the grid.
- 2) Consumers that are supplied by PV are likely to be in blackout in the night as PV does not supply energy during the nights.
- 3). Lack of inertia constant contributes to the poor voltage regulation and low power quality produce by PV array. It therefore increases instability during fault.

On the other hand, wind converts energy inherent in wind to electricity through wind turbine, shaft, induction generator and various controllers to ensure proper grid integration and friendliness. Like PV, wind output power depends on the availability of wind. The variability of energy sources is a concern as it is a hot area of research over decade ago. It is clean and renewable and environmentally friendly but is not reliable. Also, wind turbine especially the doubly-fed induction generator has the ability to provide supplementary active and reactive power to the existing grid.

For some reasons, solar PV and wind turbine can form a viable hybrid power sources. Other energy sources that can form hybrid sources with solar PV are diesel generator, batteries, fuel cells, small hydropower system. [2]. Detail of the list can be found in ref [2]. The location of wind and solar is site dependent and can be used in remote area where the cost of electricity is expensive

### III. MODELING OF HYBRID DISTRIBUTED GENERATION

#### 3.1 Modelling Doubly-Fed Induction Generator (DFIG) For Stability Studies

DFIG is widely preferred as the electrical generator for a wind turbine because of easy control and robustness [21]. DFIG is a wound rotor induction generator with voltage source converter connected to the slip-rings of the rotor. DFIG interact with the grid through the rotor and stator terminal. The induction generator is connected to the grid through the stator terminals, but the rotor terminals are connected to the grid via a partial-load variable frequency AC/DC/AC converter (VFC) [22] as shown in Fig. 1.

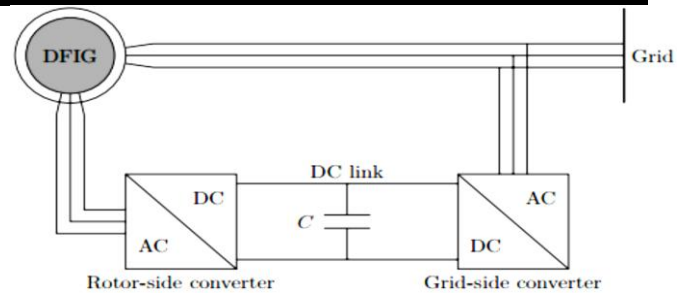


Fig. 1: DFIG with its converter [22]

To represent induction machine under system disturbance, it is desirable to use a double-cage model which represents transient and sub transient behaviour of the machine accurately [23-26]. For modelling the DFIG converters, it is assumed that the converters are ideal and the DC link voltage between the converters is constant. The rotor side converter is connected to the rotor of DFIG via brushes while the grid-side converter is connected to the grid. A capacitor is connected between the converters that act as DC voltage source. The DC voltage source decouples the rotor side converter from the grid-side converter. The rotor side converter is modelled as a voltage source whereas the grid-side converter is modelled as a current source [27],[28]. The torque and the speed are controlled by the rotor side converter. The rotor speed is controlled by q-component of the injected voltage, through rotor side converter. The d-component of the rotor side converter voltage is used for compensation for the generator magnetizing reactive power. The main objective for the grid-side converter is to keep the dc-link voltage constant. In DFIG, the rotor side converter is controlled by using different control techniques such as scalar and vector controls. In scalar control, the torque and flux have a coupling effect while in vector control, the torque and flux has a decoupling effect.

The DFIG equipped with four-quadrant ac-to-ac converter increases the transient stability margin of the electric grids compared to the fixed-speed wind systems based squirrel-cage generators [28]. The stator and the rotor modelling of DFIG are given below:

$$u_{ds} = -R_s i_{ds} - \omega_s \psi_{qs} + \frac{d\psi_{ds}}{dt} \quad (1)$$

$$u_{qs} = -R_s i_{qs} + \omega_s \psi_{ds} + \frac{d\psi_{qs}}{dt} \quad (2)$$

$$u_{dr} = -R_r i_{dr} - s\omega_s \psi_{qr} + \frac{d\psi_{dr}}{dt} \quad (3)$$

$$u_{qr} = -R_r i_{qr} + s\omega_s \psi_{dr} + \frac{d\psi_{qr}}{dt} \quad (4)$$

where  $s$  is the slip,  $u$  is the voltage,  $i$  is the current,  $R$  is the resistance, and  $\psi$  is the flux, is the synchronous speed of

the stator field. All quantities are measured in per unit. The subscripts d and q stand for direct and quadrature component, respectively while subscripts r and s stand for rotor and stator respectively.

The real and reactive power at the rotor and the stator can be calculated by:

$$P_s = u_{ds}i_{ds} + u_{qs}i_{qs} \quad (5)$$

$$Q_s = u_{qs}i_{ds} - u_{ds}i_{qs} \quad (6)$$

$$P_r = (u_{dr}i_{dr} + u_{qr}i_{qr}) \quad (7)$$

$$Q_r = (u_{qr}i_{dr} - u_{dr}i_{qr}) \quad (8)$$

For DFIG

$$P = P_s + P_r = u_{ds}i_{ds} + u_{qs}i_{qs} + u_{dr}i_{dr} + u_{qr}i_{qr} \quad (9)$$

$$Q = Q_s + Q_r = u_{qs}i_{ds} - u_{ds}i_{qs} + u_{qr}i_{dr} - u_{dr}i_{qr} \quad (10)$$

### Rotor equations modeling

The general relations between wind speed and aerodynamic torque hold [17]:

$$T_t = \frac{1}{2} \rho \pi R^3 v^2 \frac{C_p(\lambda, \beta)}{\lambda} \quad (11)$$

And the power is shown as

$$P_w = \frac{\rho}{2} C_p(\lambda, \beta) A_R v_w^3 \quad (12)$$

The power coefficient  $C_p$  of the wind turbine in equation 12 is a function of tip-speed ratio  $\lambda$  which is given by:

$$\lambda = \frac{\omega R}{v} \quad (13)$$

$T_t$ =turbine aerodynamic torque (Nm),  $\rho$ = specific density of air ( $\text{kg/m}^3$ ),  $v$ = wind speed (m/s),  $R$ =radius of the turbine blade (m),  $C_p$ = coefficient of power conversion,  $\beta$  = pitch angle,  $P$ =power extracted from the airflow (W),  $\lambda$ = Tip speed ratio,

$\omega$ = is the rotational speed of the wind turbine shaft

The value of  $Q$  fed into the grid in equation 11 above depends on the control of the power electronic in the grid sides. This does not affect active power except that the efficiency of the inverter can be incorporated into the last two variables. In this paper, for transient stability studies of power systems the generator is represented by third order model as indicated in DIGSILENT [21]. In this case the model is obtained by neglecting the stator transients for the fifth order model of induction machine. It shows that there are three electrical equations and one mechanical equation. The model is in d-q expressed in rotor reference frame. In rotor reference frame, the d axis in the rotor reference frame is chosen collinear to the rotor phase winding and the position of the rotor reference frame is the actual position of the rotor.

The dynamic model of the generator is completed by mechanical equation as indicated below:

The electrical torque can be expressed by:

$$T_e = \psi_{dr}i_{qr} - \psi_{qr}i_{dr} \quad (14)$$

Obviously, there is a change in generator speed as a result of the difference in electrical and mechanical torque. This is expressed as:

$$\frac{d\omega}{dt} = \frac{1}{2H} (T_m - T_e) \quad (15)$$

Where  $H$  is the inertial constant(s) and this is specified in DIGSILENT as acceleration time constant in the induction generator type.  $T_m$  and  $T_e$  is the mechanical and electrical torque respectively.

### 3.2 Modeling of Small Hydro Turbine

The power available in water current is proportional to the product of head and flow rate [30].

The general formula for any hydro power is:

$$P_{hyd} = \rho g Q H \quad (16)$$

Where:  $P_{hyd}$  is the mechanical power produced at the turbine shaft (Watts),  $\rho$  is the density of water ( $1000 \text{ kg/m}^3$ ),  $g$  is the acceleration due to gravity ( $9.81 \text{ m/s}^2$ ),  $Q$  is the water flow rate passing through the turbine ( $\text{m}^3/\text{s}$ ),  $H$  is the effective pressure head of water across the turbine (m). The hydro-turbine converts the water pressure to mechanical shaft power, which further rotates the generator coupled on the same shaft [31-33]. The relation between the mechanical and the hydraulic powers can be obtained by using hydraulic turbine efficiency  $\eta_h$ , as expressed by the following equations:

$$P_n = \eta_h P_{hyd} \quad (17)$$

$$Q = A v$$



where  $A$  is the area of the cross section ( $m^2$ ) and  $v$  is the water flow speed ( $m/s$ ),

And the whole equation is derived from Bernoulli's theorem which states that:

$$\frac{v^2}{2g} + h + \frac{p}{\rho g} = \frac{P_{hyd}}{\rho g Q} \quad (18)$$

where  $p$  is the pressure of water ( $N/m^2$ ).

### 3.3 Solar Cell Modeling

Solar PV effect is a basic physical process through which solar energy is converted directly into electrical energy. It consists of many cells connected in series and parallel. The voltage and current output is a nonlinear relationship. It is essential therefore to track the power since the maximum power output of the PV array varies with solar radiation or load current. The equivalent diagram of a solar cell is represented by one diode model as shown in Fig. 2.

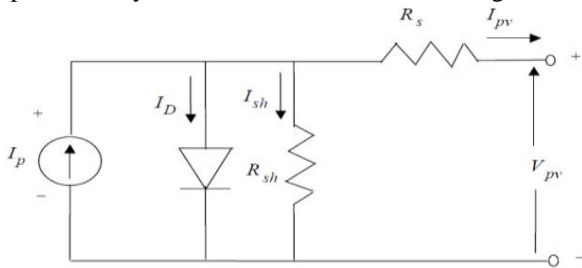


Fig.2: Model for single solar cell

The output terminal of the circuits is connected to the load. The output current source is the difference between the photocurrent  $I_p$  and the normal diode current  $I_D$ . Ideally the relationship between the output voltage  $V_{pv}$  and the load current  $I_{pv}$  of a PV cell or a module can be expressed as if we assume that the current  $I_{sh}$  in shunt resistor  $R_{sh}$  is neglected. [33-36].

$$I_{pv} = I_p - I_D = I_p - I_o \left[ \exp \left( \frac{V_{pv} + I_{pv} R_s}{m K T_c / q} \right) - 1 \right] \quad (19)$$

where  $I_p$  is the photocurrent of the PV cell (in amperes),  $I_o$  is the saturation current,  $I_{pv}$  is the load current (in amperes),  $V_{pv}$  is the PV output voltage (in volts),  $R_s$  is the series resistance of the PV cell (in ohms) and  $m$ ,  $K$  and  $T_c$

represent respectively the diode quality constant, Boltzmann's constant and temperature.  $q$  is electron charge ( $1.602 \times 10^{-19} C$ ) [38].

The power output of a solar cell is given by

$$P_{pv} = V_{pv} I_{pv} \quad (20)$$

Where  $I_{pv}$  is the output current of solar cell (A).  $V_{pv}$  is the solar cell operating voltage (V),  $P_{pv}$  is the output power of solar cell (W). The output power depends on the temperature and the irradiance [39].

## IV. ARRANGEMENT OF THE PROPOSED CONFIGURATION

### 4.1 Modified Single Machine Infinite Bus System

Fig 3 shows the modified single machine infinite bus system model used in this paper. This power system model consists of an infinite bus system (Grid) represented by GEN1, one centralized generator (GEN2), a hybrid distributed generation (HDG) and two equal loads (LOAD1 and LOAD2). GEN1 is connected to bus 2 via line 3. The transmission lines (line 1, line2 and line3) are modeled as equivalent  $\pi$  transmission lines. Line 1 and line 2 are 100km long each, while line 3 is 40km long. GEN 2 is connected to bus 3 via a 100MVA transformer (transformer 1) and has a capacity of 80MW and 60MVar. The DG/HDG consisting of wind generator (DFIG), SOLAR PV and small hydropower system (SHP) is connected to bus 3 via another 100MVA transformer (Transformer 2). Each DFIG is rated 8MW, 0.89 power factor lagging. The SOLAR PV is rated 8MW real power at unity power factor. When SOLAR PV alone is connected to the HDG bus, a capacitor bank is used at that bus to compensate for reactive power. The hydropower is rated 8MW and 4MVar. LOAD1 and LOAD2 are connected to bus 2 and bus 3, respectively, and are rated 80MW and 40MVar each.

DIGSILENT power factor 14.1 was used to model this test system. To investigate the effect of a large disturbance, a three-phase fault was applied in the middle of line 2 and cleared after 200ms by removing the line.

Proposed Hybrid Distributed Generation Configuration

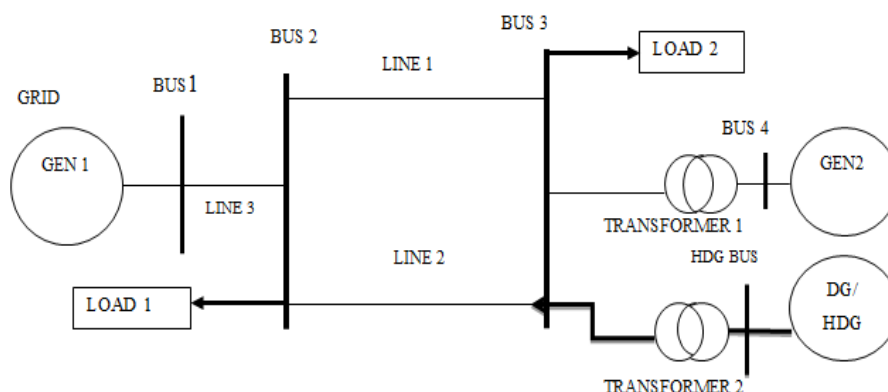


Fig.3: Modified Single Machine Infinite Bus System.

The focus is to investigate the impact of Hybrid solar PV, wind turbine (Doubly-Fed Induction Generator- DFIG) and small hydropower systems (SHP) on transient stability when it is used as complementary energy sources. In order to obtain all possible combinations, a truth table is formed as shown in Table 1. The truth table shows how the three generators can be combined to form HDG. The first column shows various scenarios. There are 8 scenarios.

For example, scenario 1 shows the case where there is no integration of DG/HDG. Scenario 2 shows the case where only SHP is integrated and so on. Zero (0) means no generator is connected while one (1) means a generator is connected. The base cases are single source DGs (Scenarios 2, 3 and 5). These base cases were chosen in order to draw out comparisons between complementary HDG and single source DG.

Table.1: Truth table describing the combination of different DG

SCENARIOS	WIND TURBINE (DFIG)	SOLAR PV	SMALL HYDROPOWER (SHP)	INFERENCE
1	0	0	0	No DG Integration
2	0	0	1	Small Hydropower only (Base case 1)
3	0	1	0	SOLAR PV only (Base case 2)
4	0	1	1	SOLAR PV and Small Hydropower
5	1	0	0	Wind turbine only (Base case 3)
6	1	0	1	DFIG and Small Hydropower
7	1	1	0	DFIG and SOLAR PV
8	1	1	1	DFIG, SOLAR PV, Small Hydropower (SHP)

#### PARTIAL ENERGY COMPLEMENTARITY INDEX

The partial energy complementarity index evaluates the relation between the average value of the availability functions. If the average values are equal the index should be equal to one (50% each). If those values are different the index should be smaller and tend to zero as the differences increase [42]

#### V. SIMULATION SCENARIOS

The simulation scenarios are discussed in this section.

Case study 1 consists of scenarios 2 (Small Hydropower alone), 3 (SOLAR PV alone) and 5 (DFIG alone) which are the base cases.

Case study 2 consists of scenario 4 (Hybrid SOLAR PV and Small Hydropower)

Case study 3 consists of scenario 6 (Hybrid DFIG and Small Hydropower)

Case study 4 consists of scenario 7 (Hybrid DFIG and SOLAR PV)

Case study 5 consists of scenario 8 (Hybrid DFIG, SOLAR PV and Small hydropower)

Three penetration levels of HDG ( $PL_{HDG}$ ) were considered:

- (i) Import mode,  $PL_{HDG}=40\%$ , %Complementarity ratio( $CL_{HDG}$ ): (50% equally)
- (ii) Balanced mode,  $PL_{HDG}=50\%$ , %Complementarity ratio( $CL_{HDG}$ ): (50% equally)
- (iii) Export mode,  $PL_{HDG}=80\%$ , %Complementarity ratio( $CL_{HDG}$ ): (50% equally)

The penetration level for HDG is defined as:

$$\% PL_{HDG} = \frac{P_{HDG}}{P_{HDG} + P_{CG}} \times 100 \quad (21)$$

where  $\%PL_{HDG}$  is the percentage penetration of the DG/HDG,  $P_{HDG}$  is the active power generated by HDG and  $P_{CG}$  is the active power from the centralized generators (GRID and GEN2).

$$\% \text{Complementarity level } (CL_{HDG}) = \frac{P_{HDG}}{P_{LOAD}} \times 100 \quad (22)$$

Note that  $P_{CG} + P_{HDG} = P_{LOAD}$

where  $P_{LOAD}$  is the power delivered to the load and  $\%CL_{HDG}$  is the percentage complementarity level

In all the simulations, the active and the reactive power of GEN2 are kept constant. The descriptions of the penetration levels are as follows as well as complementary ratio:

**Import mode:** In this mode, the load demands are supplied by GEN2 and HDG with additional supply from the GRID. This is shown in Fig 4. The penetration level is 40% while the energy complementarity index is 50%

**Balanced mode:** In this mode, the load demands are met by the combination of GEN2 and HDG without any extra

supply from the GRID. This means that the power generated by HDG and GEN 2 is sufficient to meet the load demands. This is shown in Fig 5. The penetration level is 50% while the energy complementarity index is 50%

**Export mode:** In this mode, HDG and GEN2 supply the loads and export the excess generation to the GRID. This is shown in Fig 6. The penetration level is 80% while the energy complementarity index is 50%

## VI. TRANSIENT STABILITY INDICATOR

### 6.1 Impact of Hybrid Distributed Generation Using CCT

To measure the impact of HDG on transient stability, the critical clearing time (CCT) is used as the stability index. This index measures the stability margin and indicates the robustness of the system to disturbances. The longer the CCT, the longer the system can tolerate the fault, and the more robust is the system. The impact of penetration level and based on import mode, balanced mode and export mode on transient stability with HDG is investigated by monitoring the CCT. To assess the level of instability, the rotor angle is monitored when a temporary three-phase fault is applied in the middle of line 2 while the CCT is monitored by applying three-phase fault on line 2 at different locations from bus 3. The locations of the fault are 0%, 20%, 40%, 60%, 80% 100% of the total length of the transmission line (bus 3-bus2). In other word, the fault distance is the distance from bus 3 to the fault location. For example, when the

fault occurs at bus 3, the fault location will be 0% and when the

fault occurs at bus 2, the fault location will be 100% and so on. The CCT is calculated by increasing the fault clearing time (FCT) until the rotor angle of GEN 2 reaches its critical clearing angle where further increase will make the system unstable.

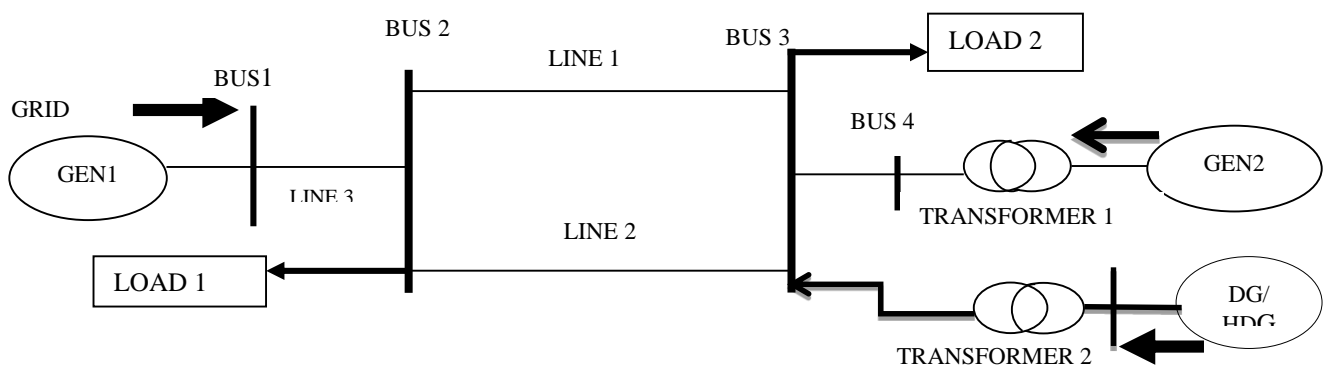
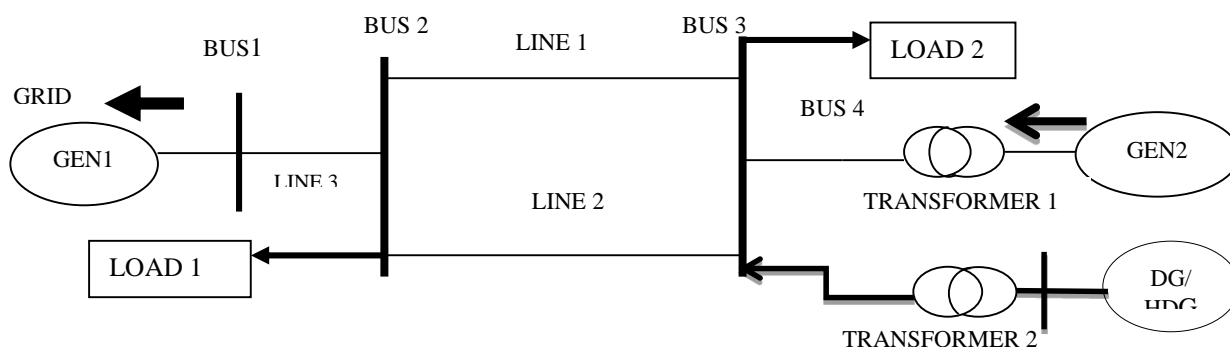
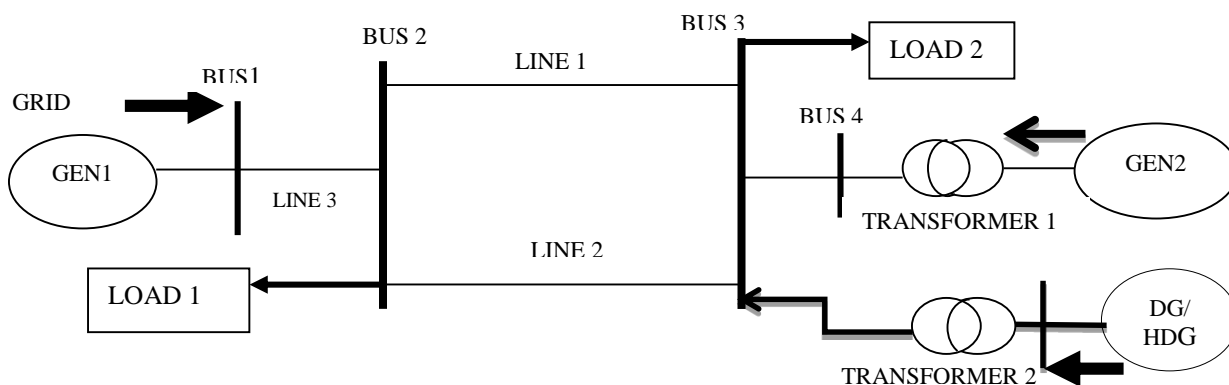


Fig.4: Modelling configuration for import mode



because the penetration of DFIG is now high (80%). The HYBRID DFIG+SOLAR PV and SOLAR PV are transiently stable as shown in Fig 9 compared to when

DFIG alone is used. The settling time when HYBRID DFIG+SOLAR PV is used is faster than when SOLAR PV alone or DFIG alone are used.

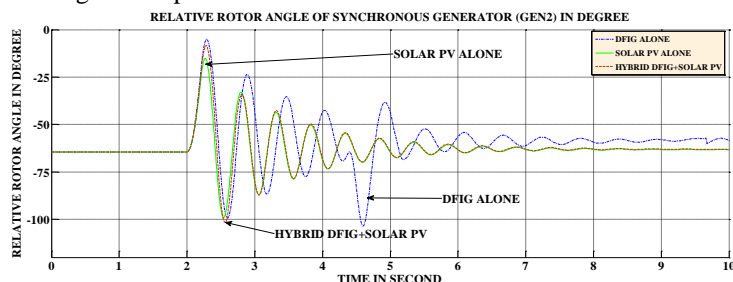


Fig.7: Comparison of the impact of SOLAR PV alone, DFIG alone and HYBRID DFIG+SOLAR PV on the rotor angle of GEN2 (Import mode)

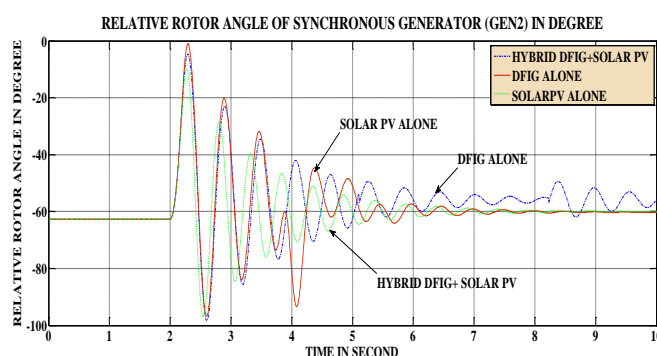


Fig.8: Comparison of the impact of SOLAR PV alone, DFIG alone and HYBRID DFIG +SOLAR PV on the rotor angle of GEN2 (Balanced mode)

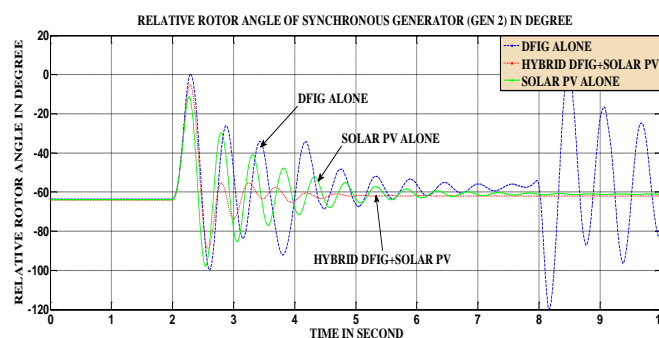


Fig 9: Comparison of the impact SOLAR PV alone, DFIG alone and HYBRID DFIG +SOLAR PV on the rotor angle of GEN2 (Export mode)

As it can be seen, the instability increases as the penetration level of the DG/HDG increases. If HYBRID DFIG+SOALR PV is used, the rotor angle shows a reduced first swing compared to DFIG alone.

Figs 10-12 show the simulation results when HYBRID DFIG+SOLAR PV, HYBRID DFIG+SHP, HYBRID SOLAR PV+SHP and DFIG alone were integrated into the grid, for import, balanced and export modes respectively. For import mode, (see Fig 10), there is not much difference in the first swing of rotor angle of all the curves though the highest first swing occurs when DFIG alone is integrated. The same happened in Fig 11, the rotor angle of GEN 2 when DFIG alone was integrated shows the highest instability. HYBRID SOLAR PV+SHP shows improved

stability compared to DFIG alone. For the export mode (see Fig 12), the rotor angle of GEN2 when DFIG alone was integrated went out of step but when DFIG alone was combined with other energy sources (HYBRID DFIG+SOLAR PV, HYBRID DFIG+SHP), the transient stability is improved. When HYBRID SOLAR PV+SHP was used, the rotor angle of GEN 2 is more stable compared to the rest in Fig 12. The three hybrids (HYBRID DFIG+SOLAR PV, HYBRID DFIG+SHP, HYBRID SOLAR PV+SHP) settle down within 6 seconds while the DFIG alone is unstable even up till 10 seconds. HYBRID SOLAR PV+SHP shows the lowest first swing, followed by HYBRID DFIG+SHP, and then HYBRID DFIG+SOLAR PV.



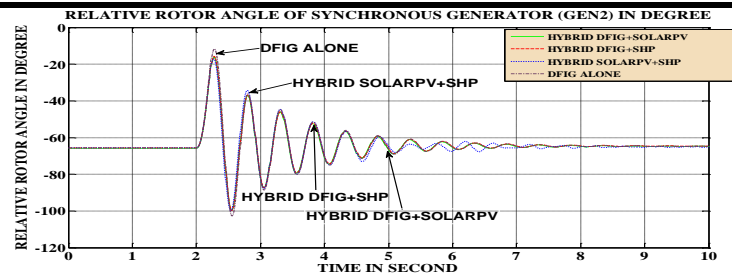


Fig.10: Comparison of the impact of HYBRID DFIG+ SOLAR PV, HYBRID DFIG+ SHP, HYBRID SOLAR PV +SHP, and DFIG alone system on the rotor angle of GEN2 (Import mode)

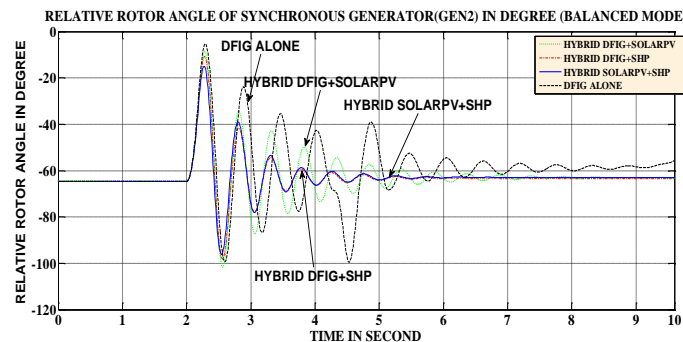


Fig 11: Comparison of the impact of HYBRID DFIG+ SOLAR PV, HYBRID DFIG+ SHP, HYBRID SOLAR PV +SHP, and DFIG alone system on the rotor angle of GEN2 (Balanced mode)

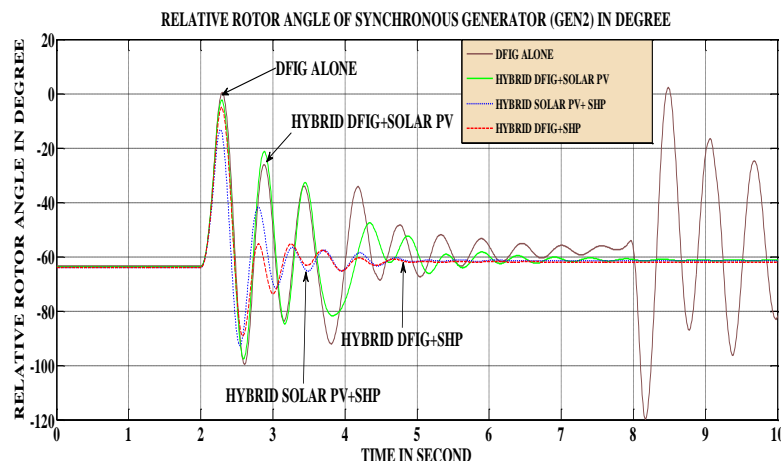


Fig.12: Comparison Of the impact of HYBRID DFIG+ SOLAR PV, HYBRID DFIG+ SHP, HYBRID SOLAR PV +SHP, and DFIG alone system on the rotor angle of GEN2 (Export mode).

It is already established from the simulations in Figs 7-12 that as the penetration level increases the instability also increases irrespective of the HDG type used. As a result of this, export mode

## 7.2 HDG Penetration Level and Different Fault Locations Impact on Critical Clearing Time (CCT)

In this section, the impact of HDG penetration level, different HDG types and fault locations on the critical clearing time (CCT) is investigated. The decrease in critical clearing time (CCT) indicates an increase in instability (decrease stability margin). Tables 2-4 show the CCT values and the average values of the CCT of the power system network for import, balanced and export modes when SHP alone, SOLAR PV alone and DFIG

alone were integrated into the system, respectively. From Tables 2-3, it is observed that, as the fault location is increasing from 0% to 60%, the CCT values also increased from relatively smaller values to maximum values and then decreased again from 80% fault location to 100%. This is fairly in agreement with the literature which state that the maximum transfer admittance occurs at the midpoint of the transmission line. The curve between transfer admittance and the distance of the fault will be symmetrical about 0.5 p.u. length, where maximum transfer admittance occurs if the circuit is symmetrical about the middle of the line. The CCT value will begin to decrease after the midpoint. Table 4 followed a similar pattern except for export mode where the maximum value

of the CCT occurs at location 80% instead of 60%. However, the difference between the maximum CCT value of 80% and that at 60% is marginal (i.e., 0.0185%) which can be neglected.

Also from Tables 2-4, it can be seen that the transient stability margin decreases with increasing penetration level. For example, in Table 2, when the fault was applied at 100km from bus 3, i.e. exactly on bus 2, the CCT value decreases from 280ms in the import mode to 278ms in the balanced mode and later to 270ms in the export mode. The average value of the CCT at the import mode is 333.3ms, balanced mode is 329.7ms and the export mode is 318.5ms. This shows that, as the penetration level of the HDG increases, the CCT decreases (i.e., transient stability margin reduces). The same applied to Tables 3-4. As the penetration level increases, the decrease in the CCT values is very significant when DFIG alone is used compared to other DGs. This can be explained why the system with DFIG became unstable at export mode. This can be seen from the average values of the CCT reported in Tables 2-4. Furthermore, the CCT value depends on the type of DG used. For example, the average values of the CCT when SHP alone is integrated into the grid (see Table 2) are higher at all the modes than the average values of the CCT when SOLAR PV alone is integrated into the grid (see Table 3). The average values of the CCT at all the modes when DFIG alone is connected to the grid are the smallest. This suggests that instabilities arising from integrating DFIG alone are higher compared to when SOLAR PV alone and SHP alone are connected. These CCT values agreed with the initial simulations when the rotor angle was monitored that the increase in penetration level increases the transient instability.

*Table.2: The critical clearing time of synchronous generator (GEN2) with integrated SHP Alone*

SHP Alone			
Fault location	Import mode	Balanced mode	Export mode
%	CCT (ms)	CCT (ms)	CCT (ms)
0	280	267	256
20	320	315	310
40	370	370	356
60	390	390	370
80	360	355	349
100	280	278	270
Average (ms)			
	333.3	329.7	318.5

*Table.3: The critical clearing time of synchronous generator (GEN2) with integrated SOLAR PV Alone*

SOLAR PV Alone			
Fault location	Import mode	Balanced mode	Export mode
%	CCT (ms)	CCT (ms)	CCT (ms)
0	265	260	255
20	310	300	295
40	350	340	330
60	370	350	340
80	340	320	310
100	265	250	240
Average (ms)			
	316.7	303.3	295

*Table.4: The critical clearing time of synchronous generator (GEN2) with integrated DFIG Alone*

DFIG Alone			
Fault location	Import	Balanced mode	Export
%	CCT (ms)	CCT (ms)	CCT (ms)
0	250	40	30
20	290	60	40
40	320	70	50
60	330	80	53
80	310	70	54
100	240	90	40
Average (ms)			
	290	68.3	44.5

Tables 5–7 show the CCT values and the average values of the CCT when HYBRID SOLAR PV+SHP, HYBRID DFIG+SHP and HYBRID DFIG+SOLAR PV were integrated into the grid, respectively.

For example, at the export mode, the average values of the CCT for HYBRID SOLAR PV+SHP, HYBRID DFIG+SHP and HYBRID DFIG+SOLAR PV are 290ms, 256.7ms and 216.7ms, respectively.

This suggests that when HYBRID SOLAR PV+SHP is used, the system is more transiently stable (improved stability margin) compared to when HYBRID DFIG+SHP and HYBRID DFIG+SOLAR PV were used. This can be seen also from all the modes in Tables 5-7.

Comparing hybrid type with a single source, the average values of the CCT when HYBRID SOLAR PV+SHP is used indicates an improved stability compared to when DFIG alone and SOLAR PV alone are used except in the export mode of SOLAR PV. But in the case of SHP alone, the average values of the CCT are higher at the balanced and export modes alone compared to when HYBRID SOLAR PV+SHP is used.

The CCT values and the average values of the CCT when HYBRID DFIG+SOLAR PV+SHP is connected to the grid are shown in Table 8. It can be seen that for the export mode, the average value of the CCT is smaller compared to other hybrids in Tables 5-7. The average values of the CCT for the import and the balanced modes in Fig 8 are generally smaller than the hybrid with two DGs such as HYBRID SOLAR PV +SHP and HYBRID DFIG+SHP except in the balanced mode when HYBRID DFIG+SHP is used. The difference between the average value of the CCT at a balanced mode when HYBRID DFIG+SOLAR PV+SHP and HYBRID DFIG+SHP is used is small (i.e., 0.0181%) and can be neglected. However, the average values of the CCT for HYBRID DFIG+SOLAR PV+SHP are higher at the import and balanced mode compared with when HYBRID DFIG+SOLAR PV is used. This suggests that the system with three DGs is more prone to instability than the system with two DGs and the stability worsen as the penetration increases compared to other hybrids.

Table.5: The critical clearing time of synchronous generator (GEN2) with integrated HYBRID SOLAR PV+SHP

HYBRID SOLAR PV+SHP			
Fault location	Import mode	Balanced mode	Export mode
In %	CCT(ms)	CCT(ms)	CCT(ms)
0	270	267	260
20	330	310	300
40	390	360	320
60	420	370	330
80	390	340	300
100	290	260	230
Average (ms)			
	348.3	317.8	290

Table.6: The critical clearing time of synchronous generator (GEN2) with integrated HYBRID DFIG+SHP

HYBRID DFIG+SHP			
Fault location	Import mode	Balanced mode	Export mode
In%	CCT(ms)	CCT(ms)	CCT(ms)
0	250	240	200
20	303	300	270
40	350	330	290
60	380	350	290
80	350	320	270
100	255	250	220
Average (ms)			
	326.6	298.3	256.7

Table.7: The critical clearing time of synchronous generator (GEN2) with HYBRID DFIG +SOLAR PV

HYBRID DFIG +SOLAR PV			
Fault location	Import mode	Balanced mode	Export mode
In %	CCT(ms)	CCT(ms)	CCT(ms)
0	240	250	150
20	295	290	230
40	340	310	210
60	360	320	230
80	330	290	260
100	240	240	220
Average (ms)			
	300.8	283.3	216.7

Table 8: The critical clearing time of synchronous generator with integrated HYBRID DFIG+SOLAR PV+SHP

HYBRID DFIG+SOLAR PV+ SHP			
Fault location	Import mode	Balanced mode	Export mode
In %	CCT(ms)	CCT(ms)	CCT(ms)
0	256	252	100
20	300	300	160
40	340	340	210
60	360	360	240
80	310	330	220
100	250	240	150
Average (ms)			
	302.7	303.7	180

Comparing the export mode of Table 7 and Table 8, it shows that from a stability point of view and based on the simulation results, the stability is improved when DFIG is hybridized with other DG but worsen when hybridized with two DGs under a high penetration level. At import mode and balanced mode when the penetration is low and moderate, respectively, the average values of the CCT when HYBRID DFIG+SOLAR PV+SHP is used is better than when HYBRID DFIG+SOLAR PV is used. However, the average CCT when HYBRID DFIG+SOLAR PV+SHP is used is lower compared to when HYBRID SOLAR PV+SHP was used at all the modes.

The CCT value depends on the penetration level, fault location as well as the HDG types used. The CCT decreases with increase in penetration level irrespective of the HDG types used.

### 7.3 HDG Penetration Level and Location of HDG Impact on Rotor Angle

The location of HDG is determined by the availability of primary energy source. HDG should be sited in a place

where the primary energy source is abundantly available. HDG can be sited at a single point (concentrated) or on several places in such a way that the generators are centrally coordinated (dispersed). Dispersed HDG is assumed to be close to the load (e.g., rooftop solar PV) while concentrated is located where the energy source could be found and possibly far from the load. This section explains the impact of HDG on the grid when the HDGs are dispersed, and when they are concentrated on a single point. Note that the simulation results presented in this section are for export mode only. The followings were investigated:

- 1) Dispersed and concentrated HYBRID SOLAR PV + SHP
- 2) Dispersed and concentrated HYBRID DFIG+ SHP

- 3) Dispersed and concentrated HYBRID DFIG+ SOLAR PV

#### 7.4 Location of HDG Impact on Rotor Angle

Fig 13-Fig 15 shows the simulations that are used to investigate the impact of the location of HDG on transient stability. It is observed from the simulations that transient stability margin is improved (i.e., smaller first swing and quicker settling time) when dispersed HDG is used compared to concentrated HDG. The reason for this is probably due to the higher voltage drop in the concentrated compared to dispersed HDG since dispersed HDG is generally close to the load, therefore the voltage drop is small.

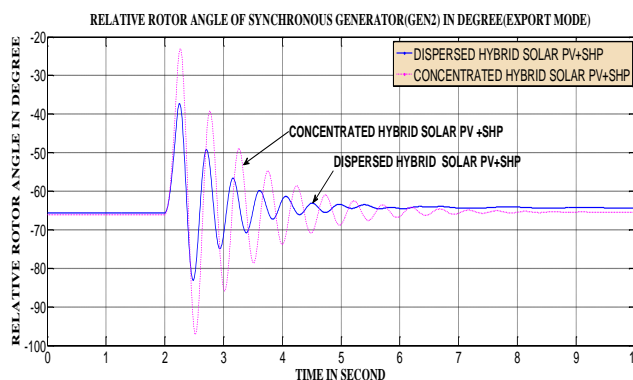


Fig 13: Rotor angle of GEN2 with concentrated and dispersed HYBRID SOLAR PV+ SHP

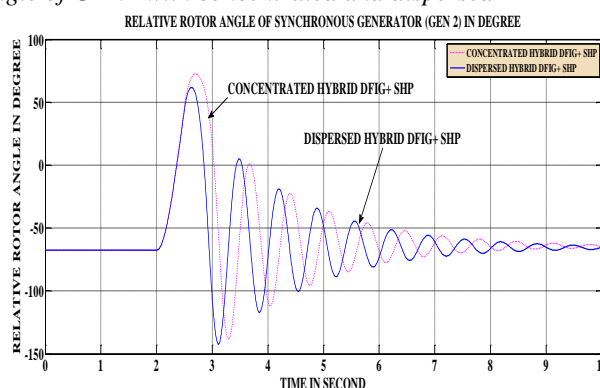


Fig14: Rotor angle of GEN2 with concentrated and dispersed HYBRID DFIG+ SHP

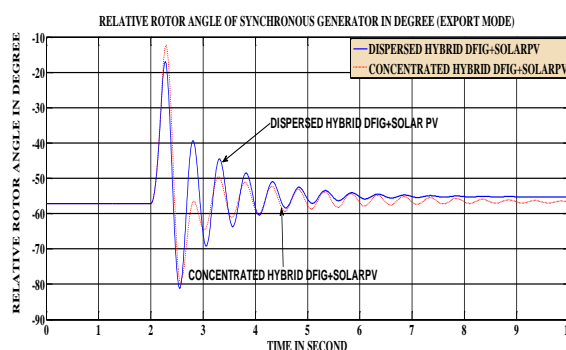


Fig 15: Rotor angle of GEN2 with concentrated and dispersed HYBRID DFIG+ SOLAR PV

In all the graphs (Fig 13-Fig 15), concentrated HDG shows higher first swing and longer settling time compared to dispersed HDG. It can also be seen that the impact of transient stability depends on the HDG type involved. For example, HDG using SOLAR PV and SHP is more stable than HYBRID DFIG+SHP or HYBRID DFIG+SOLAR PV. The less stable system is hybrid DFIG+SOLAR PV.

### 7.5 Location of HDG Impact on Critical Clearing Time (CCT)

Again, in this section, only the results of export mode are shown. The CCTs for concentrated and dispersed HDG systems at export mode are shown in Table 9. For example, when HYBRID SOLAR PV+SHP is used, the CCT when dispersed HDG is used is 375ms compared to 330ms for concentrated HDG. The remaining values in the table also show that dispersed HDG has an improved stability compared to concentrated HDG. This further supports the results already established in the above simulations that the transient stability of a dispersed generation is better than concentrated HDG.

Table 9: Critical clearing time of a synchronous generator (GEN2) for concentrated and dispersed HDG scenarios

	CCT (ms) (Dispersed)	CCT (ms) (Concentrated)
HYBRID SOLAR PV + SHP	375	330
HYBRID DFIG+ SHP	380	265
HYBRID DFIG+ SOLAR PV	310	300
HYBRID DFIG+SOLAR PV+ SHP	250	230

## VIII. CONCLUSION

When HDG is employed in distributed generation concept for voltage control and load balancing, it is transiently stable compare to when single source DG is employed. Generally, it is accepted that most DG are complementary but it might not be transiently stable. The results in this paper show that DFIG with other energy sources shows increasing instability even as the penetration level increases. Transient stability under complementarity nature depends on the HDG types, penetration level and the location of the DG.

## REFERENCES

- [1] F.Monforti et al ‘ Assessing complementarity of wind and solar resources for energy production in Italy. A Monte Carlo approach. Renewable Energy 63 (2014) pp576-586.
- [2] T.Ackerman,G. Andersson, and L.Soder. “Distributed generation, a definition” Electric Power Energy Research Vol,57, no3, pp195-204, 2001
- [3] J.Momoh, G.D.Boswell, “Improving power Grid Efficiency using Distributed Generation” Proceedings of the 7th international conference on power system operation and planning, pp.11-17, Jan., 2007.
- [4] <http://www.energy.ca.gov/2007publications/CEC-500-2007-021/CEC-500-2007-021.PDF>.
- [5] A.M.Azmy, “ Simulation and Management of Distributed Generation units using intelligent techniques”, Ph.D. Thesis submitted to the department electrical engineering University of Duisburg-Essen 2005.
- [6] P.K Olulope, K.A Folly, “Impact of Hybrid Distributed Generation On Transient Stability of Power System” Power and Energy Systems Applications (PESA 2012), Las Vegas, USA, November 12 – 14, 2012, pp97-105.
- [7] P.K Olulope, K.A Folly, Ganesh K. Venayagamoorthy, “Modeling And Simulation of Hybrid Distributed Generation and Its Impact on Transient Stability of Power System”, International conference on Industrial technology (ICIT) 2013, 25-27 February 2013.
- [8] J Paska, P.Biczal, M.Klos, “Hybrid power systems- An effective way of utilizing primary energy sources”, Electric Power Systems Research, Elsevier, 2009, pp.1-8.
- [9] C. Wang, “Modeling and control of hybrid Wind/photovoltaic/fuel cell distributed generation system”.Ph.D Dissertation submitted to Montana State University, July 2006.
- [10] V.V Thong, J. Driesen, R. Belmans, “Transmission system operation concerns with high penetration level of distributed generation”, Universities power and Engineering Conference UPEC, pp.867-8717, 4-6Sept., 2007.
- [11] T. Tran-Quoc, L.Le Thanh, Ch.Andrieu, N. Hadjsaid, C. Kieny, J.C Sabonnadiere, K. Le, O. Devaux, O.Chilard “Stability analysis for the distribution networks with distributed generation” Proc.2005/2006 IEEE/PES Transmission & Distribution Conference & Exposition, vol. 1–3, Dallas, TX, USA, May 21–26 pp. 289–294. 2006.
- [12] V.V. Knazkins “Stability of Power Systems with Large Amounts of Distributed Generation” PhD Thesis submitted to University Stockholm, Sweden, 2004.
- [13] A Ishchenko “Dynamics and stability of distributed networks with dispersed Generation”, Ph.D thesis



- submitted to Eindhoven University of technology, 16 Jan., 2008.
- [14] M. Reza, "Stability analysis of transmissions Systems with high penetration of distributed generation", PhD Thesis submitted to Delf University of Technology Delft, The Netherlands, 2006.
- [15] Y. Tiam, "Impact on the power system with a large generation of photovoltaic generation", PhD Thesis submitted to the University of Manchester Institute of Science and Technology, Feb., 2004, pp. 53-55.
- [16] Vechiu I, Camblong H, Papia G, Dakyo B, Nichita C. Dynamic simulation model of a hybrid power system: performance analysis. *International Journal of Automotive Technology* 2006;7(7):1-9.
- [17] S. Sotirios B, Papadopoulos P. Demetrios. "Efficient design and simulation of an expandable hybrid (wind-photovoltaic) power system with MPPT and inverter input voltage regulation features in compliance with electric grid requirements. *Electric Power Systems Research* 2009;79:1271-85
- [18] Mehdi Dali, Jamel Belhadj, Xavier Roboam. Design of a stand-alone hybrid photovoltaic-wind generating system with battery storage, [http://journal.esrgroups.org/jes/papers/4\\_3\\_7.pdf](http://journal.esrgroups.org/jes/papers/4_3_7.pdf).
- [19] Joanne Hui, Alireza Bakhshai, Praveen K. Jain. A hybrid wind- solar energy system: a new rectifier stage topology. In: *Applied Power Electronics Conference and Exposition (APEC)*, 2010 Twenty-Fifth Annual IEEE, 21e25 Feb., 2010, pp. 155-61.
- [20] Arutchelvi Meenakshisundaram, Daniel Samuel Arul. "Grid connected hybrid dispersed power generators based on PV array and wind-driven induction generator". *Journal of Electrical Engineering* 2009;60(6):313-20.
- [21] A. D. Hansen, C. Jauch, P. Sørensen, F. Iov, F. Blaabjerg, "Dynamic wind turbine models in power system simulation tool DIGSILENT", *Risø National Laboratory, Roskilde*, Dec. 2003. Access: [www.digsilent.es/tl\\_files/digsilent/files/powerfactory/application.../ris-r-1400.pdf](http://www.digsilent.es/tl_files/digsilent/files/powerfactory/application.../ris-r-1400.pdf)
- [22] L. L. Freris, *Wind energy conversion systems*. Prentice Hall, 1990.
- [23] P. E. Sørensen, A.D. Hansen, L. Janosi, J. Bech, and B. Bak-Jensen, "Simulation of Interaction between Wind Farm and Power System." *Technical University of Denmark* Dec-2002. Access: [orbit.dtu.dk](http://orbit.dtu.dk)
- [24] M. V. A. Nunes, J. A. P. Lopes, H. H. Zurn, U. H. Bezerra, and R. G. Almeida, "Influence of the variable-speed wind generators in transient stability margin of the conventional generators integrated in electrical grids," *IEEE Trans. Energy Convers.*, vol. 19, no. 4, pp. 692 – 701, Dec. 2004.
- [25] J. Morren and S. W. H. de Haan, "Ridethrough of wind turbines with doubly-fed induction generator during a voltage dip," *IEEE Trans. Energy Convers.*, vol. 20, no. 2, pp. 435 – 441, Jun. 2005.
- [26] J. B. Ekanayake, L. Holdsworth, X. Wu, and N. Jenkins, "Dynamic modeling of doubly fed induction generator wind turbines," *IEEE Trans. Power Syst.*, vol. 18, no. 2, pp. 803 – 809, May 2003.
- [27] M. A. Poller, "Doubly-fed induction machine models for stability, assessment of wind farms," in *Power Tech Conference Proceedings 2003 IEEE Bologna*, 2003, vol. 3, p. 6 pp. Vol.3.
- [28] W. Qiao, "Dynamic modeling and control of doubly fed induction generators driven by wind turbines," in *Power Systems Conference and Exposition, 2009. PSCE '09. IEEE/PES*, 2009, pp. 1 –8.
- [29] D. Gautam, V. Vittal, and T. Harbour, "Impact of increased penetration of DFIG based wind turbine generators on transient and small signal stability of power systems," in *2010 IEEE Power and Energy Society General Meeting*, 2010, p. 1.
- [30] Dolf Gielen, "Renewable Energy Technologies; Cost Analysis Series." IRENA International Renewable Energy Agency, Jun- 2012.
- [31] H. Ramos, "Guidelines For Design of Small Hydropower Plants." Jul-1999.
- [32] "Small Hydropower Systems," U.S. Department of Energy (DOE) by the National Renewable Energy Laboratory (NREL), Jul. 2001.
- [33] Hydropower basics <http://www.microhydropower.net/basics/turbines.php>.
- [34] L. Ye, H. B. Sun, X. R. Song, and L. C. Li, "Dynamic modeling of a hybrid wind/solar/hydro microgrid in EMTP/ATP," *Renew. Energy*, vol. 39, no. 1, pp. 96–106, Mar. 2012.
- [35] Mukund R. Patel, Ph.D., P.E., *Wind and Solar Power Systems*. United States of America: CRC Press.
- [36] L. Gray, *The physics of the solar cell* A. Luque, S. Hegedus (Eds.), *Handbook of Photovoltaic Science and Engineering*, Wiley, New York (2003), pp. 61–111 (Chapter 3).
- [37] R. Chenni, M. Makhoulouf, T. Kerbach, and A. Bouzid, "A detailed modeling method for photovoltaic cells," *Energy*, vol. 32, no. 9, pp. 1724–1730, Sep. 2007.
- [38] Ramos Hernanz et.al, "Modelling of Photovoltaic Module", *International Conference on Renewable Energies and Power Quality ICREPQ'10* Granada (Spain), 23th to 25th March, 2010..
- [39] M.de Blas, J. Torres, E. Prieto, and A. Garcia, "Selecting a suitable model for characterizing

photovoltaic devices,” *Renew. Energy*, vol. 25,no.3, pp. 371–380, Mar. 2002

- [40] J. Kepka, ‘Load Modeling for Power System Analysis” Poland: Wroclaw University of Technology; 2014. p. 1–4. Access: [eeeic.org/proc/papers/111.pdf](http://eeeic.org/proc/papers/111.pdf)
- [41] P.K Olulope, ‘Transient Stability Assessment of Hybrid Distributed Generation Using Computational Intelligence Approaches’ PhD Thesis submitted to University of Cape Town Department of Electrical Engineering, South Africa, June, 2014. Solar plants to provide
- [42] A. Beluco et al ‘Dimensionless index evaluating the time complementarity between solar and hydraulic energies’ *Renewable Energy* 33 (2008) 2157-2165

# Comparing the Dynamic Impact of Hybrid Distributed Generation with Single Source DG

P. K Olulope

Ekiti State University, Ado- Ekiti, Nigeria

[paulade001@yahoo.com](mailto:paulade001@yahoo.com)

**Abstract**— Due to the natural intermittent properties of some renewable energies, the grid is subjected to instability, insufficient power delivery and fluctuation. When these renewable energies are combined together to address the challenge of power shortage, increasing energy demand, and voltage drop, the grid is subject to different stabilities issues compare to the single energy source. This paper compares the dynamic behavior of single energy with mixed energy sources. The paper compares the impact of DFIG alone, Solar PV alone and Small Hydro power alone with hybrid type under distributed generation concept on transient stability of power system. To investigate this investigation, a DIgSILENT power factory library models was used as a component model for wind Turbine / Solar PV and small hydropower system. The simulation was carried out on single machine infinite system.

**Keywords**— Distributed Generation, Hybrid distributed generation, export modes, stability margin, single energy source.

## I. INTRODUCTION

Hybrid distributed generation with multi- source is common in the present day electric grid due to the steep rise in electrical demand across the globe. Two or more energies are combined together to reduce incessant load shedding. The hybrid system is connected to distribution system in order to reduce voltage drop which often occur when the load is far from the generating stations. Besides, market deregulation and growing concern about global warming and climate change, the desire to reduce greenhouse gas emission is driving the power and energy sector in general away from the traditional vertical integration and cost-based regulation towards increased exposure to market forces. Under DG paradigm small generators also known as distributed generators are connected close to customers at the distribution level in order to solve the challenge of voltage drop. Generally, single source DG has been employed to solve the challenge of Voltage drop. Common among them are Solar PV, wind Turbine, etc. However, when these DGs

are hybridized together to form two or more energy sources, they could form a viable energy sources that can have more impact than the single energy source. Hybrid distributed generation is preferable due to their complementary roles but have different dynamic behaviors which could impact negatively on the system than single energy source. Hybrid distributed generation can be defined as a small set of co-operating units that generates electricity and heat, with diversified primary energy carriers (Renewable and non-renewable), while the coordination of their operation takes place by utilization of advanced power electronics and are located close to the consumers end. They are either grid connected or standalone system, renewable or non-renewable system [1]. It can be described as distributed generation when it is connected close to the consumers to deliver power to local or industrial load [2]. The use of Currently, there are wide-spread uses of distributed generation across the globe though the level of penetration is still low [2, 3]. In 2011, few grid systems have penetration levels above five percent. Examples are Denmark – 26%, Portugal – 17%, Spain – 15%, Ireland – 14%, and Germany – 9%. For the U.S. in 2011, the penetration level was estimated at 2.9% [4]. Germany, Denmark and Ireland are already proposing a significant proportion of installed capacity to be connected to the distribution system below 100kV [5]. By year 2020, the penetration level of DG in some countries such as USA is expected to increase by 25% as more independent power producers; consumers and utility company imbibe the idea of distributed generation [6]. In the same way, solar PV is gaining wide spread especially in Germany. 3% of total generation in Germany today is from solar PV. South Africa also concludes that the realization of the vision 2030 will be based on solar PV, Concentrated solar power (CSP) and wind power [7]. However, the rapid progress in renewable energy power generation technologies, and the awareness of environmental protection have been the major reasons why alternative energy and distributed generation is a promising areas [8].

Because some of renewable energy sources can complement each other, multi-source alternative energy systems have great potential to provide higher quality and more reliable power to consumers than a system based on a single source [9]. The larger the penetration level of hybrid distributed generation (HDG) in a power system, the more difficult it becomes to predict, to model, to analyze and to control the behavior of such system [9]. Some HDG using induction generators are not grid friendly because they consume reactive power instead of generating it. Most power converters do not have adequate control mechanism to actively support DG integration. The system inertia for some of them (e.g., solar PV or fuel cell) is extremely low. They are weather dependent with constant daily load variation [10]. Also, existing protection mechanism might not be able to take care of the problem of bi-directional power flow that takes place due to DG connection in radial networks. New design controllers are needed to effectively manage the multi-energy sources distributed generation in order to service remote villages.

Due to the natural intermittent properties of wind and solar PV, stand alone wind/PV renewable energy systems normally require energy storage devices or some other generation sources to form a hybrid system. The possibility of hybrid system is shown in fig 1.

In an electrical power grid without energy storage, energy sources that rely on energy stored within fuels (coal, oil, gas) must be scaled up and down to match the rise and fall of energy production from intermittent energy sources. In this way the operators can actively adapt energy production to energy consumption in order to increase efficiency and lower the cost of energy production and to facilitate the use of intermittent energy sources. In the USA the demand for electricity generation is mainly driven by price volatility i.e using distributed generation for continuous use or for peaking use (peak shaving) [3]. During seasonal changes, some energy sources might have to switch on during off peak hour while others during peak hour in order to reduce cost and enhance load balancing within the system. These configurations among many other things need to be investigated to know the dynamic interaction between the hybrids distributed generation and the grid.

Several works have been done on distributed generation but most of the work is based on single energy source [9, 10, 11, 12 and 13]. Ref [14] investigated the impact of high penetration of DG on transient stability. The DGs considered in the case study are rotary generator and non-rotary generator. It is found that DG influences the system transient

stability differently depending on DG penetration levels, DG grid- connection-strength, different DG technologies, and DG protection schemes. Reference [8] modeled and examined the dynamic impact of fuel cell on transient stability of power system network. Reference [15] investigated the impact of high penetration of Solar PV on the transient stability. Several other papers reported the dynamic state of the system as the penetration level increases.

Also several hybrid power systems have been developed [16-17]. An isolated network for very low voltage decentralized energy production and storage based on photovoltaic and wind was developed, mainly considering the energy management and control of the photovoltaic and wind hybrid system [18]. A grid connected hybrid scheme for residential power supply based on an integrated PV array and a wind-driven induction generator were discussed [19, 20].

However, all the hybrid power systems were based on steady state, unit sizing, optimization techniques in order to extract maximum power from the hybrid system and standalone. None of them mention transient state and none either consider additional energy sources such as small hydropower system. Interaction of HDG interaction, additional power transmitted across distribution corridor, unexpected fault, bidirectional power flow from Hybrid DG, electromechanical oscillation due to system with different inertia constant, torsional interaction of wind turbine with power system control and grid are some of the new things to investigate for effective integration of HDG in order to prevent the future grid from any unexpected cascaded event that can lead to serious technical challenges. This study investigates the dynamic impact of hybrid Wind/ PV/small Hydro power on transient stability. To investigate this impact, the modeling of grid connected wind /Solar PV/small hydro power with single machine infinite system were carried out in DIGSILENT power factory. The configuration of the proposed typical grid connected hybrid distributed generation (HDG) consists of converter driven synchronous wind generator Solar PV and small hydro power. The wind turbine is integrated through PWM converter into the existing grid while the solar PV incorporated into the system consists of DC sources integrated through PWM inverter. The small hydropower system is modeled as synchronous generator.

The rest of the paper is organized as follows: Section 2 describes the hybrid distributed generation concept. Section 3 gives the mathematical modeling of HDG. Section 4

describes the simulation setup in DiGSILENT. Section 5 gives the transient stability indicator and section 6 gives the

results and discussion. Conclusion is described in section VII.

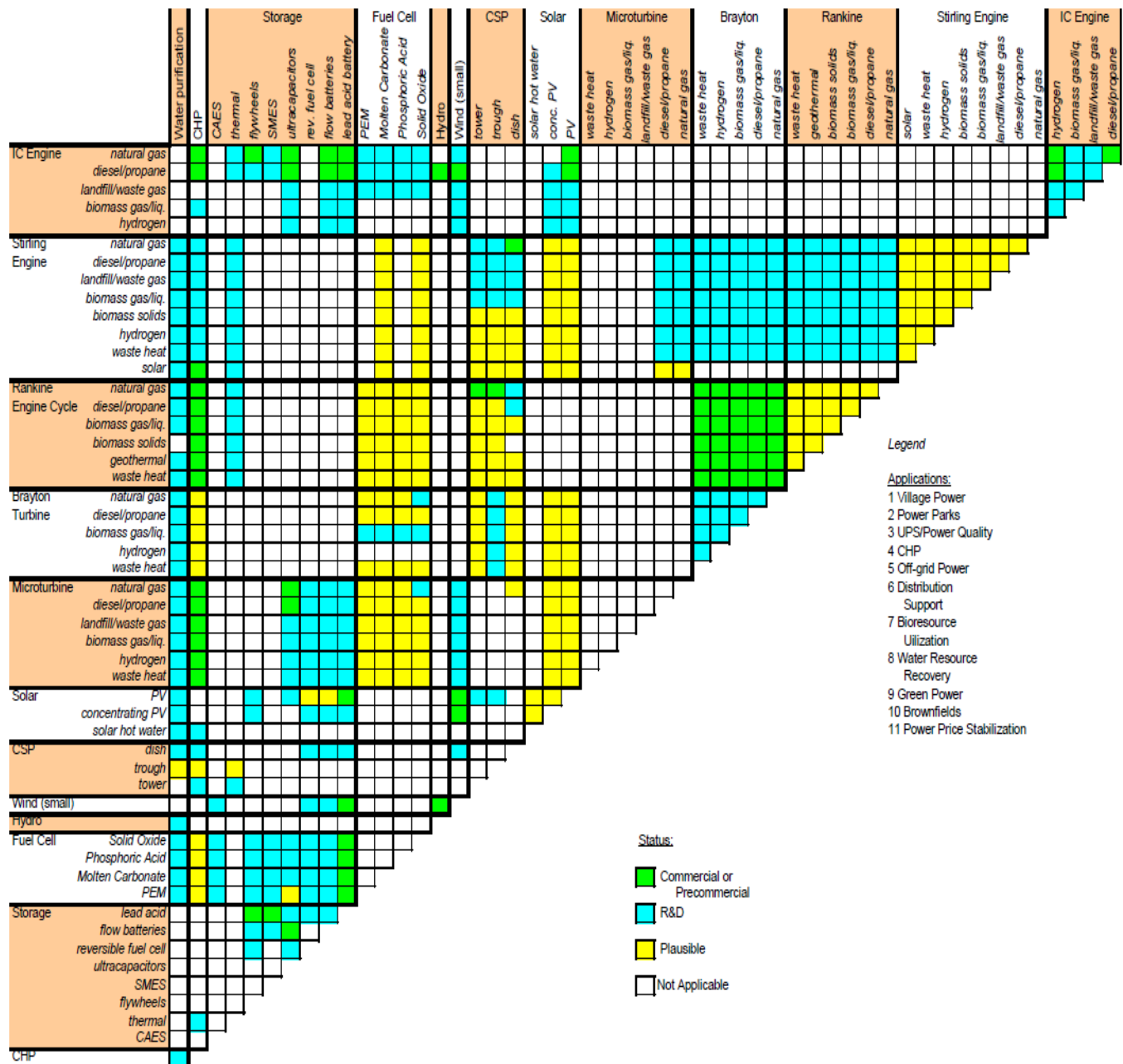


Fig.1: Matrix describing the hybrid distributed generation [1]

## II. DISTRIBUTED GENERATION AND HYBRID DISTRIBUTED GENERATION CONCEPT

Small generators connected to the distributed network in order to service the consumer load is called distributed generation. Also, a large wind farm connected to the network to meet

consumer demand is also assumed to be distributed generation. Presently, the promising sources of distributed generation are wind turbine and Solar PV. A Solar PV cell harvest energy directly from sunlight and converting it to electricity. Due to the high initial cost, the number of customer



involved in the usage of solar PV is still low. Later, as the cost of PV began to decrease, there will be an increasing usage across the globe and several other applications will be developed [7]. However, the low running cost and the maintenance cost of these PVs as well as the long life usage make it an attractive alternative energy source.

Also, wind turbine especially the doubly-fed induction generator has the ability to provide supplementary active and reactive power to the existing grid.

It converts energy inherent in wind to electricity through wind turbine, shaft, induction generator and various controllers to ensure proper grid integration and friendliness. Like PV, wind output power depends on the availability of wind.

Many of the primary energy sources are complimentary and abundant in nature which gives it a good opportunity to increase availability, power quality and flexibility of power supply when they are fully optimized. The objective of the integration is to capitalize on the strengths of both conventional and renewable energy sources, both cogeneration and non-cogeneration types. The combination of hybrid power generation was represented in matrix form in ref [7]. Fig 2 shows the detail configuration of the proposed hybrid distributed generation. Three scenarios are mentioned in this paper namely the import mode, balanced mode and the export mode but only the export mode is analysed. The export mode is shown in Fig2 and it describes how the load is supplied by the centralized generator and distributed generator. The modes are further explained below:

**Import mode:** In this mode, the load demands are supplied by GEN2 and HDG with additional supply from the GRID. This is shown in Fig2.

**Balanced mode:** In this mode, the load demands are met by the combination of GEN2 and HDG without any extra supply from the GRID. This means that the power generated by HDG and GEN 2 is sufficient to meet the load demands. This is shown in Fig 2

**Export mode:** In this mode, HDG and GEN2 supply the loads and export the excess generation to the GRID. This is shown in Fig 2.

The penetration level for HDG is defined as:

$$\% PL_{HDG} = \frac{P_{HDG}}{P_{HDG} + P_{CG}} \times 100 \quad (1)$$

where  $\% PL_{HDG}$  is the percentage penetration of the DG/HDG,  $P_{HDG}$  is the active power generated by HDG and  $P_{CG}$  is the

active power from the centralized generators (GRID and GEN2).

$$P_{CG} + P_{HDG} = P_{LOAD}$$

where  $P_{LOAD}$  is the power delivered to the load

In all the simulations, the active and the reactive power of GEN2 are kept constant.

$\% PL_{HDG}$  is the percentage penetration of the DG or hybrid DG. While  $P_{HDG}$  is the power generated by two or more DG and  $P_{CG}$  is the power generated by the grid. The combination of hybrid power generation was represented in matrix form in ref [1]. Figure 2 shows the detail configuration of the proposed hybrid distributed generation. In fig2, the load is supplied by the centralized and distributed generator while in export mode the HDG exported its excess generation to the grid. The combination of the DG and GEN2 are used to supply the load with zero contributed to or from the grid (GEN1) (Balanced mode). The export mode can be explained when the excess power is released to the grid.

### III. MODIFIED SINGLE MACHINE INFINITE BUS SYSTEM

Fig 2 shows the modified single machine infinite bus system model used in this paper. This power system model consists of an infinite bus system (Grid) represented by GEN1, one centralized generator (GEN2), a hybrid distributed generation (HDG) and two equal loads (LOAD1 and LOAD2). GEN1 is connected to bus 2 via line 3. The transmission lines (line 1, line2 and line3) are modeled as equivalent  $\pi$  transmission lines. Line 1 and line 2 are 100km long each, while line 3 is 40km long. GEN 2 is connected to bus 3 via a 100MVA transformer (transformer 1) and has a capacity of 80MW and 60MVA. The DG/HDG consisting of wind generator (DFIG), SOLAR PV and small hydropower system (SHP) is connected to bus 3 via another 100MVA transformer (Transformer 2). Each DFIG is rated 8MW, 0.89 power factor lagging. The SOLAR PV is rated 8MW real power at unity power factor. When SOLAR PV alone is connected to the HDG bus, a capacitor bank is used at that bus to compensate for reactive power. The hydropower is rated 8MW and 4MVA. LOAD1 and LOAD2 are connected to bus 2 and bus 3, respectively, and are rated 80MW and 40MVA each.

DIgSILENT power factor 14.1 was used to model this test system. To investigate the effect of a large disturbance, a three-phase fault was applied in the middle of line 2 and cleared after 200ms by removing the line.

## Proposed Hybrid Distributed Generation Configuration

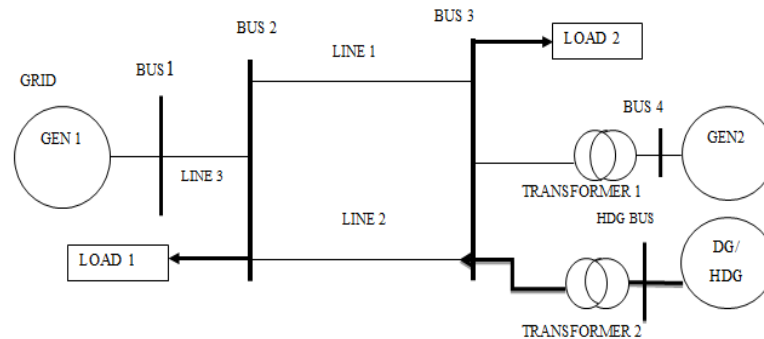


Fig.2: Modified Single Machine Infinite Bus System.

The focus is to investigate the impact of Hybrid solar PV, wind turbine (Doubly-Fed Induction Generator- DFIG) and small hydropower systems (SHP) on transient stability. In order to obtain all possible combinations, a truth table is formed as shown in Table 1.

Table.1: Truth table describing the combination of different DG

SCENARIOS	WIND TURBINE (DFIG)	SOLAR PV	SMALL HYDRO POWER (SHP)	INFERENCE
1	0	0	0	No DG Integration
2	0	0	1	Small Hydropower only (Base case 1)
3	0	1	0	SOLAR PV only (Base case 2)
4	0	1	1	SOLAR PV and Small Hydropower
5	1	0	0	Wind turbine only (Base case 3)
6	1	0	1	DFIG and Small Hydropower
7	1	1	0	DFIG and SOLAR PV
8	1	1	1	DFIG, SOLAR PV, Small Hydropower (SHP)

The truth table shows how the three generators can be combined to form HDG. The first column shows various scenarios. There are 8 scenarios. For example, scenario 1 shows the case where there is no integration of DG/HDG. Scenario 2 shows the case where only SHP is integrated and so on. Zero (0) means no generator is connected while one (1) means a generator is connected. The base cases are single source DGs (Scenarios 2, 3 and 5). These base cases were chosen in order to draw out comparisons between HDG and single source DG,

#### IV. SIMULATION SCENARIOS

The simulation scenarios are discussed in this section.

Case study 1 consists of scenarios 2 (Small Hydropower alone), 3 (SOLAR PV alone) and 5 (DFIG alone) which are the base cases.

Case study 2 consists of scenario 4 (Hybrid SOLAR PV and Small Hydropower)

Case study 3 consists of scenario 6 (Hybrid DFIG and Small Hydropower)

Case study 4 consists of scenario 7 (Hybrid DFIG and SOLAR PV)

Case study 5 consists of scenario 8 (Hybrid DFIG, SOLAR PV and Small hydropower)

Three penetration levels of HDG ( $PL_{HDG}$ ) were considered:

- (i) Import mode,  $PL_{HDG}=40\%$
- (ii) Balanced mode,  $PL_{HDG}=50\%$
- (iii) Export mode,  $PL_{HDG}=80\%$

The penetration level for HDG is defined as:

$$\% PL_{HDG} = \frac{P_{HDG}}{P_{HDG} + P_{CG}} \times 100$$

where  $\%PL_{HDG}$  is the percentage penetration of the DG/HDG,  $P_{HDG}$  is the active power generated by HDG and  $P_{CG}$  is the active power from the centralized generators (GRID and GEN2).

Note that  $P_{CG} + P_{HDG} = P_{LOAD}$

where  $P_{LOAD}$  is the power delivered to the load

In all the simulations, the active and the reactive power of GEN2 are kept constant. The descriptions of the penetration levels are as follows:

**Import mode:** In this mode, the load demands are supplied by GEN2 and HDG with additional supply from the GRID. This is shown in Fig 3a.

**Balanced mode:** In this mode, the load demands are met by the combination of GEN2 and HDG without any extra supply from the GRID. This means that the power generated by HDG and GEN 2 is sufficient to meet the load demands. This is shown in Fig 3b

**Export mode:** In this mode, HDG and GEN2 supply the loads and export the excess generation to the GRID. This is shown in Fig 3c.

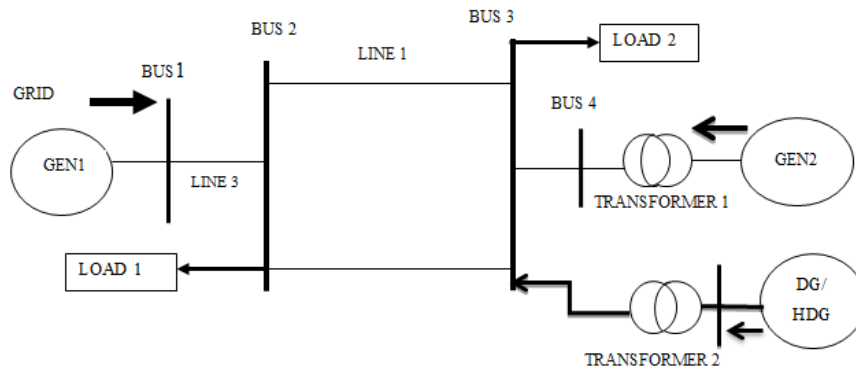


Fig 3a: Modelling configuration for import mode

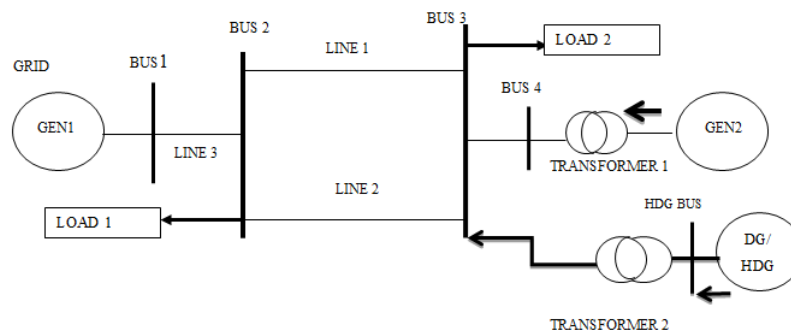


Fig 3b: Modeling configuration for balanced mode

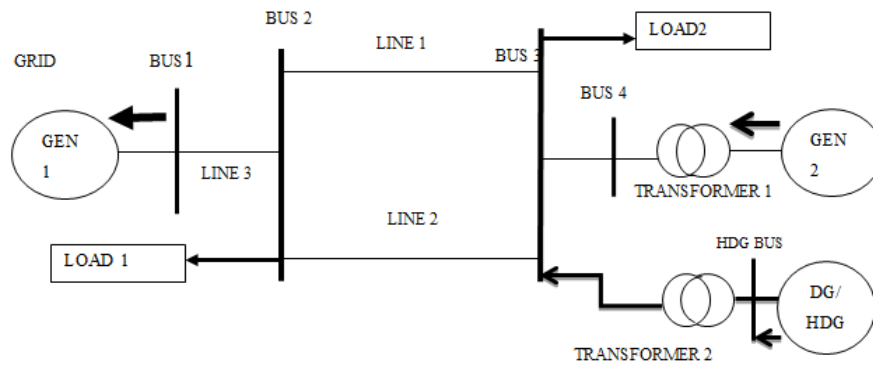


Fig 3c: Modeling configuration for export mode

## V. MODELING OF HYBRID DISTRIBUTED GENERATION:

### 5.1 Wind Generator

The generator is made of wound rotor synchronous generator and the voltage equations follows the general equations reported in [18] as described in equation 2-4 below. The assumption is that the magnetic flux distribution in the rotor is sinusoidal in order to allow vector modelling.

$$u_{ds} = -R_s i_{ds} - \omega_m \psi_{qs} + \frac{d\psi_{ds}}{dt} \quad 2$$

$$u_{qs} = -R_s i_{qs} + \omega_m \psi_{ds} + \frac{d\psi_{qs}}{dt} \quad 3$$

$$u_{fd} = R_{fd} i_{fd} + \frac{d\psi_{fd}}{dt} \quad 4$$

The flux equation s:

$$\psi_{ds} = -(L_{dm} + L_{\sigma s}) i_{ds} + L_{dm} i_{fd} \quad 5$$

$$\psi_{qs} = -(L_{qm} + L_{\sigma s}) i_{qs} \quad 6$$

$$\psi_{fd} = L_{fd} i_{fd} \quad 7$$

Where  $\psi_{fd}$  indicates the field quantities. In 3<sup>rd</sup> order modelling the quantities  $d\psi/dt$  is neglected in order to

focus on the phenomenon that are of interest. Hence the equations reduced to:

$$u_{ds} = -R_s i_{ds} + \omega_m (L_{sQ} + L_{qm}) i_{qs} \quad 8$$

$$u_{qs} = -R_s i_{qs} - \omega_m (L_{sQ} + L_{dm}) i_{ds} \quad 9$$

$$u_{fd} = -R_{fd} i_{fd} + \frac{d\psi_{fd}}{dt} \quad 10$$

The electromagnetic torque is calculated from this equation as well as the active and reactive power.

$$T_e = \psi_{ds} i_{qs} - \psi_{qs} i_{ds} \quad 11$$

The active and the reactive power released to the grid are calculated as:

$$P_s = u_{ds} i_{ds} + u_{qs} i_{qs} \quad 12$$

$$Q_s = u_{qs} i_{ds} - u_{ds} i_{qs} \quad 13$$

The integration through the power converters follows the same procedure with DFIG. It is integrated through vector control decoupled means. In the same way, the rotor side control the active and reactive power while the grid-side converter controls the voltage and the reactive power..

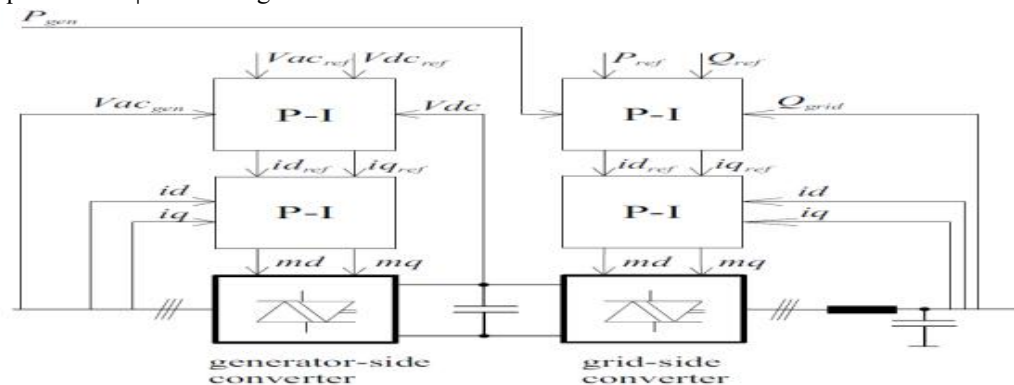


Fig 4: Frequency-converter with two PWM-converters and intermediate DC Voltage circuit [21]

### 5.2. Modeling of wind Turbine Rotor equations modeling

The general relations between wind speed and aerodynamic torque hold [17]:

$$T_t = \frac{1}{2} \rho \pi R^3 v^2 \frac{C_p(\lambda, \beta)}{\lambda} \quad 14$$

And the power is shown as

$$P_w = \frac{\rho}{2} C_p(\lambda, \beta) A_R v_w^3 \quad 15$$

The power coefficient  $C_p$  of the wind turbine in equation 14 is a function of tip-speed ratio  $\lambda$  which is given by:

$$\lambda = \frac{\omega R}{v} \quad 16$$

$T_t$ =turbine aerodynamic torque (Nm),  $\rho$ = specific density of air (kg/m<sup>3</sup>),  $v$ = wind speed (m/s),  $R$ =radius of the turbine blade (m),  $C_p$ = coefficient of power conversion,  $\beta$  = pitch angle,  $P$ =power extracted from the airflow (W),  $\lambda$ = Tip speed ratio,

$\omega$ = is the rotational speed of the wind turbine shaft

The value of  $Q$  fed into the grid in equation 13 above depends on the control of the power electronic in the grid sides. This does not affect active power except that the efficiency of the inverter can be incorporated into the last two variables. In this paper, for transient stability studies of power systems the generator is represented by third order model as indicated in DigSILENT [18]. In this case the model is obtained by neglecting the stator transients for the fifth order model of induction machine. It shows that there are three electrical equations and one mechanical equation. The model is in d-q expressed in rotor reference frame. In rotor reference frame, the d axis in the rotor reference frame is chosen collinear to the rotor phase winding and the position of the rotor reference frame is the actual position of the rotor.

Obviously, there is a change in generator speed as a result of the difference in electrical and mechanical torque. This is expressed as:

$$\frac{d\omega}{dt} = \frac{1}{2H} (T_m - T_e) \quad 17$$

Where  $H$  is the inertial constant(s) and this is specified in DigSILENT as acceleration time constant in the induction generator type.  $T_m$  and  $T_e$  is the mechanical and electrical torque respectively.

### 5.3. Modeling of Small Hydro Turbine

The power available in water current is proportional to the product of head and flow rate.

The general formula for any hydro power is:

$$P_{hyd} = \rho g Q H \quad 18$$

Where:  $P$  is the mechanical power produced at the turbine shaft (Watts),  $\rho$  is the density of water (1000 kg/m<sup>3</sup>),  $g$  is the acceleration due to gravity (9.81 m/s<sup>2</sup>),  $Q$  is the water flow rate passing through the turbine (m<sup>3</sup>/s),  $H$  is the effective pressure head of water across the turbine (m). The hydro-turbine converts the water pressure to mechanical shaft power, which further rotates the generator coupled on the

same shaft. The relation between the mechanical and the hydraulic powers can be obtained by using hydraulic turbine efficiency  $\eta_h$ , as expressed by following equations:

$$P_n = \eta_h P_{hyd} \quad 19$$

$$Q = Av$$

And the whole equation is derive from Bernoulli's theorem which states

$$\frac{v^2}{2g} + h + \frac{p}{\rho g} = \frac{P_{hyd}}{\rho g Q} \quad 20$$

Where  $v$  is the water flow speed (m/s),  $A$  is the area of the cross section (m<sup>2</sup>)  $p$  is the pressure of water (N/m<sup>2</sup>).

### 3.3. Solar cell modeling

PV effect is a basic physical process through which solar energy is converted directly into electrical energy. It consists of many cells connected in series and parallel. The voltage and current output is a nonlinear relationship. It is essential therefore to track the power since the maximum power output of the PV array varies with solar radiation or load current. This is shown by Matlab simulation. The equivalent diagram of a solar cell is represented by one diode model as shown in fig 5

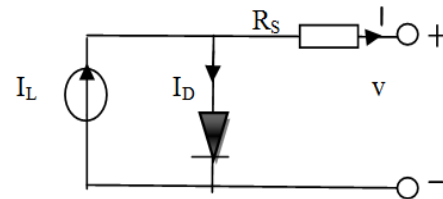


Fig 5: Model for single solar cell

The output terminal of the circuits is connected to the load. The output current source is the different between the photocurrent  $I_{ph}$  and the normal diode current  $I_D$ . Ideally the relationship between the output voltage  $V$  and the load current  $I$  of a PV cell or a module can be expressed as [20,21]

$$I_{pv} = I_{ph} - I_D = I_{ph} - I_0 \left[ \exp \left( \frac{V_{pv} + I R_s}{m K T_c} \right) - 1 \right] \quad 21$$

Where  $I_{ph}$  is the photocurrent of the PV cell (in amperes),  $I_0$  is the saturation current,  $I_{pv}$  is the load current (in amperes),  $V_{pv}$  is the PV output voltage (in volts),  $R_s$  is the series resistance of the PV cell (in ohms) and  $m$ ,  $K$  and  $T_c$  represent respectively the diode quality constant, Boltzmann's constant and temperature.

The power output of a solar cell is given by

$$P_{pv} = V_{pv} I_{pv} \quad 22$$



Where  $I_{pv}$  is the output current of solar cell (A).  $V_{pv}$  is the solar cell operating voltage (V),  $P_{pv}$  is the output power of solar cell (W).

## VI. TRANSIENT STABILITY INDICATOR

### Impact of Hybrid Distributed Generation Using CCT

To measure the impact of HDG on transient stability, the critical clearing time (CCT) is used as the stability index. This index measures the stability margin and indicates the robustness of the system to disturbances. The longer the CCT, the longer the system can tolerate the fault, and the more robust is the system. The impact of penetration level based on import mode, balanced mode and export mode on transient stability with HDG is investigated by monitoring the CCT. To assess the level of instability, the rotor angle is monitored when a temporary three-phase fault is applied in the middle of line 2 while the CCT is monitored by applying three-phase fault on line 2 at different locations from bus 3. The locations of the fault are 0%, 20%, 40%, 60%, 80% and 100% of the total length of the transmission line (bus 3-bus2). In other word, the fault distance is the distance from bus 3 to the fault location. For example, when the fault occurs at bus 3, the fault location will be 0% and when the fault occurs at bus 2, the fault location will be 100% and so on. The CCT is calculated by increasing the fault clearing time (FCT) until the rotor angle of GEN 2 reaches its critical clearing angle where further increase will make the system unstable.

## VII. RESULTS AND DISCUSSIONS

For clarity, the impact of single source DG and HDG is shown at different case studies. The following simulations are recorded for export mode only as indicated in section IV:

- Case study 2 is compared with each of the DG in case study 1
- Case study 3 is compared with each of the DG in case study1
- Case study4 is compared with each of the DG in case study 1
- Case study 5 is compared with each of the DG in case study1

### CASE STUDY 2

The graphs in Fig 6-8 show the graphs for case study 3 with case study 1

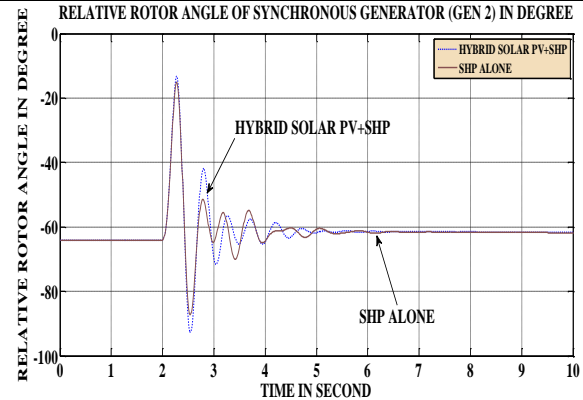


Fig 6: Comparison Of the impact of Hybrid SOLAR PV-SHP and SHP alone on the rotor angle of GEN2 (Export mode)

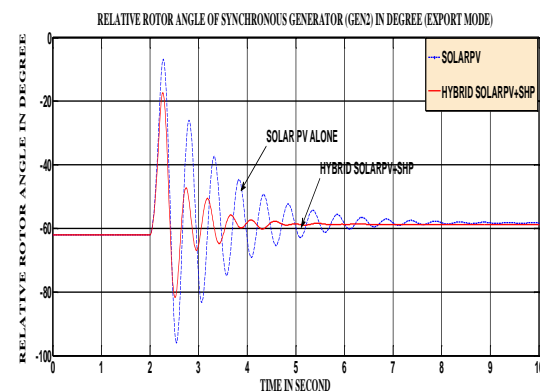


Fig 7: Comparison Of the impact of Hybrid Solar PV-SHP and solar PV alone on the rotor angle of GEN2 (Export mode)

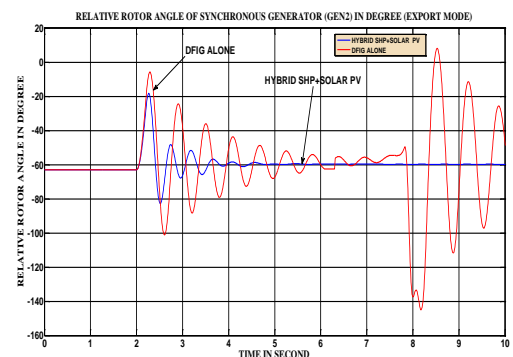


Fig 8: Comparison Of the impact of HYBRID SHP +SOLAR PV and DFIG alone on the rotor angle of GEN2 (Export mode).

Figs 6-8 show the simulations when Hybrid Solar PV +SHP is compared with SHP, Solar PV and wind turbine. It can be seen that when DFIG alone was connected the system has more oscillations compared with the cases with SOLAR PV alone and SHP. This suggests that when DFIG alone is integrated into the system, the system is prone to more

instability compared to SOLAR PV alone and HYBRID SOLAR PV +SHP. This is due to the crowbar which is triggered to block the rotor side converter and as a result, the voltage cannot recover completely immediately after the fault is cleared because the rotor side converter cannot provide the necessary reactive power to the generator for magnetization purpose. The generator then absorbs reactive power from the grid. When HYBRID SOLAR PV+SHP is connected, the system is more transiently stable than when DFIG alone is connected. This can be seen at the settling time. The settling time when HYBRID SOLAR PV+SHP is integrated into the grid is 4.5 seconds compared with 10 seconds for DFIG alone. The combination of SHP and SOLAR PV has improved the first swing and the subsequent swings. This is because of the good transient stability characteristics of SOLAR PV and SHP as seen in Fig 6 and Fig 7. When SHP alone is used, the system seems to have a better transient stability in terms of first swing compared with when HYBRID SOLAR PV +SHP is used. However, for the subsequent oscillations, when SHP alone or when HYBRID SOLAR PV+SHP is used, they have similar settling time. The system is transiently stable when HYBRID SOLAR PV+SHP is integrated compared to when Solar PV alone is integrated. This can be seen in the first swing and the oscillation duration. The oscillation duration when Solar PV alone is used is 9 seconds while that of HYBRID SOLAR PV+SHP is 5 seconds.

### CASE STUDY 3

The graphs in Fig 9-11 show the graphs for case study 3 with case study 1

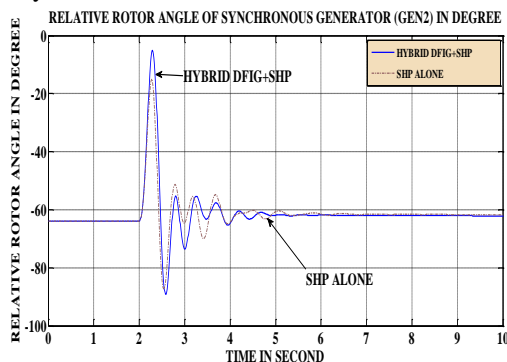


Fig 9: Comparison Of the impact of HYBRID DFIG+ SHP and SHP alone on the rotor angle of GEN2 (Export)

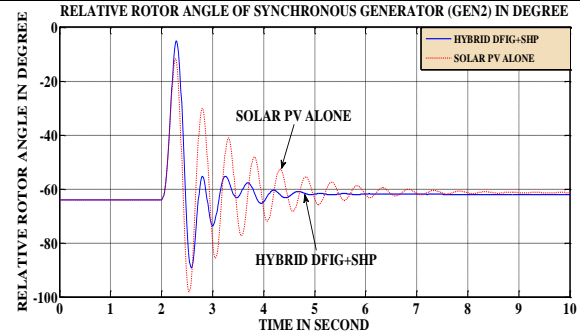


Fig 10: Comparison Of the impact of HYBRID DFIG+ SHP and SOLAR PV alone on the rotor angle of GEN2 (Export)

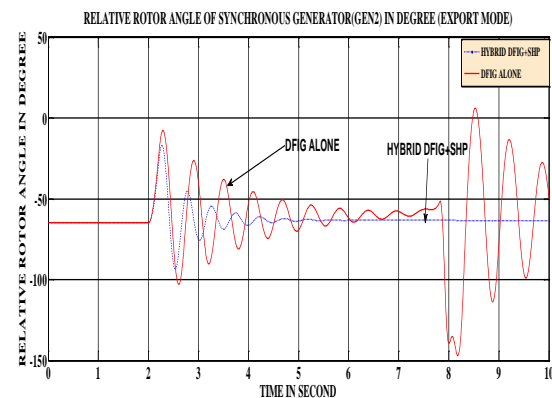


Fig 11: Comparison of the impact of HYBRID DFIG+ SHP and DFIG alone on the rotor angle of GEN2 (Export)

The graph in Fig 11 indicates worsen instability when DFIG alone is used compared to when Hybrid DFIG+SHP is used. However, the degree of instabilities is not as high in the simulations in Fig9-10 as that of Fig 11. The system is transiently stable when HYBRID DFIG+SHP is integrated compared to when DFIG alone is integrated at the same time when SOLAR PV alone is integrated. The stability of Hybrid DFIG+ SHP is worsened especially at the first swing but settle almost at the same time with oscillation when SHP is integrated.

### CASE STUDY 4

The graphs in Fig 12-14 show the graphs for case study 4 with case study 1

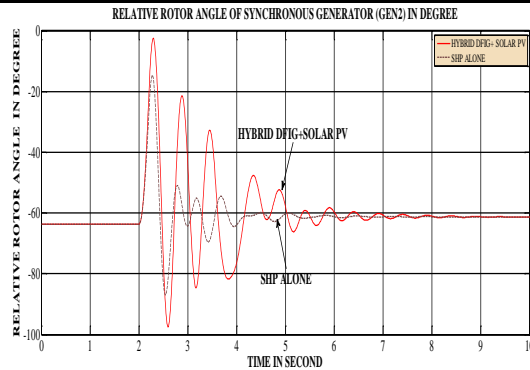


Fig 12: Comparison of the impact of HYBRID DFIG+SOLAR PV and SHP alone on the rotor angle of GEN2 (Export)

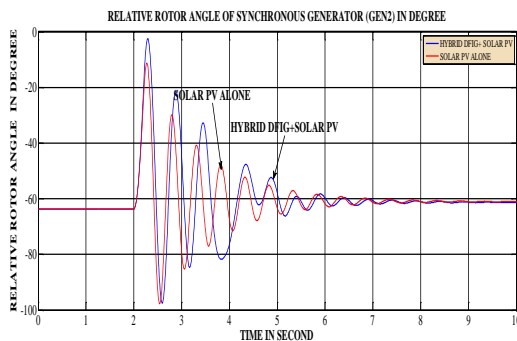


Fig 13: Comparison of the impact of HYBRID DFIG+SOLAR PV and SOLAR PV alone on the rotor angle of GEN2 (Export)

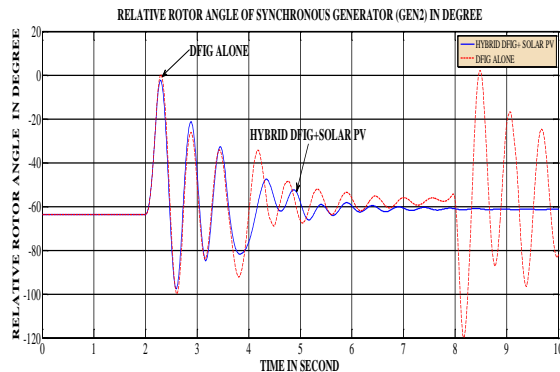


Fig 14: Comparison Of the impact of HYBRID SOLAR PV+DFIG and DFIG alone on the rotor angle of GEN2 (Export)

In Figs12-14, Hybrid SOLAR PV+DFIG shows an improved stability except in the case of HYBRID DFIG+SOLAR PV and SHP. This is because of the presence of DFIG in the hybrid combinations that made the oscillation higher than the SHP. However, the settling time is improved

## CASE STUDY 5

The graphs in Fig 15-17 show the graphs for case study 5 with case study 1

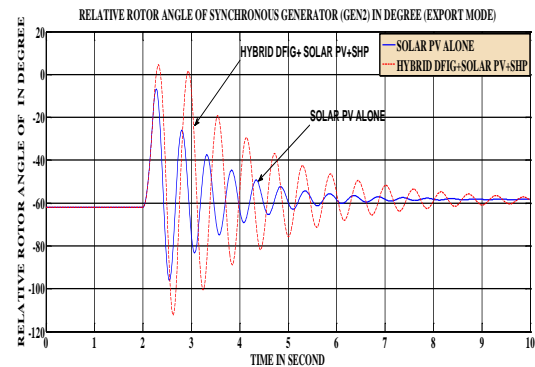


Fig15: Comparison of the impact of HYBRID DFIG+ SOLAR PV+SHP and SOLAR PV alone on the rotor angle of GEN2 (Export)

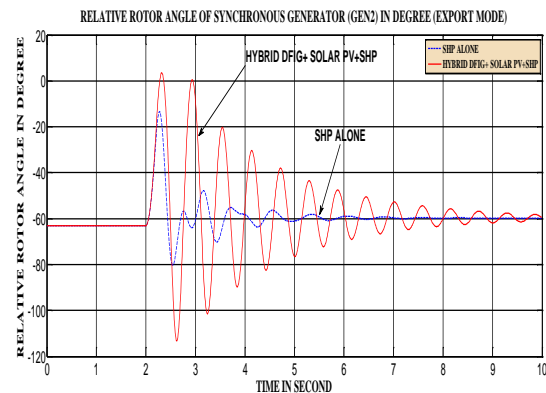


Fig 16: Comparison of the impact of HYBRID DFIG+ SOLAR PV+SHP and SHP alone on the rotor angle of GEN2 (Export)

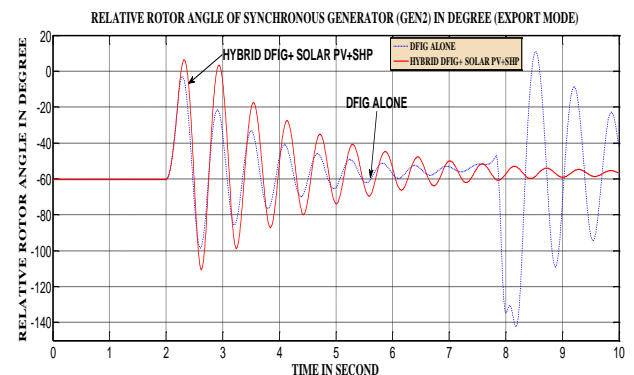


Fig 17: Comparison of the impact of HYBRID DFIG+ SOLAR PV+SHP and DFIG alone on the rotor angle of GEN2 (Export)

The graph in Figs 15-17 shows that when Hybrid DFIG+SOLARPV+SHP is integrated, the stability is worsen compared to SOLAR PV alone, SHP alone and DFIG alone.

### VIII. CONCLUSION

The graphs in Figs 6-17 show the rotor angle swings of GEN 2 when SOLAR PV alone, DFIG alone and its HYBRID form are integrated into the system. The export modes are shown in the figures above. When three DGs are integrated, the system stability margin is lower which means the system experience more instability than the one with two DGs. The results show that the stability depends on the type of DG used. When DFIG is used, it shows more instability than other type of DG. Besides, Hybrid DG is transiently stable compared to single DG except when SHP is used. When SHP is used, the single DG is more stable. It means that SHP helps in the stability of the system because, synchronous generator in SHP supply reactive power and thus bring improvement to the stability of the system when under a severe fault.

### REFERENCES

- [1] J Paska, P.Biczal, M.Klos, "Hybrid power systems-An effective way of utilizing primary energy sources", Electric Power Systems Research, Elsevier, 2009, pp.1-8.
- [2] T.Ackerman, G. Andersson, and L.Soder. 'Distributed generation, a definition' Electric Power Energy Research 2001:57,195-204,.
- [3] J.Momoh, G.D.Boswell, "Improving power Grid Efficiency using Distributed Generation" Proceedings of the 7<sup>th</sup> international conference on power system operation and planning, pp.11-17, Jan., 2007
- [4] [http://en.wikipedia.org/wiki/Wind\\_power#Penetration](http://en.wikipedia.org/wiki/Wind_power#Penetration)
- [5] [http://en.wikipedia.org/wiki/Solar\\_power\\_in\\_Germany#Statistics](http://en.wikipedia.org/wiki/Solar_power_in_Germany#Statistics)
- [6] <http://www.energy.ca.gov/2007publications/CEC-500-2007-021/CEC-500-2007-021.PDF>.
- [7] M. Edkins A. Marquard H. Winkler 'South Africa's Renewable energy policy roadmap
- [8] A.M.Azmy, Simulation and Management of Distributed Generation units using intelligent techniques, Ph.D. Thesis submitted to the department electrical engineering University of Duisburg-Essen 2005.
- [9] C.Wang, 'Modeling and control of hybrid wind/photovoltaic/fuel distributed generation system.
- [10] V.V Thong, J. Driesen, R. Belmans, "Transmission system operation concerns with high penetration level of distributed generation", Universities power and Engineering Conference UPEC, 4-6Sept., 2007, pp.867-871.
- [11] T. Tran-Quoc, L.Le Thanh, Ch.Andrieu, N. Hadjsaid, C. Kieny, J.C Sabonnadiere, K. Le, O. Devaux, O.Chilard Stability analysis for the distribution networks with distributed generation" in *Proc.2005/2006 IEEE/PES Transmission & Distribution Conference & Exposition*, vol. 1-3, Dallas, TX, USA, May 21-26, 2006 Proceedings Paper, pp. 289-294.
- [12] V.V. Knazkins "Stability of Power Systems with Large Amounts of Distributed Generation" PhD Thesis submitted to University Stockholm, Sweden, 2004.
- [13] A Ishchenko 'Dynamics and stability of distributed networks with dispersed Generation, Ph.D thesis submitted to Eindho-ven University of technology, 16 Jan., 2008.
- [14] M. Reza, Stability analysis of transmissions Systems with high penetration of distributed generation", PhD Thesis submitted to Delf University of Technology Delft, The Netherlands, 2006.
- [15] Y.Tiam, "Impact on the power system with a large generation of photovoltaic generation", PhD Thesis submitted to the University of Manchester Institute of Science and Technology, Feb., 2004, pp.53-55.
- [16] Vechiu I, Camblong H, Papia G, Dakyo B, Nichita C. Dynamic simulation model of a hybrid power system: performance analysis. *International Journal of Automotive Technology* 2006;7(7):1-9.
- [17] Skretas Sotirios B, Papadopoulos Demetrios P. Efficient design and simulation of an expandable hybrid (wind-photovoltaic) power system with MPPT and inverter input voltage regulation features in compliance with electric grid requirements. *Electric Power Systems Research* 2009;79:1271-85
- [18] Mehdi Dali, Jamel Belhadj, Xavier Roboam. Design of a stand-alone hybrid photovoltaic-wind generating system with battery storage, [http://journal.esrgroups.org/jes/papers/4\\_3\\_7.pdf](http://journal.esrgroups.org/jes/papers/4_3_7.pdf).
- [19] Joanne Hui, Alireza Bakhshai, Praveen K. Jain. A hybrid wind-solar energy system: a new rectifier stage topology. In: *Applied Power Electronics Conference and Exposition (APEC)*, 2010 Twenty-Fifth Annual IEEE, 21e25 Feb., 2010, pp. 155-61.
- [20] Arutchelvi Meenakshisundaram, Daniel Samuel Arul. GRID connected hybrid dispersed power generators based on pv array and wind-driven induction generator. *Journal of Electrical Engineering* 2009;60(6):313-20.
- [21] A. D. Hansen, C. J. P. Sørensen, F.Iov, F. Blaabjerg, 'Dynamic wind turbine models in power system simulation tool DlgSILENT.